

PROJECT MANUAL FOR:  
WATERPROOFING/RENOVATION WORK AT THE  
TORIAN PLUM PARKING STRUCTURE - Phase II

STEAMBOAT SPRINGS, COLORADO

**R C R B D**

100% CONSTRUCTION DOCUMENTS

**RECORD SET**

NOVEMBER 21, 2017

TECHNICAL SPECIFICATIONS



LANDSCAPE ARCHITECT

Wenk Associates  
1130 31st Street, Suite 101  
Denver, Colorado 80205  
(303) 628-0003

CIVIL ENGINEER

Landmark Consultants, Inc  
P.O. Box 774943  
141 9th Street  
Steamboat Springs, CO 80477  
(970) 871-9494



STRUCTURAL/WATERPROOFING ENGINEER

MARTIN/MARTIN Consulting Engineers  
12499 W. Colfax Ave  
Lakewood, Colorado 80215  
(303) 431-6100

MECHANICAL/ELECTRICAL/PLUMBING CONSULTANT

MEP Engineering, Inc  
6402 S. Troy Circle  
Centennial, CO 80111  
(303) 936-1633



IRRIGATION CONSULTANT

HydroSystems KDI, Inc  
860 Tabor Street, Suite 200  
Lakewood, CO 80401  
(303) 980-5327

PMG/OWNER REP SERVICES

Martin/Martin, Inc.  
12499 W. Colfax Ave  
Lakewood, Colorado 80215  
(303) 431-6100

TITLE PAGE FOR:

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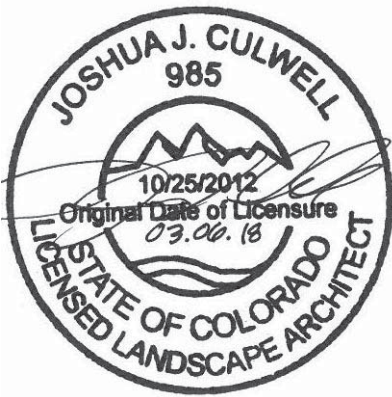
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NOVEMBER 21, 2017

TECHNICAL SPECIFICATIONS



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**R C R B D**

**RECORD SET**

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**R C R B D**

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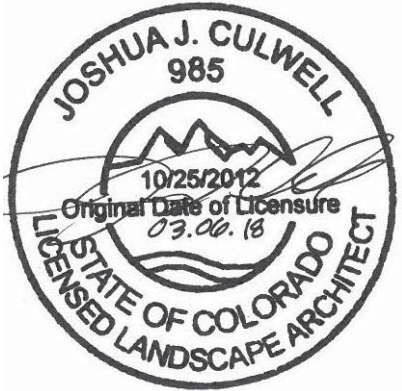
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## SECTION 00100

### INSTRUCTIONS TO BIDDERS

#### 1.1 BIDDERS' QUALIFICATIONS

The Owner may make such investigations as necessary to determine the ability of the bidder to perform the work, and the bidder shall furnish to the Owner all such information and data for this purpose, as the Owner may request. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of, such bidder fails to satisfy the Owner that such bidder is properly qualified to carry out the obligations of the agreement and to complete the work contemplated.

#### 1.2 BID SHCEDULE

Release to Bidders – Thursday November 16<sup>th</sup>, 2017

Pre-Bid Meeting – Tuesday December 5<sup>th</sup>, 2017

Receive Bids – Thursday December 14<sup>th</sup>, 2017

Interview Dates – December 19 – 21<sup>st</sup>, 2017

Anticipated Award Date – December 22<sup>nd</sup>, 2017

Anticipated Construction Schedule – April 16<sup>th</sup> through November 1<sup>st</sup>, 2018

#### 1.3 PRE-BID INFORMATION

The Owner shall provide to bidders, prior to bidding, all information which is pertinent to, and delineates and describes, the land owned and rights-of-way acquired or to be acquired.

In the condition that enough interest is shown there will be a pre-bid meeting held on site, on Tuesday December 5<sup>th</sup>, 2017.

#### 1.4 CONDITIONS AFFECTING THE WORK

Bidders must satisfy themselves of the accuracy of the estimated quantities and conditions of the work by examination of the site, and review of the drawings and specifications, including addenda. After bids have been submitted, the bidder shall not assert that there was a misunderstanding concerning the quantities of work or of the nature of the work to be done.

**Each bidder is responsible for inspecting the site and for reading and being thoroughly familiar with the Project Manual. The failure or omission of any bidder to do any of the foregoing shall in no way relieve any bidder from any obligation in respect to his bid.**

The latest OSHA regulations are to be followed and will be strictly enforced.

#### 1.5 REQUIREMENTS AFFECTING THE BID FORM

Each bid must be submitted in a sealed envelope or emailed, addressed to:

Attn: Eric Barney, PE  
Martin/Martin  
12499 W. Colfax Avenue  
Lakewood, CO 80215

Email: ebarney@martinmartin.com

Each sealed envelope or email containing a bid must be plainly marked as bid for Torian Plum Parking Structure Waterproofing/Renovation – Phase 2 and bear the name of the bidder, address, and license number if applicable. If sent by mail, the sealed envelope containing the bid must be enclosed in another envelope addressed to the Engineer.

All bids must be made on the required bid form. All blank spaces for bid prices must be filled in, in ink or typewritten, and the bid form must be fully completed and executed when submitted. Only one copy of the bid form is required. The bid form shall be submitted attached to the remainder of the Project Manual.

Subcontractor's listings and Equipment Supplier's Listings and schedule of values shall also be submitted with the bid.

**A conditional or qualified bid will not be accepted.**

#### 1.6 BONDS

A performance bond in the amount of one-hundred percent (100%) of the contract price, with a corporate surety approved by the Owner will be required for the faithful performance of the contract.

Attorneys-in-fact who sign performance bonds must attach to each bond a certified and current dated copy of their power of attorney.

**A bid bond is not required to be submitted as a part of this project.**

#### 1.7 METHOD OF AWARD

A written Notice of Award will be issued to the lowest responsible bidder within sixty (60) days. However, the Owner may waive any informalities or minor defects or reject any and all bids. Any bid may be withdrawn prior to the above scheduled time for the opening of bids or authorized postponement thereof. Any bid received after the designated time and date shall not be considered. Should there be reasons why the contract cannot be awarded within the specified period, the time may be extended by mutual agreement between the Owner and the bidder. The Owner reserves the right to award any and all bid schedules or portions thereof and to accept the bid deemed most advantageous to the owner.

#### 1.8 EXECUTION OF AGREEMENT

The bidder to whom the contract is awarded will be required to execute the agreement and furnish the required performance bond and certificates of insurance with the agreement and Project Manual to be executed by the Owner, within seven (7) working days following receipt of notice he has been awarded the contract.

In case of failure of the bidder to execute the agreement, the Owner may, at his option, consider the bidder in default, in which case the bid bond accompanying the proposal shall become the property of the Owner.

The Owner, within ten (10) working days of receipt of acceptable performance bond, certificates of insurance, and agreement signed by the party to whom the contract was awarded, shall sign the agreement and return to such party an executed duplicate of the agreement. Should the Owner not execute the agreement within such period, the bidder may, by written notice, withdraw his signed agreement. Such notice of withdrawal shall be effective upon receipt of the notice by the Owner.

#### 1.9 NOTICE TO PROCEED

The notice to proceed shall be issued within seven (7) working days of the execution of the agreement by the Owner. Should there be reasons why the notice to proceed cannot be issued within such period, the time may be extended by mutual agreement between the Owner and Contractor. If the notice to proceed has not been issued within that period or within the period mutually agreed upon, the Contractor may terminate the agreement without further liability on the part of either party.

#### 1.10 CONTRACT REQUIREMENTS

The Project Manual contains the provisions required for the construction of the project. Information obtained from an officer, agent, or employee of the Owner or any other person shall not affect the risks or obligations assumed by the Contractor, or relieve him from fulfilling any of the conditions of the contract.

#### 1.11 REQUIREMENTS OF REGULATORY AGENCIES

All applicable laws, ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the contract throughout.

#### 1.12 EQUAL OPPORTUNITY

The bidder agrees to abide by the requirements under Executive Order No. 11246, as amended, including specifically the provisions of the equal opportunity clause.

END OF SECTION



SECTION 00300 ADDENDUM 4

BID FORM

1.1 BID FORM

The bid form bound with this Project Manual must be used in submitting a bid. Substitute forms are not acceptable. See Instructions to Bidders for requirements concerning proper completion and submittal of the Bid Form.

END OF SECTION

BID FORM

January 25<sup>th</sup>, 2018

Torian Plum Condominiums Home Owners Association  
1855 Ski Time Square Drive  
Steamboat Springs, Colorado 80487

Re: Torian Plum Parking Structure – Phase 2

PROJECT NUMBER 17.1295

Ladies and Gentlemen:

The undersigned hereby states he has carefully examined the project manual, drawings, and other contract documents; has fully investigated the location, character, and extent of the work to be done as described for the referenced project. The undersigned hereby further states he is familiar with the type of work involved.

The bidder agrees to hold this bid open for thirty (30) days from the bid opening date and to accept the provisions of the Instructions to Bidders regarding disposition of bid security. The bidder will enter into and execute a contract within seven (7) working days from the date of Notice of Award, if awarded on the basis of this bid, and will furnish acceptable performance bond, certificates of insurance, construction schedules, schedule of values, and other necessary contract documents.

The undersigned declares that he has exercised his own judgement regarding the interpretation of data from the Engineer, Owner, and his own sources, which he/she believes pertinent to arriving at the amounts for the work to be completed under these contract documents.

The undersigned is aware that the contract completion time is of the essence to the Owner and that the Owner demands the work be substantially completed one-hundred and fifty (150) calendar days from issuance of the Notice to Proceed as set forth in the agreement and shall be compensated by the Contractor to the Owner at the rate of Two-Thousand dollars and no hundredths (\$2,000.00) per day beyond such maximum period for completion, if the project is not finished by November 22, 2018 the Owner shall be compensated by Contractor, at the rate of Five Thousand dollars (\$5,000) per day beyond such maximum period for completion, for ordinary and general damages and inconvenience (exclusive of any special damages).

## BID SCHEDULES

The undersigned (in compliance with the Invitation to Bid) hereby proposes to do all work called for in said Project Manual and as shown on said drawings and detail drawings, and to furnish all labor, materials, tools, construction equipment, operation equipment, and all appurtenances necessary for completion of said work at the unit prices shown on the following Bid Schedules. Unit bid prices will be used in case of a discrepancy with total price extensions. It is understood the description of work and the quantities of work and materials, as included herein, is brief and is intended only to indicate the general nature of the work which is more particularly described in Section 01025, Measurement and Payment. The actual final quantities will be field measured and agreed to for final payment. The Owner reserves the right to award any or all bid schedules or portions thereof.

General Bid Notes

1. **Contractor is required to have all schedules below associated with the project completed by November 22, 2018.**
2. **Mobilization is as listed below:**
  1. When 3% of the original contract amount is earned, 15 percent of the amount bid for mobilization will be paid.
  2. When 10% of the original contract amount is earned, 50 percent of the amount bid for mobilization will be paid.
  3. When 25% of the original contract amount is earned, 60 percent of the amount bid for mobilization will be paid.
  4. When 50% of the original contract amount is earned, 95 percent of the amount bid for mobilization will be paid.
  5. Upon completion of all work on the project, 100 percent of the amount bid for mobilization will be paid.

ITEM	DESCRIPTION	UNIT	QTY	UNIT COST	TOTAL
	<b>Bid Schedule</b>				
1	General Conditions (Includes Mobilization)	LS	1		
				<b>TOTAL</b>	
	<b>DEMOLITION</b>				
2	Excavation & Backfill (Edge of Garage)	CY	725		
3	Excavation & Haul (Over Garage)	CY	364		
4	Excavation for Hot Tub & Prep for New Hot Tub	LS	1		
5	Removals - Concrete Pavement	SF	7543		
6	Removals - Concrete Pavement (Over Structure)	SF	4920		

ITEM	DESCRIPTION	UNIT	QTY	UNIT COST	TOTAL
7	Removals - Concrete Unit Pavers	SF	2590		
8	<b>Removals - Landscape</b>	<b>SF</b>	<b>2034</b>		
9	<b>Removals - Landscape (Over Structure)</b>	<b>SF</b>	<b>670</b>		
10	Removals - Trees	EA	11		
11	Removals - Existing Plantar Walls	LF	61		
12	Removals - Light Poles	EA	5		
13	Removals - Storm Sewer Inlet	EA	1		
14	Removals - Storm Sewer Pipe	LF	152		
15	Remove Existing Waterproofing - Horizontal	SF	6526		
16	Remove Existing Waterproofing - Vertical	SF	3132		
17	Remove & Reset Concrete Unit Pavers	SF	3453		
18	Remove & Reset Existing Fire Pit	EA	1		
19	Remove & Relocate Existing Perennials & Grasses	SF	1250		
20	Remove & Reset Existing Bollard Lights	EA	4		
21	Sawcut Existing Concrete	LF	154		
22	Tree Protection	LF	331		
23	Hot Tub Removal - 4 Total	LS	1		
				<b>TOTAL</b>	
	<b>PARKING STRUCTURE REPAIR</b>				
24	Inject Leaks at Inverted Tee Beams	LF	60		
25	Inject Leaking Wall Cracks with Hydrophobic Grout	LF	60		
26	Inject Leaks at Double Tee Flanges	LF	70		
27	Repair & Seal Pipe Penetrations	EA	13		
28	Clean Walls of all Activated Grout				
29	Repair Damaged Concrete Surface	SF	40		



ITEM	DESCRIPTION	UNIT	QTY	UNIT COST	TOTAL
30	Removal of Efflorescence & Staining on Walls & Overhead Precast				
				<b>TOTAL</b>	
	<b>WATERPROOFING SITE PLAN</b>				
31	Surface Preparation	SF	9658		
32	Waterproofing Membrane (Walls - Vertical)	SF	3132		
33	Waterproofing Membrane (Walls - Horizontal)	SF	6526		
34	Provide Exterior Wall Cladding and Finish to Match Existing				
35	Lap New Waterproofing with Existing System				
36	Provide Isolation Board and Cove Joint Sealant Between New Paving and Existing Sidewalk or Wall				
37	Inject Cracks in Foundation Walls				
38	Provide Full Depth Curtainwall Urethane Injection Where Opposite Side Access is Prohibited				
39	Clean Walls of All Activated Urrethane Grout				
				<b>TOTAL</b>	
	<b>CIVIL</b>				
40	4" SDR PVC Sanitary Sewer	LF	100		
41	4" SDR PVC Sanitary Sewer Tie/In Connection	EA	1		
42	Sanitary Sewer Cleanout	EA	3		
43	4" HDPE Perforated Drain Line	LF	204		
44	4" HDPE Storm Sewer Line	LF	30		
45	6" HDPE Storm Sewer Line	LF	660		
46	8" HDPE Storm Sewer Line	LF	274		
47	10" HDPE Storm Sewer Line	LF	190		
48	6" Nyloplast WYE Fitting	EA	6		

ITEM	DESCRIPTION	UNIT	QTY	UNIT COST	TOTAL
49	8" Nyloplast Inline Drain	EA	4		
50	12" Nyloplast Drain Basin W/ Solid Cover	EA	2		
51	12" Nyloplast Drain Basin	EA	12		
52	15" Nyloplast Drain Basin W/ Solid Cover	EA	2		
53	15" Nyloplast Drain Basin	EA	3		
54	18" Nyloplast Drain Basin W/ Solid Cover	EA	2		
55	18" Nyloplast Drain Basin	EA	4		
56	24" Nyloplast Drain Basin W/ Solid Cover	EA	2		
57	24" Nyloplast Drain Basin	EA	2		
58	Nyloplast Reducer to 12" Inlet or Solid Cover	EA	15		
59	ACO K-100 Trench Drain	LF	173		
60	Trench Drain Tie In	EA	3		
61	Roof Drain Tie/ Tie In Connection	EA	24		
62	6" Nyloplast Cleanout	EA	24		
63	Manhole Adjustments - Work Around Ex. Grease Trap	LS	1		
				<b>TOTAL</b>	
	<b>Hardscape</b>				
<b>64</b>	<b>Colloidal Concrete or Washed No.57 Stone</b>	<b>CY</b>	<b>381</b>		
65	Concrete Subgrade Slab (6" Depth)	SF	5200		
66	Class 6 Aggregate Base Course (2" Depth)	CY	3		
<b>67</b>	<b>Class 6 Aggregate Base Course (6" Depth)</b>	<b>CY</b>	<b>92</b>		
68	Class 6 Aggregate Base Course (12" Depth)	CY	37		
69	Colorado Concrete Valley Pan - On & Off Structure	LF	362		
70	Concrete Pavement (6" Thickness)	SF	600		

ITEM	DESCRIPTION	UNIT	QTY	UNIT COST	TOTAL
71	Concrete Unit Pavers (Primary Color) - Vehicular	SF	3600		
<b>72</b>	<b>Concrete Unit Pavers (Primary Color) - Pedestrian</b>	<b>SF</b>	<b>6553</b>		
73	Concrete Unit Paver (Type B) - Pool	SF	3728		
74	Concrete Unit Pavers (Secondary Color)	SF	525		
75	Precast Concrete Pool Coping	SF	213		
76	Colored Concrete Band - On Structure (6" Width)	LF	16		
77	Colored Concrete Band - Off Structure (6" Width)	LF	415		
78	Colored Concrete Stair - 1 Tread	SF	28		
79	Stone Veneer Seat Wall (1'-6" Width x 2'-0" Height Max.)	LF	55		
80	Raw Siloam Stone - Premium Size Slabs	TN	55		
81	Stacked Stone Slabs - Premium Size Slabs	LF	300		
				<b>TOTAL</b>	
	<b>LANDSCAPE</b>				
82	Topsoil	CY	72		
83	Lightweight Soil	CY	65		
84	Intensive Plant Assembly - Garden Drain GR50	SF	588		
85	Irrigation System - Complete	LS	1		
86	Decidious Trees	EA	2		
87	Coniferous Trees	EA	1		
88	Shrubs	EA	6		
89	Ornamental Grasses	EA	94		
90	Perennials	EA	611		
91	Landscape Replacement/Repair	SF	1670		
<b>92</b>	<b>Pool Side Planter Irrigation</b>	<b>LS</b>	<b>1</b>		

ITEM	DESCRIPTION	UNIT	QTY	UNIT COST	TOTAL
93	Pool Side Plantar Mulch	CY	0.5		
94	Pool Side Plantar Soil	CY	4		
95	Pool Side Plantar 3/4" washed rock	CY	1		
96	Pool Side Plantar Waterproofing Membrane	SF	130		
97	Pool Side Plantar Filter Fabric	SF	65		
98	Pool Side Plantar Core Drill Holes	EA	30		
99	Pool Side Plantar Drain Covers	EA	20		
				<b>TOTAL</b>	
	<b>SNOWMELT INFRASTRUCTURE - MECHANICAL</b>				
100	Boiler Room (Allowance - Plans In Progress)	LS	1		
101	<b>Snowmelt Boilers</b>	LS	1		
102	<b>Snowmelt Pumps &amp; Hydronic Specialties</b>	LS	1		
103	Snowmelt Piping in the Boiler Room	LS	1		
104	Gas Piping in the Boiler Room	LS	1		
105	Boiler Room Plumbing	LS	1		
106	Snowmelt Piping - Lower Level	SF	11253		
107	Snowmelt Piping - Mid Level	SF	6125		
108	Snowmelt Manifold with Manifold Enclosure	EA	5		
109	Snowmelt Zone Control Valve	EA	3		
110	Snowmelt Systems Conduit	LS	1		
111	<b>Snowmelt System Controls</b>	LS	1		
112	Test and Balance Snowmelt System	EA	1		
113	Boiler Room Baseboard Heat	EA	2		
114	Connection of Lower Plaza to Existing System	LS	1		



ITEM	DESCRIPTION	UNIT	QTY	UNIT COST	TOTAL
115	Mainline Stub-Out for Future Snowmelt	LS	1		
116	Gas & Sanitary Stub for Future Kitchen	LS	1		
				<b>TOTAL</b>	
	<b>Electrical</b>				
<b>117</b>	<b>Pedestrian Light Poles (Custom)</b>	<b>EA</b>	<b>8</b>		
118	Wall Lights at Stone Veneer Wall	EA	5		
119	LED Strip Light	EA	3		
120	Exit Sign	EA	1		
121	Holiday Event Receptacles	EA	8		
122	Conduit	LS	1		
123	Wiring	LS	1		
124	Panel "BP"	LS	1		
125	Heat Tape	LS	1		
				<b>TOTAL</b>	
	<b>Amenities</b>				
126	Hot Tub Replacement (Price Provided LS By PPS)				
<b>127</b>	<b>Deck Replacement</b>	<b>SF</b>	<b>532</b>		
<b>128</b>	<b>Cabana Structure @ Deck</b>	<b>LS</b>	<b>1</b>		
129	Pool Planters	EA	10		
<b>130</b>	<b>Pool Fence/Repair Replace</b>	<b>LF</b>	<b>144</b>		
<b>131</b>	<b>Pool Gate</b>	<b>EA</b>	<b>2</b>		
132	Screen Fence	LS	1		
133	Replace 2 Spas on Southside (Price Provided by PPS)				
134	Replace Swimming Pool Tile (Price Provided by PPS)				
				<b>TOTAL</b>	

**Bid Schedule Total: Base Bid**

\$\_\_\_\_\_

Total price written: \_\_\_\_\_  
\_\_\_\_\_

The undersigned (in compliance with the Invitation to bid) hereby proposes to do all **Base Bid** work called for in said Project Manual, and as shown on said drawings, for completion of said work at the lump sum amount of \_\_\_\_\_ dollars and \_\_\_\_\_ cents (\$\_\_\_\_\_).

In submitting this bid it is understood that the right to reject any and all bids has been reserved by the Owner.

Dated this \_\_\_\_\_  
day of \_\_\_\_\_, 2017

Name of Bidder \_\_\_\_\_

Address \_\_\_\_\_

Telephone Number \_\_\_\_\_

Authorized Officer \_\_\_\_\_

Title \_\_\_\_\_

SECTION 00430

SUBCONTRACTOR LISTINGS

1.1 SUBCONTRACTOR LISTING

The subcontractor listing bound with this project manual shall be provided by the Contractor with the executed contract prior to Owner's signature.

END OF SECTION



Project Name: Torian Plum Parking Structure – Phase 2

Project Number: 17.1295

The undersigned proposes to utilize the services of the following subcontractors for this project. All Subcontractors must be listed and submitted with the Bid Documents, and any additions or substitutions must be approved by the owner.

SUBCONTRACTOR  
WORK

TRADE OR SCOPE OF

Name of Bidder \_\_\_\_\_  
By \_\_\_\_\_  
Date \_\_\_\_\_

SECTION 00450

EQUIPMENT SUPPLIERS LISTINGS

1.1 EQUIPMENT SUPPLIER LISTING

The equipment supplier listing bound with this project manual shall be provided by the Contractor with the bid documents.

END OF SECTION

Project Name: Torian Plum Parking Structure Waterproofing/Renovation – Bid Package

Project Number: 17.1295

The undersigned proposes to utilize the following equipment to be installed for this project.

ITEM

SUPPLIER

Name of Bidder\_\_\_\_\_

By\_\_\_\_\_

Date\_\_\_\_\_

SECTION 00500

AGREEMENT FORM

1.1 AGREEMENT FORM

- A. The agreement form bound with this Project Manual will be used as the contract between Owner and Contractor.

END OF SECTION

## AGREEMENT

This Agreement is made this \_\_\_\_\_ day of \_\_\_\_\_, 2017, between Torian Plum Condominiums Homeowners Association, an association located in the City of Steamboat, County of Routt, State of Colorado, hereinafter referred to as "Owner", and \_\_\_\_\_, a Corporation, hereinafter referred to as "Contractor."

Section 1. Scope of Work. Contractor shall perform all work in accordance with the plans and specifications set forth in the Contract Documents, as specified herein, Sky Way Business Center & RMAA Slope Repair, including furnishing all supervision, labor, equipment and materials therefor, hereinafter referred to as "Project".

Section 2. Contract Price. Owner shall pay Contractor for the performance of work and completion of the Project the total price of \_\_\_\_\_ and \_\_\_\_\_ cents (\$ \_\_\_\_\_) in accordance with the bid proposal submitted by Contractor (see Exhibit B). The Contract Price shall be subject to adjustment for changes in the plans and specifications or for extensions of time to complete performance, if approved by Owner and Contractor as hereinafter provided, and for changes in quantities, if bid on a unit-price basis in the bid proposal, which shall be verified by the Engineer.

Section 3. Progress Payments. Owner will make progress payments monthly on account of the Contract Price in accordance with partial payment applications prepared by the Contractor for work performed to date and approved by the Engineer and Owner. Contractor shall submit all partial payment applications for the last completed work period to the Engineer by the first Tuesday of each month. Progress payments shall not constitute final acceptance of work. Owner may withhold progress payments if: (a) Contractor's performance is inadequate or defective and not remedied in accordance with the Engineer's directions; (b) Contractor does not make prompt and proper disbursements to subcontractors on receipt of progress payments from Owner; (c) Contractor does not promptly pay for materials, labor or equipment furnished by third parties; (d) claims or liens are filed on the Project; or (e) in the Engineer's opinion, Contractor's performance is not progressing satisfactorily or completion of the Project is jeopardized by Contractor's performance.

Section 4. Retainage. The Owner shall retain from progress payments 10% of the calculated value of completed work for the first 50% of the contract amount, if the Contractor is satisfactorily performing all work under and is in compliance with terms of this Agreement. If Contractor has timely submitted its progress payment application in accordance with the terms of the Agreement, the Owner shall authorize payment of the amounts due there under on or before the end of the calendar month (or, if different, the partial payment date specified elsewhere in the Contract Documents) or as soon thereafter as practical. Unless otherwise approved by the Owner, in its sole discretion, the retained amount will be retained by the Owner until all work and other responsibilities of the Contractor under this Agreement have been completed satisfactorily and finally accepted by the Owner.

Section 5. Final Payment. Owner shall make final payment to Contractor in accordance with Section 38-26-107, C.R.S., within sixty (60) days after final acceptance of performance by Owner, as specified in Section 6 herein, and after receipt of the Engineer's confirmation to Owner that the Project has been completed satisfactorily. Upon completion of the Project and notice thereof to Owner, the Engineer shall inspect the Project and may reject any portion of performance not in conformity with the Contract Documents. Defective materials, equipment or work shall be remedied immediately by Contractor and before final payment.

In no event shall final payment be due until Contractor has delivered to Owner a complete release

of all claims or liens against the Project and has produced the necessary receipts or waivers indicating final and total payment to all persons who have furnished materials, labor and equipment on which a lien or claim might potentially be filed. Publication of notice of final settlement pursuant to legal requirements shall also precede final payment to Contractor.

By making final payment, Owner waives all claims against Contractor, except those expressly declared to Contractor in writing or those arising out of: (a) defective performance appearing after final acceptance; (b) performance in patent noncompliance with Contract Documents, unless expressly waived by Owner; (c) outstanding claims of any nature, including but not limited to claims for property damage or personal injury arising during the construction period or liens against the Project; or (d) Contractor's failure to execute any warranties, guarantees or bonds, or to provide insurance or other indemnification required by the Contract Documents. By accepting final payment, Contractor thereby waives any and all claims of every nature against Owner, except those expressly declared to Owner in writing prior to final payment.

Section 6. Final Acceptance. Final acceptance of the Project shall follow inspection and approval of Contractor's performance by the Engineer, along with inspection by appropriate manufacturers' representatives and governmental officials pursuant to local, state and federal requirements, if necessary. Owner shall have the right and authority to determine the acceptability of Contractor's performance for conformity with the Contract Documents, which determination shall be conclusive and binding upon Contractor. Final acceptance by Owner is subject to the provisions of Section 5 herein and in no manner affects or releases any warranties or guarantees with Contractor or manufacturers of Project equipment.

The Project, when presented to Owner for final acceptance, shall be delivered free from any and all liens, claims or encumbrances, whether then in existence or later established by law, statute, ordinance or otherwise. No lien, claim or encumbrance against the Project or the Project site shall be outstanding or otherwise unsettled at the time of final acceptance. The right to assert any lien, claim or encumbrance against the Project, after final acceptance by Owner and final payment to Contractor, is hereby waived by Contractor on behalf of itself and any subcontractor, laborer, materialman, equipment supplier, manufacturer or other person.

Section 7. Commencement and Completion of Performance. Contractor shall commence performance on April 16<sup>th</sup>, 2018 or after, written notice to proceed will be provided prior to April 16<sup>th</sup>, 2018, and will diligently prosecute all work through completion. Unless an extension of time is granted by Owner as herein provided, Contractor shall substantially complete the Project on November 2<sup>nd</sup>, 2018. If Contractor does not complete performance on November 2<sup>nd</sup>, 2018, Contractor shall be responsible for all additional costs incurred by Owner due to such late performance. In addition, if Contractor does not complete performance on November 2<sup>nd</sup>, 2018, Owner shall be compensated by Contractor, at the rate of Two Thousand dollars (\$2,000) per day beyond such maximum period for substantial completion, if the project is not finished by November 22, 2018 the Owner shall be compensated by Contractor, at the rate of Five Thousand dollars (\$5,000) per day beyond such maximum period for substantial completion, for ordinary and general damages and inconvenience (exclusive of any special damages) to Owner. Such sum shall not be considered a penalty but shall be deemed a reasonable measure of general damages which will be suffered by Owner as a consequence of such delays, such damages being difficult to ascertain by precise measurement.

No extension of time to complete performance shall be granted under normal circumstances. Extensions of time to complete performance may be authorized for any actual period of delay, on an occurrence basis, for: (a) adverse weather or climatic conditions not reasonably anticipated; (b) major labor disputes; (c) acts of God; (d) detrimental acts of Owner; (e) acts of another contractor in the

performance of related work under a separate contract with Owner; (f) delays resulting from the intervention of governmental agencies in the performance of the work on the Project, if not caused by Contractor; or (g) other extraordinary circumstances beyond Contractor's reasonable control. Foreseeable weather delays or failures in delivery of equipment or materials shall not constitute cause for an extension of time to complete performance. Any request for an extension of time to complete performance, including adjustments to the Contract Price resulting therefrom, shall be submitted in writing to the Engineer for Owner's approval within ten (10) days after such occurrence, and the decision of Owner shall be conclusive and binding upon Contractor.

Section 8. Default. At any time Owner may give to Contractor written notification of grounds for default, if: (a) Contractor fails to perform in an adequate or specified manner or proceeds in willful violation of the conditions, provisions, or terms of this Agreement or the Contract Documents, as determined by the Engineer or Owner; (b) Engineer advises Owner that performance of work on the Project is being delayed unnecessarily or that Contractor is executing its responsibilities hereunder in bad faith or contrary to the intent of this Agreement; (c) performance is not fully completed within the maximum period of time specified for completion under Section 7 herein; (d) work to be performed by Contractor under this Agreement is assigned without Owner's consent; (e) Contractor is insolvent or files for bankruptcy; (f) Contractor makes a general assignment of assets for the benefit of creditors; (g) a receiver is appointed for Contractor; or (h) other serious and reasonable cause exists, which jeopardizes completion of the Project. If Contractor shall not remedy or otherwise correct the grounds for default within ten (10) days or such additional period of time specified by Owner after receipt of such notice, Owner may thereafter terminate this Agreement and direct Contractor to discontinue any further performance on the Project, and Contractor shall then immediately stop all work on the Project and forfeit all rights hereunder. Owner, in its discretion, may request the surety of Contractor to complete the Project, or may contract with others or pay itself to perform such work at the expense of Contractor and its surety. Any increase in costs over the Contract Price and any special damages incurred by Owner as a consequence of such default, including reasonable attorneys' fees, shall be paid and satisfied in full by Contractor and its surety.

Section 9. Termination. At any time Owner may, without cause and without prejudice to any other right or remedy hereunder, elect to abandon the Project and to terminate this Agreement. In such event, Owner shall give to Contractor written notification of Project termination at least ten (10) days in advance of the Project termination date. Owner shall pay Contractor for the performance of all work, including retainage, to the Project termination date and for such additional amounts as, in the judgement of the Engineer, are reasonable to compensate Contractor for the termination of this Agreement. Final payment to Contractor shall be made in accordance with Section 5 herein.

Section 10. Taxes, Licenses, Permits and Regulations. In all operations connected with the Project, Contractor shall pay all fees, charges and taxes imposed by law, except for sales and use taxes from which Owner and the Project are exempted by law, and shall obtain all licenses and permits necessary for completion of the Project, paying all fees therefor unless otherwise specified by the Engineer. Contractor shall comply with all laws, ordinances, codes, rules and regulations of all governmental authorities, whether local, state or federal, relating to the performance of work on the Project and, particularly, in complying with those laws concerning the environment, workmen's compensation, safety and health, state labor and materials, and equal employment opportunity. Owner shall, upon request, furnish Contractor with a copy of its certificate of tax exemption, which allows construction of the Project without incurring sales or use taxes thereon. Owner shall not reimburse Contractor for any sales or use taxes paid to the State of Colorado or any county or municipality from which Owner or the Project are exempted by law.

Contractor certifies that Contractor shall comply with the provisions of Section 8-17.5-101 et seq., C.R.S.

Contractor shall not knowingly employ or contract with an illegal alien to perform work under this Agreement or enter into an agreement with a subcontractor that knowingly employs or contracts with an illegal alien. The Contractor represents, warrants, and agrees that it has confirmed the employment eligibility of all employees who are newly hired for employment to perform work under the Agreement through participation in either the E-Verify Program or the Department Program described in Section 8-17.5-101, C.R.S. The Contractor shall not use either the E-Verify Program or the Department Program procedures to undertake pre-employment screening of job applicants while the public contractor for services is being performed. If the Contractor obtains actual knowledge that a subcontractor performing work under the Agreement knowingly employs or contracts with an illegal alien, the Contractor shall (i) notify the subcontractor and Owner within three (3) days that Contractor has actual knowledge that the subcontractor is employing or contracting with an illegal alien; and (ii) terminate the subcontract with the subcontractor if within three (3) days of receiving such notice, the subcontractor does not stop employing or contracting with the illegal alien, unless the subcontractor provides information to establish that the subcontractor has not knowingly employed or contracted with an illegal alien. The Contractor shall comply with all reasonable requests made in the course of an investigation by the Colorado Department of Labor and Employment. If the Contractor fails to comply with any requirement of Section 8-17.5-102(2), C.R.S. the Owner may terminate the Agreement for breach, and Contractor shall be liable for actual damages to the Owner and any other provision herein notwithstanding. If the Contractor participates in the Department Program, the Contractor shall provide the affirmation required under Section 8-17.5-102(5)(e)(III), C.R.S. to the Owner.

Section 11. Indemnification. Contractor shall indemnify, defend, and hold Owner, and its agents, employees, engineers and attorneys, harmless from and against all costs, claims, damages, judgments, losses and expenses of every nature, including reasonable attorneys' fees, arising at any time out of any act or omission of Contractor, and its employees, subcontractors and their employees, and all other persons directly or indirectly involved in or performing work for the Contractor on the Project.

Section 12. Insurance. Contractor shall, during the term of this Agreement (a) maintain all insurance required by the Colorado State Workmen's Compensation Act or any other employee benefit law; (b) provide broad form general liability and such additional insurance in amounts specified in Exhibits A and A-1, designating Owner and Engineer as "additional insureds" thereunder; and (c) furnish casualty insurance for protection against damage, explosion, fire, vandalism, theft and other such dangers ordinarily included under such coverage, including loss of use resulting therefrom, to the full insurable value of all property, structures, equipment and material of Owner within Contractor's control, designating Owner as "loss payee" thereunder. Contractor shall file certificates of insurance coverage satisfactory to Owner prior to commencement of performance. Such certificates shall provide that coverages afforded thereunder shall not be canceled until at least thirty (30) days' prior written notice has been given to Owner.

Section 13. Performance Bond. Contractor shall provide to Owner, prior to commencement of performance, a general performance bond executed by Contractor and an acceptable corporate surety, or other surety or authorized collateral approved by Owner, in the full amount of the Contract Price, including provision for any adjustment thereof in accordance with the terms of this Agreement. Such performance bond shall expressly guarantee the (a) faithful performance of this Agreement and completion of the Project in strict compliance with all Contract Documents, according to the intent and meaning thereof; (b) repair and replacement, if required, or payment of the costs of all defective equipment, materials and work performed on the Project or as provided under any guarantee, condition or other Contract Document; and (c) payment to all persons performing labor and furnishing materials, supplies, tools and equipment in connection with completion of the Project. Contractor shall obtain such performance bond on Owner's behalf separate and apart from any similar bonds or surety or warranty agreements entered into independently between Owner and any manufacturer or supplier.



Section 14. Warranties and Guarantees. Contractor hereby represents, warrants and guarantees to Owner all workmanship, equipment and materials on or made a part of the Project and its structures for a period of one (1) year from and after the date of final acceptance. Such warranty and guarantee shall be construed to include, but is not limited to, representations that all workmanship, equipment or materials are of good quality, free from any defects or irregularities, and in absolute conformity with Contract Documents. If any defect in workmanship, equipment or materials arises within such one-year period, Contractor shall remedy or otherwise correct such defect without cost to Owner within ten (10) days after receipt of written notice of any such defect. In the event of Contractor's failure to repair such defect within ten (10) days or such additional period of time specified by Owner after receipt of such notice, Owner may contract or arrange for such repair at the complete expense of Contractor and its surety. Contractor expressly declares that the performance bond specified in Section 13 herein, shall remain in full force and effect during the period of this warranty and guarantee. Contractor shall provide such warranty and guarantee in Owner's behalf separate and apart from other warranties, guarantees and surety agreements entered into independently between Owner and any manufacturer or supplier.

Section 15. Subcontractors. Contractor shall submit a list of all major subcontractors engaged to work on the Project prior to commencement of performance. All contracts between Contractor and subcontractors shall conform explicitly to all applicable provisions of this Agreement and the Contract Documents. In all events, Contractor shall be responsible and held liable for any bonding, insurance, warranties, indemnities, progress payments and completion of performance of or to such subcontractors. Upon receipt of progress and final payments from Owner, Contractor shall disburse the same immediately to subcontractors without any requirement of Owner to supervise the same. No contractual relationship shall exist between Owner and any subcontractor because of the subletting of any part of the Project work.

Section 16. Engineer. Official authority for the surveillance and administration of all performance under this Agreement is hereby delegated to the Engineer and Geotechnical Engineer on behalf of the Owner, who is MARTIN/MARTIN, Inc., Consulting Engineers (referred to herein as "Engineer"), unless otherwise provided in the Contract Documents. Throughout the construction period, the Engineer/Geotechnical Engineer, or such other duly authorized representative of Owner, shall observe the Project and shall consult with Contractor in regard to any inquiries, directions or interpretations of Contract Documents.

Section 17. Change Order. Contractor shall consult with the Engineer and Geotechnical Engineer before a material change or alteration in Contract Documents is undertaken by Contractor, whether or not the Contract Price is affected thereby. Any change in the Contract Price shall be considered a material change for purposes of this Section 17. Any material change or alteration shall be approved in advance by proper written order signed by the Engineer and, if an adjustment to the Contract Price in excess of Five Hundred Dollars (\$500) results therefrom, by the Owner. Otherwise, Contractor proceeds at its own risk and expense, and Owner, in its discretion, may order the removal and reconstruction of any unauthorized performance in actual conflict with the Contract Documents.

Section 18. Contract Documents. The Contract Documents which comprise the entire agreement and contract between Owner and Contractor, consist of this Agreement and any Addendum thereto; the documents contained in the Project Manual, including but not limited to notice to bidders, instructions to bidders, bid or proposal, performance, payment and maintenance bond, notice of award, notice to proceed, drawings, general and specific specifications, and any Addendum to such specifications; and any modifications, change orders or other such revisions properly authorized after the execution of this Agreement. Also included as part of the contract documents are the plans for the project, dated October 20, 2017.

Section 19. No Damages for Delay. The Contractor agrees that delays resulting from any causes other than acts or omissions of the Owner, its employees, agents or other acting on its behalf shall be considered fully compensated by an extension of the Contract Time (see Exhibit B) and the Contractor agrees to make no claim for monetary damages for such delays, unless authorized pursuant to Section 24-91-103.5(1), C.R.S. in no event shall the Contractor be entitled to recover any delay costs caused by the agents or anyone for whom it is responsible. The Contractor's damages for delays resulting from acts or omissions of the Owner, its limited to extend general condition costs associated with a delay, unless authorized pursuant to Section 24-91-103.5(1), C.R.S.

Section 20. Consequential Damages. The Contractor and Owner waive claims against each other for consequential damages arising out of or relating to the Contract Documents other than consequential damages authorized pursuant to Section 8-17.5-102, C.R.S. This mutual waiver includes: (a) damages incurred by Owner for Rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and (b) damages incurred by Contractor for principal office expenses including the compensation of personal stationed there, for losses of financing, business and reputation and for loss of profit, except anticipated profit arising directly from the work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with the Contract Documents. Nothing contained in this paragraph shall be deemed to preclude an award of liquidated damages, where applicable, in accordance with the requirements of the Contract Documents.

Section 21. Owner Representations and Contractor Remedy Granting Provisions.

- (a) The Owner makes the following representations: (i) The Owner has appropriated money equal to or in excess of the Contract Price. (ii) the Owner, by issuing any change order or other directive requiring additional compensable work to be performed by Contractor without Contractor's consent, which work causes the aggregate amount payable under the Agreement to exceed the amount appropriated for the original Contract Price, represents to the Contractor that lawful appropriations to cover the costs of the additional work have been made.
- (b) For any form of change order or directive, other than a clarification, by the Owner, requiring additional compensable work to be performed, the Owner shall reimburse the Contractor for the Contractor's cost on the periodic basis set forth in the Contract Documents for additional directed work performed until a change order is finalized and approved by the Contractor as authorized in accordance with Section 17. In no instance shall the periodic reimbursement be required before the Contractor has submitted an estimate of cost to the Owner for the additional compensable work to be performed.
- (c) Upon the Owner's issuance of any change order or directive, other than a clarification, requiring additional compensable work to be performed without the Contractor's consent, the Contractor may request in writing within five (5) days from the date of such issuance that the Owner provide written assurance that appropriations are immediately available to the Owner for payment to the Contractor prior to performance of such additional work. Such written assurances may include, but are not limited to, a letter from the Owner explaining the expected sources of funding for the additional work. In the event that the Contractor makes such a request within five (5) days and the Owner does not provide written assurance reasonably satisfactory to the Contractor, the Contractor may stop work until such time as the Owner provides satisfactory assurances. The Contractor's acceptance of a change order in accordance with any assurances provided under this paragraph shall not limit or restrict the Contractor from making a claim under the Contract Documents for an adjustment to the Contract Price or the contract times or otherwise for expenses or damages directly attributable to the Contractor's stoppage of the work as permitted hereunder.

Section 22. Assignment. Contractor shall not, at any time, assign any interest in this Agreement to any person or entity without the prior written consent of Owner. The terms of this Agreement shall inure to and be binding upon the successors and assigns of the parties hereto.

Section 23. Amendment. This Agreement may be amended, from time to time, by agreement between the parties hereto. No amendment, modification or alteration of this Agreement shall be binding upon the parties hereto unless the same is in writing and approved by the duly authorized representatives of each party hereto.

Section 24. Severability. If any term, section or other provision of this Agreement shall, for any reason, be held to be invalid or unenforceable, the invalidity or unenforceability of such term, section or other provisions shall not affect any of the remaining provisions of this Agreement.

Section 25. Waiver. No waiver by either party of any right, term or condition of this Agreement shall be deemed or construed as a waiver of any other right, term or condition, nor shall a waiver of any breach hereof be deemed to constitute a waiver of any subsequent breach, whether of the same or of a different provision of this Agreement.

Section 26. Remedies. None of the remedies provided to either party under this Agreement shall be required to be exhausted or exercised as a prerequisite to resort to any further relief to which such party may then be entitled. Every obligation assumed by, or imposed upon, either party hereto shall be enforceable by any appropriate action, petition or proceeding at law or in equity. In addition to any other remedies provided by law, this Agreement shall be specifically enforceable by either party. This Agreement shall be construed in accordance with the laws of the State of Colorado, and particularly those relating to governmental contracts.

Section 27. Counterparts. This Agreement may be executed in multiple counterparts, each of which shall constitute an original, but all of which shall constitute one and the same document.

Section 28. Entirety. This Agreement constitutes the entire Agreement between the parties concerning the subject matter herein, and all prior negotiations, representations, contracts, understandings or agreements pertaining to such matters are merged into and superseded by this Agreement.

Section 29. Conflicting Provisions. In the event any provision of this Agreement conflicts with any provision of any other Contract Document, then the provisions of this Agreement shall govern and control such conflicting provisions.

Section 30. Miscellaneous. Unless otherwise expressly provided, any reference herein to days shall mean calendar days. All times stated in this Agreement are of the essence.



**ADDENDUM NO. 1**  
**Torian Parking Structure Waterproofing/Renovation – Phase 2**

**December 7, 2017**

The following modifications and clarifications are made a part of the Contract Documents for the Torian Parking Structure Waterproofing/Renovation – Phase 2 project.

**General:**

1. The current bid schedule that was sent out on November 30, 2017 will be adhered to for the bidding of this project.
2. Assume the excavation depth to the top of the parking structure will be approximately 2' at the plaza and 14' at the pool elevation.
3. Business will need to remain open during construction with at least one form of egress.
4. Wayfinding will be required to safely direct the public around the project site and to businesses. There may be additional wayfinding based on the construction phasing of the project.
5. Staging areas will be coordinated with Torian. The parking structure and the parking stalls along Torian Plum Drive are a possibility.
6. Orange snow fence will be acceptable for a construction boundary. If large excavations are needed to be left open over night a they will need to be steel plated or a more secure 8' chain fence will be required to secure the area. If it is found that the public is continually entering the jobsite a chain fence will need to be used (include in the mobilization line).
7. The hours of operation will be the same as Phase 1, Monday through Friday 7:30 am to 5:30 pm. Light duty work is acceptable on the weekends. If additional work hours are required, it will need to be arranged with the property manager.
8. An engineers estimate will not be provided.
9. The existing pavers that are to be reused are set with polymeric sand.
10. The geotechnical report that will be used for this project is provided within the bid documents.
11. The Fire egress for the jobsite will be determined at a later date.
12. Determination if the ADA walk on the east side of the property will need to remain open during construction will be decided on a later date.
13. A preferred construction access plan will be provided at a later date.

**Clarifications:**

1. Bid Documents can be emailed to Eric Barney at ebarney@martinmartin.com rather than providing three hard copies. Reference to the latest bid schedule sent out on November 30, 2017 for dates.
2. There will be a minimum of a 4' excavation on the vertical face of the parking structure (reference detail 4/S2.2).
3. The weight restrictions for the parking structure are 15,000 lbs. limit for loaded or construction or maintenance equipment. Please see sheet S0.1 under "Design Criteria."
4. Heat tape is required in the roof drains please refer to note #8 and #9 on sheet E1.0 for all the locations heat tape is required.
5. The boiler room plans are currently not complete there is a \$200,000 allowance for the boiler room. Once the plans become available the winning contractor will rebid the boiler room.
6. The light poles are currently being designed and plans will be issued at a later date.
7. The existing sign at the top of the stairs is not to be removed. The sign shown on L3.7 is for a future gateway at a different location. The foundations for the sign are to be placed with this construction phase. The plans for the gateway sign foundation will be provided at a later date.

**Specifications:**

1. A notice to proceed will be provided prior to April 16, 2018. The construction schedule will be from April 16<sup>th</sup> to November 2<sup>nd</sup>, 2018. If work is not substantially completed by November 2<sup>nd</sup>,

2018 liquidated damages of \$2,000 per day will occur. If work is not completed by November 22<sup>nd</sup>, 2018 liquidated damages of \$5,000 per day will occur. There is no longer a 150-day construction schedule. Please see section 00700 General Conditions under 1.30 for the definition of substantial completion.

2. The steel specifications for the light pole will be ASTM A36 or ASTM A572.

Prepared by: Martin/Martin, Inc.  
Eric Barney, P.E.

Date: December 7, 2017

Attachments: *Section 00100 – Instructions to Bidders*  
*Section 00500 – Agreement Form*

#### ADDENDUM NO. 1

This Addendum must be signed, attested below, and attached to the Bid submitted to MARTIN/MARTIN Consulting Engineers or the Bid may be rejected.

By: \_\_\_\_\_

\_\_\_\_\_  
ATTEST: \_\_\_\_\_ BIDDER: \_\_\_\_\_

\_\_\_\_\_  
DATE: \_\_\_\_\_

COMPANY: \_\_\_\_\_  
\_\_\_\_\_

ADDRESS: \_\_\_\_\_  
\_\_\_\_\_

**ADDENDUM NO. 2**  
**Torian Parking Structure Waterproofing/Renovation – Phase 2**

**December 12, 2017**

The following modifications and clarifications are made a part of the Contract Documents for the Torian Parking Structure Waterproofing/Renovation – Phase 2 project.

**General:**

1. The Owner's Representative will be available on site on a part time basis. They be onsite approximately 4 days per week give or take as needed throughout the duration of the project.
2. All items not included in the Precision Pools and Spas, Inc. quote will need to be included on the contractors bid.
3. Vertical waterproofing will only be required in the areas where horizontal waterproofing is placed.
4. Precision Pool and Spas quote does not state the depth of the hot tub. The pool is not being modified other than the pool tile being replaced by Precision Pool and Spa. The approximate dimensions of the pool are 39'-8"x19'-8" with a depth of 3' on the shallow side and 5' in the center, please field verify. Please refer to the plans for the layout of the new hot tub. Assume the hot tub water depth to be 3'-6" with 6" of free board.

**Clarifications:**

1. Bid all items noted as pending structural review based on the details shown in the plan and after the structural drawings are released these items will be re-bid by the winning contractor. Martin/Martin Inc. will be providing the structural review/drawings for these items.
2. The contractor will be required to obtain and pay for all permits necessary to complete the work. All permits will need to be submitted to Routt County Regional Building Department for review.
3. Please assume the thickness of the concrete that needs to be removed is all 6".
4. There is not a plan that shows a specific location of where potholing should occur. See sheet DM1.0 under Note 2 concerning utility crossings and refer to C1.0 for the overall site utilities as well as E1.0 for electrical utilities. Potholing should be performed at the contractors discretion.
5. Items that are to be determined at a later date will be bid as follows. Assume that an 8' chain link fence will be required to secure the jobsite from the public around the perimeter of the project. ADA access will be done by using the elevators and coordination with the owner's representative and Torian Plum management. The specific construction access plan will be created by the owner's representative and voted on by the HOA board, the plan is subject to change due to unforeseen circumstances, if any additional cost will be incurred due to the construction access plan, we will ask the winning contractor to provide a change order. Maintaining fire egress and wayfinding will be included in the construction access plan. If any additional wayfinding is needed a laminated 8.5"x11" piece of paper directing the public at the general access area will be acceptable.
6. The options for keeping the Silver Linings business open during excavation are performing work outside of normal business hours. If an open excavation is required to be left open the area will need to be steel plated. Coordination with the owner's representative and the Torian Plum management team will be required to perform this work without interrupting the businesses daily operation.
7. The type A vehicle paver is 80 mm (3 1/8") thick and the type A pedestrian paver is to be 60 mm (2 1/4") thick.
8. The type B pool paver manufacturers cut sheet states that 12"x24" is manufactured in both 1 1/2" and 2" thicknesses, see attached, the 2" thick paver is preferred.
9. A paver sealer is not required for this project.
10. Specification section 321413.13 applies for the pavers that are on the roof deck and around the pool. The bedding material differs from the bedding sand from the specification for Concrete Unit

Pavers 321413. The bedding material from specification section 321413.13 allows for moisture to infiltrate through the sub surface more effectively.

**Specifications:**

1. The specifications for lightweight are under specification 073363 Intensive Garden Roof Assembly, 2.02 Materials, F. Growing Materials (page 5 and 6). This includes the specification requirement for the lightweight soil.
2. Reference specification 011025 Measurement and Payment (page 27) L1.0 to L4.1-114 Deck Replacement. Additional information is shown on D1.0 Demolition for the outline of the deck to be removed. See sheet L1.0 for revised extents of the deck. See detail 01 Pool Area Deck and Shade Structure on sheet L3.5 for deck framing plan.
3. Attached is the specification for the water and sewer line trenching and backfilling.

Prepared by: Martin/Martin, Inc.  
Eric Barney, P.E.

Date: December 12, 2017

Attachments: *Precision Pools and Spas, Inc. – Pool/Spa Purchase Installation Agreement*  
*Section 02621 – Water and Sewer Line Trenching and Backfilling*  
*Cool Roof Series – Cut Sheets*

ADDENDUM NO. 2

This Addendum must be signed, attested below, and attached to the Bid submitted to MARTIN/MARTIN Consulting Engineers or the Bid may be rejected.

By: \_\_\_\_\_

\_\_\_\_\_  
ATTEST: \_\_\_\_\_ BIDDER: \_\_\_\_\_

\_\_\_\_\_  
DATE: \_\_\_\_\_

COMPANY: \_\_\_\_\_  
\_\_\_\_\_

ADDRESS: \_\_\_\_\_  
\_\_\_\_\_



**ADDENDUM NO. 3 – Revision No.1**  
**Torian Parking Structure Waterproofing/Renovation – Phase 2**

**January 16, 2018**

The following modifications and clarifications are made a part of the Contract Documents for the Torian Parking Structure Waterproofing/Renovation – Phase 2 project.

**General:**

1. Ski Time Square and Parking Garage accesses are adequate accommodations during the closure of the lower level, east-side doors (closest to the pool). See attached email from Lee Smith of Eric Smith and associates.
2. MEP Engineering will provide signed and sealed permit plans to the building department. ~~Per Ducks Construction a permit is not required by the installing contractor. We are assuming no additional engineering/stamped plans are required from the mechanical subcontractor.~~
3. Removal of waterproofing on the small corner behind the base club is not acceptable other value options could be used but the excavation will need to take place before we can determine other options.
4. Repair/reuse existing pool fence is acceptable. However, all costs associated with a ~~new powder coat~~ *using a new direct to metal paint* should be included in the costs. Also, there will need to be a slight modification to a few of the sections of the existing pool fence at the southeast corner because the proposed wood deck to the east from the original configuration.
5. The local production of lightweight soil is acceptable.
6. The pool furniture, site furniture, trash cans, tree replacement at backside of the base club, signage/wayfinding, and relocation of signage and equipment in the pool area are not included in the bid and will be paid out of HOA reserves.
7. An updated bid form, and measurement and payment will be provided with the removals and new bid items added.
8. The bold and italicized items are the only items on the bid form that are required to be filled out.

**Clarifications:**

1. Bid the pedestrian light poles, deck and shade structure, and screen fence foundations per the attached detail for over the structure foundation and use the light pole base design for off structure items (detail 02/L3.4).
2. Bid the light poles as if you are to self-perform construction for the light pole. Use steel of grade ASTM A36 or A572, no coating is required on the steel, Bid Item No. 119.
3. Bid the pool fence to be repaired/reused. Costs should include a new ~~powder coat~~ *direct to metal paint* finish and realignment, Bid Item 132 and 133.
4. Bid the pool fence foundations for the new fence configuration based on the detail for the new pool fence (detail 01/L3.6), Bid Item No. 132 and 133.
5. Bid all wood items to be stained with Sherwin Williams #3531 Blue Shadow.
6. Bid the shade structure to have the steel members grade ASTM A36 or ASTM A572, with a powder coat finish that resembles weathered steel, Bid Item No. 130.
7. Bid the deck to be composite decking, with a color grey, Bid Item No. 129.
8. Bid item Gateway Foundations is removed from the bid schedule.
9. Revised Bid Quantity No. 25 to match structural Plans.
10. Added Bid Items No. 28, No. 30, No. 34, No.35, No.36, No.37, No.38, and No.39 to match the structural plans.
11. Bid Items No. 28, *No.30*, No. 35, No. 36, No. 37, No. 38, and No. 39 Martin/Martin will provide an Allowance
12. Revised Bid Quantity No. 64 and No. 67 for revised Transition Off Structure (detail 02/L3.7).
13. Added Bid Items No. 92 through 99 in Landscape for Pool Side Planter. *Plan on connecting the new irrigation system at location "D" on the irrigation drawings.*

14. Bid Item 101 Provide Pricing for one Boiler unit. *System pipin for the 2<sup>nd</sup> boiler/pump will be roughed in for future installation.*
- ~~15. Added Bid Item No. 118 for Gas Stub Out for Grills around the Pool~~
16. Bid Items No. 118 through No. 126 Confirm Pricing.

**Plan Revisions:**

1. DM1.0
  - a. Revised callout to remove, refinish, and reset existing pool fence.
2. L1.0
  - a. Removed symbols for future gateway footers south of cafe diva, these were not previously called out.
  - b. Removed callout for pool fence
  - c. Removed symbols for pool fence light
  - d. Added detail callout to Site Detail Keynotes for "Concrete Unit Pavers - Transition Off Strct"
  - e. Revised number for Pool Coping
  - f. Adjusted callout for Pool Fence detail callout to Existing
  - g. Revised Pool Fence Light detail callout to N/A
3. L1.1
  - a. Revised extent of Washed No. 57 Stone to 2' off structure in lower and upper plazas
  - b. Revised material callouts in Subgrade Material Legend for 6" Concrete Subgrade Slab.
  - c. Added hatch pattern and label for 4" Concrete Subgrade Slab
  - d. Revised hatch pattern around pool for 4" Conc. Subgrade Slab
  - e. Updates to Site Detail Keynotes as previously described in sheet L1.0
- ~~4. L3.0~~
  - ~~a. Removed callout for Rigid Foam Insulation on detail 03 Concrete Unit Pavers - Off Structure~~
  - ~~b. Revised detail for Concrete Pavers at Pool Area to a 4" concrete subgrade slab. Added callout for 2" dia. holes at low points of slab to be filled with pea gravel~~
5. L3.4
  - a. Removed detail 01 for Concrete Base for Entry Gateway
6. L3.6
  - a. Removed detail 01 for Pool Fence
7. L3.7
  - a. Removed callout for Rigid Foam Insulation on detail 03 Concrete Unit Pavers - Off Structure
  - b. Revised detail for Concrete Pavers at Pool Area to a 4" concrete subgrade slab. Added callout for 2" dia. holes at low points of slab to be filled with pea gravel

Prepared by: Martin/Martin, Inc.  
Eric Barney, P.E.

Date: January 10, 2018

Attachments: *ADA Opinion Email*

*Pedestrian Light Post Foundation Plan*

*Construction Plans Addendum A dated (01/05/2018) – DM1.0*

*Construction Plans Addendum A dated (01/05/2018) – L1.0*

*Construction Plans Addendum A dated (01/05/2018) – L1.1*

~~*Construction Plans Addendum A dated (01/05/2018) – L3.0*~~

*Construction Plans Addendum A dated (01/05/2018) – L3.4*

*Construction Plans Addendum A dated (01/05/2018) – L3.6*

*Construction Plans Addendum A dated (01/05/2018) – L3.7*

*Section 00300 – Bid Form Addendum 3 Revision 1*

ADDENDUM

ADDENDUM NO. 3

This Addendum must be signed, attested below, and attached to the Bid submitted to MARTIN/MARTIN Consulting Engineers or the Bid may be rejected.

By: \_\_\_\_\_

\_\_\_\_\_  
ATTEST: \_\_\_\_\_ BIDDER:

\_\_\_\_\_

DATE: \_\_\_\_\_

COMPANY: \_\_\_\_\_

\_\_\_\_\_

ADDRESS: \_\_\_\_\_

\_\_\_\_\_

**ADDENDUM NO. 4**  
**Torian Parking Structure Waterproofing/Renovation – Phase 2**

**January 25, 2018**

The following modifications and clarifications are made a part of the Contract Documents for the Torian Parking Structure Waterproofing/Renovation – Phase 2 project.

**Clarifications:**

1. Removed Bid Items No. 28, No. 30, No. 34, No.35, No.36, No.37, No.38, and No.39 if they are encountered payment will be made from contingency fund.
2. Bid Items No. 8, No. 9, and No. 72 has revised quantities.

**Plan Revisions:**

1. L1.0
  - a. Removed concrete bands at screen fencing.
2. L3.1
  - a. Added section at deck to trench grate detail.
3. L3.3
  - a. Revised Screen Fencing detail based on structural review.
  - b. Revised detail 02 Pool Fence Lighting.
  - c. Removed Pending Structural Review Note.
4. L3.4
  - a. Revised detail 03 Stone Veneer Light Pole Base – On Structure to callout reinforcing to structural detail 05/S2.3
  - b. Revised Pedestrian Light – Structure detail per structural review
  - c. Removed Pending Structural Review note
5. L3.5
  - a. Revised Pool Area Deck and Shade Structure detail base on structural review
  - b. Added decking plan
  - c. Revised foundation plan
  - d. Reference structural details for connection points on Elevation A & B
  - e. Removed Pending Structural Review note
6. L3.7
  - a. Moved Fire Pit detail from 03/L3.1 to 04/L3.7
7. IR1.0
  - a. Revised “Refer to Sheet” to include IR1.1 for Irrigation Details
8. IR1.1
  - a. Added Irrigation details 1 and 2 to sheet
  - b. Added line and bubblers to planters at deck
  - c. Added zone to mid-level system, revised zone #'s
  - d. Revised “Refer to Sheet” to include IR1.2 for Irrigation Details
9. IR1.2
  - a. Added Irrigation details 13 and 14, Bubbler and Bubbler to Planters details
  - b. Revised detail numbering
10. S2.3
  - a. Added sheet
  - b. Added details; Shade Structure Connection 1, Shade Structure Connection 2, Shade Structure Column Base, Light Pole Foundation, Shade Structure Base Detail, Screen Fence Foundation Extension

Prepared by: Martin/Martin, Inc.  
Eric Barney, P.E.

Date: January 25, 2018

Attachments: ADA Opinion Email

Construction Plans Addendum 4 dated (01/19/2018) – L1.0  
Construction Plans Addendum 4 dated (01/19/2018) – L3.1  
Construction Plans Addendum 4 dated (01/19/2018) – L3.3  
Construction Plans Addendum 4 dated (01/19/2018) – L3.4  
Construction Plans Addendum 4 dated (01/19/2018) – L3.5  
Construction Plans Addendum 4 dated (01/19/2018) – L3.7  
Construction Plans Addendum 4 dated (01/19/2018) – IR1.0  
Construction Plans Addendum 4 dated (01/19/2018) – IR1.1  
Construction Plans Addendum 4 dated (01/19/2018) – IR1.2  
Construction Plans Addendum 4 dated (01/19/2018) – S2.3  
Section 00300 – Bid Form Addendum 4  
Section 001025 – Measurement and Payment Addendum 4

#### ADDENDUM NO. 4

This Addendum must be signed, attested below, and attached to the Bid submitted to  
MARTIN/MARTIN Consulting Engineers or the Bid may be rejected.

By: \_\_\_\_\_

\_\_\_\_\_  
ATTEST: \_\_\_\_\_ BIDDER: \_\_\_\_\_

\_\_\_\_\_  
DATE: \_\_\_\_\_

COMPANY: \_\_\_\_\_

\_\_\_\_\_  
ADDRESS: \_\_\_\_\_

## SECTION 00610

### PERFORMANCE BOND

#### 1.1 PERFORMANCE BOND

The Performance Bond form bound with this project manual must be used. Substitute forms are not acceptable.

#### 1.2 POWER OF ATTORNEY

The Performance Bond must be accompanied by signed Power of Attorney, which may be on Surety's standard form.

Performance Bond must be in effect for the entire warranty period.

END OF SECTION

PERFORMANCE BOND

STATE OF COLORADO  
COUNTY OF ROUTT

KNOW ALL MEN BY THESE PRESENTS, That \_\_\_\_\_

hereinafter called the Principal, and \_\_\_\_\_

\_\_\_\_\_ a corporation duly organized under the laws of the State of \_\_\_\_\_, hereinafter called the Surety, are held and firmly bound unto Torian Plum Condominiums Home Owners Association, hereinafter called the Owner, and unto all persons, firms, and corporations who may furnish materials for, or perform labor upon the improvements, hereinafter referred to in the penal sum of \_\_\_\_\_ dollars in lawful money of the United States, to be paid to the order of the Owner, for the payment of which sum will and truly to be made, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the Principal entered into a certain agreement with the Owner, dated the \_\_\_\_ day of \_\_\_\_\_, 2017, a copy of which is hereto attached and made a part hereof, for the performance of: the “Torian Plum Parking Structure – Phase 2”.

NOW THEREFORE, if the Principal shall well, truly and faithfully perform and fulfill all the duties, obligations, undertakings, covenants, terms, conditions, and agreements of this contract, and any extensions thereof which may be granted by the Owner, with or without notice to the Surety, and during the life of any warranty required under the contract, and shall satisfy all claims and demands incurred under such contract, and shall fully indemnify and save harmless the Owner from all costs and damages which it may suffer by reason or failure to do so, and shall reimburse and repay the Owner all outlay and expense which the Owner may incur in making good any default, including cost for additional legal fees or engineering services, and shall promptly make payment to all persons, firms, subcontractors, and corporations furnishing materials, equipment, and cost of rentals for or performing labor in the prosecution of the work provided for in such contract, and any authorized extension or modification thereof, then this obligation shall be void; otherwise, to remain in full force and effect.

PROVIDED FURTHER, that if any legal action be filed upon this bond, venue shall lie in the State of Colorado. The Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract, or to the work to be performed thereunder, or the specifications accompanying the same shall in any way affect its obligation on this bond, and it does hereby waive notice of any such change, extension of time, or alteration of the specifications.

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

IN WITNESS WHEREOF, this instrument is executed in \_\_\_\_\_ counterparts, each one of which shall be deemed an original, this the \_\_\_\_\_ day of \_\_\_\_\_, 2017.

PRINCIPAL \_\_\_\_\_ (seal)

By \_\_\_\_\_ Attest \_\_\_\_\_

Title \_\_\_\_\_ Title \_\_\_\_\_

SURETY \_\_\_\_\_ (seal)

By \_\_\_\_\_

Title \_\_\_\_\_



SECTION 00650

CERTIFICATE OF INSURANCE

1.1 CERTIFICATE OF INSURANCE

The Certificate of Insurance form bound with this project manual shall be provided by the Contractor with the executed contract prior to Owner's signature. Required limits of liability and additional insureds are indicated on the certificate.

END OF SECTION

# ACORD™ CERTIFICATE OF LIABILITY INSURANCE

PRODUCER  
(Insert Insurance Company)

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.

## INSURERS AFFORDING COVERAGE

INSURED  
(Insert Contractor)

INSURER A: Travelers Indemnity Co of American

INSURER B: Travelers Casualty Insurance

INSURER C: Hartford Accident & Indemnity

INSURER D: Lexington Insurance Co (AIG)

INSURER E:

## COVERAGES

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

INSR LTR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS	
A	GENERAL LIABILITY <input checked="" type="checkbox"/> COMMERCIAL GENERAL LIABILITY <input type="checkbox"/> [ ] CLAIMS MADE <input type="checkbox"/> [ ] OCCUR <input type="checkbox"/> [ ] _____ <input type="checkbox"/> [ ] _____ GEN'L AGGREGATE LIMIT APPLIES PER <input type="checkbox"/> [ ] POLICY <input type="checkbox"/> [ ] PRO <input type="checkbox"/> [ ] LOC JECT	6802275L118	06/01/08	06/01/09	EACH OCCURRENCE  FIRE DAMAGE (Any one fire)  MED EXP (Any one person)  PERSONAL & ADV INJURY  GENERAL AGGREGATE  PRODUCTS – COMP/OP AGG	\$1,000,000  \$1,000,000  \$5,000  \$1,000,000  \$2,000,000  \$2,000,000
B	AUTOMOBILE LIABILITY <input checked="" type="checkbox"/> ANY AUTO <input type="checkbox"/> [ ] ALL OWNED AUTOS <input type="checkbox"/> [ ] SCHEDULED AUTOS <input checked="" type="checkbox"/> HIRED AUTOS <input checked="" type="checkbox"/> NON-OWNED AUTOS	BA7846L848	06/01/08	06/01/09	COMBINED SINGLE LIMIT (ea accident)  BODILY INJURY (Per accident)  PROP. DAMAGE (per accident)	\$1,000,000  \$  \$
	GARAGE LIABILITY <input type="checkbox"/> [ ] ANY AUTO				AUTO ONLY- EA ACCIDENT OTHER THAN EAACC AUTO ONLY AGG	\$  \$ \$
A	EXCESS LIABILITY <input checked="" type="checkbox"/> OCCUR <input type="checkbox"/> [ ] CLAIMS MADE <input type="checkbox"/> [ ] DEDUCTIBLE <input checked="" type="checkbox"/> RETENTION \$10,000	CUP6538Y942	06/01/08	06/01/09	EACH OCCURRENCE  AGGREGATE	\$5,000,000  \$5,000,000
C	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY	34WEGTD0323	06/01/08	06/01/09	<input checked="" type="checkbox"/> [X] WC STATUTORY LIMITS <input type="checkbox"/> [ ] OTHER E.L. – EACH ACCIDENT  E.L. DISEASE – EA EMPLOYEE  E.L. DISEASE – POLICY LIMIT	\$1,000,000  \$1,000,000  \$1,000,000
D	OTHER PROFESSIONAL Liability Claims Made	5766519	06/01/08	06/01/09	\$1,000,000 per claim \$2,000,000 annl aggr.	

Description of operations/locations/vehicles/exclusions added by endorsement/special provisions

(Insert Project Name and Owner)

CERTIFICATE HOLDER      ADDITIONAL INSURED; INSURER LETTER      CANCELLATION  
FOR PROPOSAL PURPOSES ONLY

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING INSURER WILL ENDEAVOR TO MAIL 0 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT, BUT FAILURE TO DO SO SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE INSURER, IT'S AGENTS OR REPRESENTATIVES.

AUTHORIZED REPRESENTATIVE

## SECTION 00700 - GENERAL CONDITIONS

1. DEFINITIONS
2. CONTRACT DOCUMENTS
3. RESPONSIBILITIES AND AUTHORITY OF OWNER, ENGINEER AND CONTRACTORS
4. PRECONSTRUCTION REQUIREMENTS

5. CONSTRUCTION PHASE REQUIREMENTS
6. CONTRACT CLOSEOUT
7. MISCELLANEOUS PROVISIONS

### ARTICLE 1 - DEFINITIONS

Wherever used in these General Conditions or in the other Contract Documents, the following terms have the meanings indicated which are applicable to both the singular and plural thereof:

1.1 ADDENDA - Written or graphic documents issued prior to execution of the Agreement which modify or interpret the Contract Documents by additions, deletions clarifications or corrections.

1.2 AGREEMENT - The written Agreement between Owner and Contractor covering the work to be performed.

1.3 APPLICATION FOR PAYMENT - The form which is to be used by the Contractor in requesting progress or final payment and which is to include such supporting documentation as is required by the Contract Documents.

1.4 BID - The offer or proposal of the Bidder submitted on the prescribed form setting forth the prices for the work to be performed.

1.5 BIDDER - Any person, firm or corporation submitting a Bid for the work.

1.6 BONDS - Bid and Performance Bonds and other instruments of security, furnished by the Contractor and his surety in accordance with the Contract Documents.

1.7 CHANGE ORDER - A written order to the Contractor issued after execution of the Agreement authorizing an addition, deletion or revision in the work or an adjustment in the contract price and/or the contract time.

1.8 CONTRACT DOCUMENTS - The

contract, including Advertisement for Bids or Invitation to Bid, Instructions to Bidders, Bid Form and all required attachments, Bid Bond or other bid security, Notice of Award, Agreement, Performance Bond, Notice to Proceed, General Conditions, Supplementary Conditions, Specifications, Drawings, Plans, Addenda and all modifications issued after execution of the Agreement.

1.9 CONTRACT PRICE - The total monies payable by the Owner to the Contractor under the Contract Documents and as stated in the Agreement.

1.10 CONTRACT TIME - The number of calendar days or the date stated in the Agreement for the substantial completion of the work.

1.11 CONTRACTOR - The person, firm or corporation with whom the Owner has executed the Agreement.

1.12 DAY - Calendar day of twenty-four hours measured from midnight to the next midnight.

1.13 DRAWINGS, PLANS, DETAILS - Graphic documents which show the character and scope of the work to be performed and which have been prepared or approved by the Engineer.

1.14 ENGINEER - The person, firm or corporation named as such in the Contract Document.

1.15 FIELD ORDER - A written order issued by the Engineer to the Contractor which orders minor changes in the work not involving a change in the Contract price or Contract Time.

1.16 GENERAL REQUIREMENTS -

Sections of Division 1 of the Specifications.

1.17 MODIFICATION - (a) A written amendment to the Contract Documents signed by both parties, (b) a change order, or (c) a field order. a modification may only be issued after execution of the Agreement.

1.18 NOTICE OF ACCEPTANCE - Written notice from the Owner accepting the project or portion thereof as being substantially complete and stating the date upon which the contractor's project warranty will begin.

1.19 NOTICE OF AWARD - The written notice of the acceptance of the bid from the owner to the successful bidder.

1.20 NOTICE TO PROCEED - Written notice from the Owner to the Contractor authorizing him to proceed with the work and establishing the date upon which the contract time will begin.

1.21 OWNER - A public or quasi-public body or authority, corporation, association, partnership or individual with whom the Contractor has entered into the Agreement and for whom the work is to be provided.

1.22 PRODUCT DATA - Illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other printed information furnished by the Contractor to illustrate a material, product or system for some portion of the work. Sometimes erroneously referred to as shop drawings.

1.23 PROJECT - The total construction of which the work to be provided under the contract documents may be the whole or a part.

1.24 PROJECT MANUAL - A single written document including bidding requirements, contract forms, general and supplementary conditions, specifications and other procedural, administrative or technical documents. Sometimes erroneously referred to as the specifications.

1.25 RESIDENT PROJECT REPRESENTATIVE - The authorized

representative of the Owner who is assigned to the project site or any part thereof.

1.26 SAMPLES - Physical samples of materials or products to be incorporated into the work.

1.27 SHOP DRAWINGS - Drawings, diagrams, schedules or other data prepared specifically for this project by the Contractor, a Subcontractor, manufacturer, supplier or distributor which illustrate how specific portions of the work are to be fabricated or installed.

1.28 SPECIFICATIONS - Those portions of the contract documents consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship and certain related administrative details.

1.29 SUBCONTRACTOR - An individual, firm or corporation having a direct contract with the Contractor or with any other Subcontractor for the performance of a part of the work at the site.

1.30 SUBSTANTIAL COMPLETION - That date when construction of the project or a specified part thereof is sufficiently completed in accordance with the contract documents that it can be utilized for the purpose for which it is intended.

1.31 SUPPLEMENTARY CONDITIONS - Supplements or modifications to the general conditions as required by a specific project.

1.32 SUPPLIER - Any person or organization who supplies materials or equipment for the work including that fabricated to a special design, but who does not perform labor at the site.

1.33 UNIT PRICE - An amount stated in the bid as a price per unit of measurement for materials or services as described in the contract documents.

1.34 WORK - All labor necessary to produce the construction required by the contract documents and all materials and equipment incorporated or to be incorporated in the project.

1.35 WRITTEN NOTICE - Any notice to any party of the agreement relative to any part of the

agreement which is delivered in writing. Written notice shall be deemed to have been duly served when posted by certified or registered mail to the said party at his last given address or delivered in person to said party or his authorized representative on the work.

## ARTICLE 2 - CONTRACT DOCUMENTS

### 2.1 INTENT OF CONTRACT DOCUMENTS

2.1.1 The contract documents comprise the entire agreement between Owner and Contractor concerning the work to be performed. They may be altered only by a modification.

2.1.2 The contract documents are complementary; what is called for by one is as binding as if called for by all. If, during the performance of the work, the Contractor finds a conflict, error or discrepancy in the contract documents, he shall report it to the owner and engineer in writing at once and before proceeding with the work affected thereby; however, the Contractor shall not be liable to the Owner for failure to report any conflict, error or discrepancy in the specifications or drawings unless the Contractor has actual knowledge thereof or should reasonably have known thereof.

2.1.3 It is the intent of the specifications and drawings to describe a complete project (or part thereof) to be constructed in accordance with the contract documents. Any work that may reasonably be inferred from the specifications or drawings as being required to produce the intended result shall be supplied whether or not it is specifically called for. When words which have a well-known technical or trade meaning are used to describe work, materials or equipment such words shall be interpreted in accordance with such meaning. Reference to standard specifications, manuals or codes of any technical society, organization or association, or to the code of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual or code 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. However,

no provision of any referenced standard specification, manual or code (whether or not specifically incorporated by reference in the contract documents) shall change the duties and responsibilities of Owner, Contractor or Engineer, or any of their agents or employees from those set forth in the contract documents. Clarifications and interpretations of the contract documents shall be issued by Engineer and provided for in Article 3.

2.1.4 The contract documents will be governed by the law of the place of the project.

2.2 REUSE OF CONTRACT DOCUMENTS - Neither Contractor nor any Subcontractor, manufacturer, fabricator, supplier or distributor shall have or acquire any title to or ownership rights in any of the drawings, specifications or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer; and they shall not reuse any of them on extensions of the project or any other project without written consent of Engineer and specific written verification or adaptation by Engineer.

2.3 COPIES OF DOCUMENTS - Unless otherwise specified, the Owner will furnish the Contractor with up to ten copies of the contract documents for execution of the work. Additional copies will be furnished, upon request, at the cost of reproduction.

2.4 ADDITIONAL INSTRUCTIONS AND DETAIL DRAWINGS - The Contractor may be furnished additional instructions and detail drawings by the Engineer as necessary to carry out the work required by the contract documents. The Contractor shall carry out the work in accordance with the additional detail drawings and instructions.

2.5 DISCREPANCIES - In case of conflict between the drawings and specifications, the specifications shall govern. Figure dimensions on drawings shall govern over scale dimensions, and detailed drawings shall govern over general drawings. Any discrepancies found between the drawings and specifications and site conditions or any inconsistencies or ambiguities in the drawings or specifications shall be immediately reported to

the Owner and Engineer, in writing, who shall promptly correct such inconsistencies or ambiguities in writing. Work done by the Contractor after his discovery of such discrepancies, inconsistencies or ambiguities and prior to receiving such written correction shall be done at the Contractor's work.

### ARTICLE 3 - RESPONSIBILITIES AND AUTHORITY OF OWNER, ENGINEER AND CONTRACTORS

#### 3.1 OWNER

3.1.1 LANDS AND RIGHTS-OF-WAY - Prior to issuance of notice to proceed, the Owner shall obtain all lands and right-of-way necessary for carrying out and for the completion of the work required by the contract documents, unless otherwise mutually agreed. The Owner shall provide to the Contractor information which delineates and describes the lands owned and rights-of-way acquired.

3.1.2 SURVEYS AND REFERENCE POINTS - The Owner shall furnish all boundary surveys and establish necessary bench marks, base lines, center lines slope and offset stakes for the proper location of the work. The Contractor shall give the Owner forty-eight (48) hours notice as to the location and placement of said surveys.

3.1.3 OWNERS INSTRUCTIONS - Unless otherwise specified, the Owner shall issue all communications to the Contractor through the Engineer.

3.1.4 TERMINATION OF ENGINEER - In case of termination of the employment of the Engineer the Owner shall appoint an Engineer against whom the Contractor makes no reasonable objection, whose status under the Contract Documents shall be that of the former Engineer. Any dispute in connection with such appointment shall be subject to arbitration.

3.1.5 DATA AND PAYMENTS - The Owner shall furnish all data required under the contract documents promptly and shall make payments to the Contractor promptly as due.

3.1.6 INVESTIGATIONS AND REPORTS - The Owner shall make available to the Contractor copies of investigations and tests of subsurface and latent physical conditions at the site or otherwise affecting performance of the work which have been relied upon by the Engineer in preparing the contract documents. Such investigations and reports are not guaranteed as to accuracy or completeness and are not part of the contract documents.

3.1.7 CHANGES IN THE WORK - The Owner may at any time, as the need arises, order changes in the work without invalidating the agreement. If such changes increase or decrease the amount due under the agreement, or in the contract time, an equitable adjustment shall be authorized by change order.

3.1.8 TESTING AND INSPECTION - The Owner shall provide all inspection and testing services not required by the contract documents.

3.1.9 OWNER'S USE AND ACCESS - Prior to substantial completion, the Owner may, with the recommendation of the Engineer and concurrence of the Contractor use any completed or substantially completed portions of the work. Such use shall not constitute an acceptance of such portions of the work. The Owner or his separate contractors shall have the right to enter the premises for the purpose of doing work not covered by the contract documents. This provision shall not be construed as relieving the Contractor of the sole responsibility for the care and protection of the work, or the restoration of any damaged work except as may be caused by separate contractors or other agents or employees of the Owner.

#### 3.2 ENGINEER

3.2.1 OWNER'S REPRESENTATIVE - The Engineer shall act as the Owner's representative during the construction period. He shall decide questions which may arise as the quality and acceptability of materials furnished and work performed. He shall promptly interpret the intent of the contract documents in a fair and unbiased manner.

3.2.2 VISITS TO SITE - The Engineer will make visits to the site at intervals appropriate to the various stages of construction to observe the progress and quality of the executed work and to determine in general if the work is proceeding in accordance with the contract documents. The Engineer will keep the Owner informed of the progress of the work and will endeavor to guard the Owner against defects and deficiencies in the work.

3.2.3 SHOP DRAWINGS, CHANGE ORDERS AND PAYMENTS -The Engineer shall promptly process shop drawings, change orders and payment applications as provided in other Articles of these General Conditions.

3.2.4 FIELD ORDERS - The Engineer may authorize minor changes in the work not involving an adjustment in the contract price or contract time by issuing a field order.

3.2.5 ENGINEER'S RESPONSIBILITIES - The Engineer will not be responsible for the Contractor's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto and the Engineer will not be responsible for the Contractor's failure to perform the work in accordance with the contract documents. The Engineer will not be responsible for the acts or omissions of the Contractor or of any Subcontractor, or of the agents or employees of any Contractor or Subcontractor, or of any other persons at the site or otherwise performing any of the work.

3.2.6 UNACCEPTABLE WORK - As the Owner's representative, the Engineer will have authority to recommend disapproval or rejection of unacceptable materials or workmanship and will also have authority to require special testing, whether or not the work is fabricated, installed or completed.

### 3.3 CONTRACTOR

3.3.1 LANDS AND RIGHTS-OF-WAY - The Owner shall furnish all lands and rights-of-way described under Article 3.1.1. The Contractor shall provide at his own expense and without

liability to the Owner any additional land and access thereto that the Contractor may desire for temporary construction facilities, or for storage of materials and equipment, housing, location of housing or other required uses.

3.3.2 REFERENCE POINTS - The Owner will furnish necessary benchmarks, baselines, centerlines, slope and offset stakes for the proper location of the work. The Contractor shall furnish all additional stakes as he determines necessary to assure work is completed to the proper alignment and grades required by the contract documents.

3.3.3 SUPERVISION AND SUPERINTENDENCE - The Contractor will supervise and direct the work. He will be solely responsible for he means, methods, techniques, sequences and procedures of construction. The Contractor will employ and maintain on the work a qualified supervisor or superintendent who shall have been designated by the Contractor as the Contractor's representative at the site. The supervisor shall have full authority to act on behalf of the Contractor and all communications given to the supervisor shall be as binding as if given to the Contractor. The supervisor shall be present on the site at all times as required to perform adequate supervision and coordination of the work.

3.3.4 MATERIALS, SERVICES AND FACILITIES - It is understood that, except as otherwise specifically stated in the contract documents, the Contractor will provide and pay for all materials, labor, tools, equipment, water, light, power, transportation, supervision, temporary construction of an any nature, and all other services and facilities of any nature, and all other services and facilities of any nature whatsoever necessary to execute, complete, and deliver the work within he specified time. Materials and equipment shall be so stored as to insure the preservation of their quality and fitness for the work. Stored materials and equipment to be incorporated in the work shall be located so as to facilitate prompt inspection. Manufactured articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer. Materials, supplies and equipment shall be in accordance with samples submitted by the

Contractor and approved by the Engineer. Materials, supplies or equipment to be incorporated into the work shall not be purchased by the Contractor or the Subcontractor subject to a chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller.

**3.3.5 PATENTS** - The Contractor shall pay all applicable royalties and license fees. He shall defend all suits or claims for infringement of any patent rights and save the Owner harmless from loss on account thereof, except that the Owner shall be responsible for any such loss when a particular process, design, or the product of a particular manufacturer or manufacturers is specified is an infringement of a patent, he shall be responsible for such loss unless he promptly gives such information to the Engineer.

**3.3.6 PERMITS** - Permits and licenses of a temporary nature necessary for the prosecution of the work shall be secured and paid for by the Contractor unless otherwise stated in the Supplementary Conditions. The Contractor shall also obtain and pay for all special permits called for by the supplementary conditions or various sections of the specifications. The Contractor shall pay all charges of utility service companies for temporary connections to the work and the Owner shall pay all charges of such companies for capital costs related thereto.

**3.3.7 LAWS AND REGULATIONS** - The Contractor shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the work as drawn and specified. If the Contractor observes that the contract documents are at variance therewith, he shall promptly notify the Engineer in writing and any necessary changes shall be adjusted by an appropriate modification. If the Contractor performs any work knowing or having reason to know that it is contrary to applicable laws, ordinances, rules and regulations and without notifying the Engineer, the Contractor shall bear all resulting costs. However, it shall not be the Contractor's primary responsibility to make certain that the contract documents are in accordance with such laws, ordinances, rules and regulations.

**3.3.8 TAXES** - Unless stated otherwise in the

Supplementary Conditions, the Contractor shall pay all sales, consumer, use and other similar taxes required by the law of the place where the work is performed.

**3.3.9 SCHEDULES, REPORTS AND RECORDS** - The Contractor shall prepare, maintain and submit all schedules, reports and records required by the General Conditions, Supplementary Conditions or various sections of the specifications.

**3.3.10 PROTECTION OF WORK, PROPERTY AND PERSONS** - The Contractor will be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the work. He will take all necessary precautions for the safety of, and will provide the necessary protection to prevent damage, injury or loss to all employees on the work and other persons who may be affected thereby, all the work and all materials or equipment to be incorporated therein, whether in storage on or off the site, and other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

The Contractor will comply with all applicable laws, ordinances, rules, regulations and order of any public body having jurisdiction. He will erect and maintain, as required by the conditions and progress of the work, all necessary safeguards for safety and protection. He will notify Owners of adjacent utilities when prosecution of the work may affect them. The Contractor will remedy all damage, injury or loss to any property caused, directly or indirectly, in whole or in part, by the Contractor, or his Subcontractor or anyone directly or indirectly employed by any of them or anyone for whose acts any of them be liable, except damage or loss attributable to the fault of the contract documents or to the acts or omissions of the Owner or the Engineer or anyone employed by either of them or anyone for whose acts either of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of the Contractor.

In emergencies affecting the safety of persons or



the work or property at the site or adjacent thereto, the Contractor, without special instruction or authorization from the Engineer or Owner, shall act to prevent threatened damage, injury or loss. He will give the Engineer prompt written notice of any significant changes in the work or deviations from the contract documents caused thereby, and a change order shall thereupon be issued covering the changes and deviations involved.

### 3.4 SUBCONTRACTORS

3.4.1 LIMITATION OF USE - The Contractor may utilize the service of specialty Subcontractors on those parts of the work which under normal contracting practices are performed by specialty Subcontractors. The Contractor shall not award work to Subcontractors in excess of fifty percent (50%) of the contract price without prior written approval of the Owner.

3.4.2 ACCEPTABLE SUBCONTRACTORS - The Contractor shall not employ any Subcontractor or other person or organization (including those who are to furnish the principal items of materials or equipment), whether initially or as a substitute against whom the Owner may have reasonable objection. A Subcontractor or other organization identified in writing to the Owner by the prior to execution of Agreement will be deemed acceptable. If the Owner after due investigation has reasonable objection to any Subcontractor, other person or organization proposed by the Contractor, the Contractor shall submit all acceptable substitutes and the contract price shall be increased or decreased by the difference in cost occasioned by such substitution. The Contractor shall not be required to employ any Subcontractor, person or organization against whom the Contractor has reasonable objection.

3.4.3 ACTS AND OMISSIONS - The Contractor shall be as fully responsible to the Owner for the acts and omissions of his Subcontractors and of persons either directly or indirectly employed by them, as he is for the acts and omissions of persons directly employed by him.

3.4.4 SUBCONTRACTS - The Contractor shall insert appropriate provisions in all

Subcontracts relative to the work to bind Subcontractor to the Contractor by the terms of the Contract Documents insofar as applicable to the work of Subcontractor and to give the Contractor the same power as regards terminating any subcontract that the Owner may exercise over the Contractor under any provision of the Contract Documents.

3.4.5 CONTRACTUAL RELATION - nothing contained in this contract shall create any contractual relation between any Subcontractor and the Owner.

3.4.6 DIVISION OF WORK - The divisions and sections of the specifications and the identifications of any drawings shall not control the Contractor in dividing the work among Subcontractors or delineating the work to be performed by any specific trade.

### 3.5 SEPARATE CONTRACTORS

3.5.1 OWNER'S RIGHT - The Owner reserves the right to let other contracts in connection with this project.

The Contractor shall afford other Contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work, and shall properly connect and coordinate his work with theirs. If the proper execution or results of any part of the Contractor's work depends upon the work of any other Contractor, the Contractor shall inspect and promptly report to the Engineer any defects in such work that render it unsuitable for such proper execution and results.

3.5.2 ADDITIONAL WORK - The Owner may perform additional work related to the project by himself, or he may let other contracts containing provisions similar to these. The Contractor will afford the other Contractors who are parties to such contracts (or the Owner, if he is performing the additional work himself), reasonable opportunity for the introduction and storage of materials and equipment and the execution of work, and shall properly connect and coordinate his work with theirs.

3.5.3 WRITTEN NOTICE - If the performance of additional work by other Contractors or the

Owner is not noted in the contract documents prior to the execution of the contract, written notice thereof shall be given to the Contractor prior to starting any such additional work. If the Contractor believes that the performance of such additional work by the Owner or others involves him in additional expense or entitles him to an extension of the contract time, he may make a claim therefore as provided.

#### ARTICLE 4 - PRECONSTRUCTION REQUIREMENTS

4.1 CONTRACT SECURITY - The Contractor shall furnish the Owner along with the executed contract, a performance bond in penal sum equal to the amount of the contract price, conditioned upon the performance by the Contractor of all undertakings, covenants, terms, conditions and agreements of the contract documents and upon the prompt payment by the Contractor to all persons supplying labor and materials in the prosecution of the work provided by the contract documents. Such bonds shall be executed by the Contractor and a corporate bonding company licensed to transact such business in the State in which the work is to be performed. The expense of these bonds shall be borne by the Contractor. If at any time a surety on any such bond is declared a bankrupt or loses its right to do business in the State in which the work is to be performed or is removed from the list of surety companies accepted on Federal Bonds, Contractor shall with ten (10) days after notice from the Owner to do so, substitutes an acceptable bond (or bonds) in such form and sum and signed by such other surety or sureties as may be satisfactory to the Owner. The premiums on such bond shall be paid by the Contractor. No further payments shall be deemed due nor shall be made until the new surety or sureties shall have furnished an acceptable bond to the Owner.

4.2 INSURANCE - The Contractor shall furnish the Owner along with the executed contract, certificates of insurance acceptable to the Owner indicating that coverages required by the supplementary conditions have been obtained. Certificates shall contain a provision that coverages afforded under the policies will not be canceled unless at least thirty (30) days prior

written notice has been given to the Owner. The Owner and Engineer shall be named as the additional insured under the liability policy, evidence to be shown on the certificate.

4.2.1 The Contractor and/or Subcontractor shall maintain and keep in force builders' risk insurance covering construction of real property or installation of other property during the construction period. Coverage perils to be no less than fire, extended coverage, vandalism and malicious mischief. Evidence of insurance covering property in the course of construction shall be provided with the executed agreement.

4.3 LIST OF SUBCONTRACTORS AND MATERIAL SUPPLIERS - The Contractor shall furnish the Owner along with the executed agreement a list of all Subcontractors he intends to employ on the project and all other persons or organizations furnishing the principal items of materials or equipment, along with the amounts of their subcontracts or purchase contracts.

4.4 CONSTRUCTION SCHEDULE - The Contractor shall submit to the Owner along with the executed agreement a proposed construction progress schedule showing the order in which he proposes to carry on the work, including dates at which he will start the various parts of the work, estimated date of completion of each part and, as applicable the dates at which special detail drawings will be required and respective dates for submission of shop drawings; the beginning of manufacture; the testing and the installation of materials, supplies and equipment. The schedule shall be in a form acceptable to the Engineer, and shall indicate the time start and completion of each of the line items on the schedule of values. The contract time shall be as specified in the agreement. The schedule shall be revised by change order. The Owner and Engineer shall be entitled to rely upon the accuracy of the Contractor's construction schedule in the scheduling of their own work and that of other Contractors.

4.5 SCHEDULE OF VALUES - If requested, the Contractor shall furnish the Owner along with the executed agreement a schedule of values including quantities and unit prices aggregating

the total contract price and subdividing the work into component parts in sufficient detail to serve as a basis for progress payments during construction. Upon acceptance of the schedule of values by the Engineer, it shall be incorporated by the Engineer into a standard form of periodic estimate for partial payment.

#### 4.6 PRECONSTRUCTION CONFERENCE

- Before the Contractor begins work at the site, a conference will be held for review of the construction schedule, to establish procedures for handling shop drawings and other submittals, and for processing applications for payment and to establish a working understanding among the parties as to the work.

4.7 PAYMENT DATES - At the time of executing the agreement, the Contractor and Owner shall agree on the dates that periodic estimates for partial payment are to be filed and that payment to the Contractor is due.

### ARTICLE 5 - CONSTRUCTION PHASE REQUIREMENTS

5.1 USE OF PREMISES - The Contractor shall confine construction equipment, the storage of materials and equipment and the operations of workmen to areas permitted by law, ordinances, permits or the requirements of the contract documents, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment.

5.2 FIELD ENGINEERING - Work done by the Contractor without being properly located from established base lines, centerlines, offset stakes or there basic reference points furnished by the Owner may be ordered removed and replaced at the Contractor's expense. The Contractor shall carefully preserve all Owner-established base lines, offset stakes, benchmarks, slope stakes, centerline stakes or other basic reference points. In case of willful or careless destruction of same, the Contractor will pay the cost of replacement of said stakes and shall be responsible for any error or delay in work caused thereby. In such case the Contractor shall have no claim for damages or extension of the contract time.

5.3 CLEANUP - During the progress of the work, the Contractor shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from work. At the completion of the work the Contractor shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, appliances, construction equipment and machinery, and surplus materials, and shall leave the site clean and ready for occupancy by the Owner. The Contractor shall restore to their original condition those portions of the site not designated for alteration by the Contract Documents.

5.4 RECORD DOCUMENTS - The Contractor shall keep one record copy of all specifications, drawings, addenda, modifications, shop drawings and samples at the site, in good order and annotated to show all changes made during the construction process. These shall be available to the Engineer for examination and shall be delivered to the Engineer for the Owner upon completion of the work.

#### 5.5 INSPECTION AND TESTING

5.5.1 All materials and equipment used in the construction of the project shall be subject to inspection and testing in accordance with generally accepted standards, as required and defined in the contract documents.

5.5.2 The Owner shall provide all inspection and testing services not required by the contract documents.

5.5.3 The Contractor shall provide at his expense the testing and inspection services required by the contract documents.

5.5.4 If the contract documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any work to be inspected specifically, tested, or approved by someone other than the Contractor, the Contractor shall notify the Engineer at least forty-eight (48) hours prior to the time such inspection, testing, or approval will be required. The Contractor shall then furnish the Engineer the required certificates of inspection, testing or

approval.

5.5.5 Inspections, tests or approvals by the Engineer or others shall not relieve the Contractor from his obligations to perform the work in accordance with the requirements of the contract documents.

5.5.6 The Engineer and his representatives will at all times have access to the work. If applicable, authorized representatives and agents of any participating government agency and any local government with jurisdiction shall be permitted to inspect all work, materials, payrolls, records of personnel, invoices of materials and other relevant data and records. The Contractor will provide proper faculties for such access and observation of the work and also for any inspection or testing thereof.

5.5.7 If any work is covered contrary to the instructions of the Engineer it must, if requested by the Engineer, be uncovered for his observation and if directed by the Engineer replaced at the Contractor's expense.

5.5.8 If the Engineer considers it necessary or advisable that covered work be inspected or tested by others, the Contractor, at the Engineer's request, will uncover, expose or otherwise make available for observation, inspection or testing as the Engineer may require, that portion of the work in question, furnishing all necessary labor, materials, tools and equipment. If it is found that such work is defective, the Contractor will bear all the expenses of such uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction. If, however, such work is not found to be defective, the Contractor will be allowed an increase in the contract price or an extension of the contract time, or both, directly attributable to such uncovering, exposure, observation, inspection, testing and reconstruction and an appropriate change order shall be issued.

## 5.6 CORRECTION OF WORK

5.6.1 The Contractor shall promptly remove from the premises all work rejected for failure to comply with the contract documents, whether incorporated in the construction or not, and the

Contractor shall promptly replace and re-execute the work in accordance with the contract documents and without expense to the Owner and shall bear the expense of making good all work of other Contractors destroyed or damaged by such removal or replacement.

5.6.2 All removal and replacement work shall be done at the Contractor's expense. If the Contractor does not take action to remove such rejected work within ten (10) days after receipt of written notice, the Owner may remove such work and store the materials at the expense of the Contractor.

5.7 UNFORESEEN PHYSICAL CONDITIONS - The Contractor shall promptly notify the Owner and Engineer in writing of any subsurface or latent physical conditions at the site or in an existing structure differing materially from those indicated or referred to in the contract documents. The Engineer will promptly review those conditions and advise the Owner in writing if further investigation or tests are necessary. Promptly thereafter, the Owner shall obtain the necessary additional investigations and tests and furnish copies to the Engineer and Contractor. If the Engineer finds that the results of such investigations or tests indicate that there are subsurface or latent physical conditions which differ materially from those intended in the contract documents and which could not reasonably have been anticipated by the Contractor, a change order shall be issued incorporating the necessary revisions.

## 5.8 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

5.8.1 The Contractor shall provide shop drawings and product data as may be necessary for the prosecution of the work as required by the contract documents. The Engineer shall promptly review all shop drawings and product data. The Engineer's review shall not release the Contractor from responsibility for deviations from the contract documents unless such deviations have been called to the Engineer's attention in writing at the time of submission and the Engineer has given written concurrence to such deviation. Review of shop drawings or product data by the Engineer

shall not relieve the Contractor from responsibility for errors or omissions in the shop drawings or product data.

5.8.2 When submitted for the Engineer's review, shop drawings and product data shall bear the Contractor's certification that he has reviewed, checked and approved the shop drawings or product data and they are in conformance with the requirements of the contract documents.

5.8.3 The Contractor shall also submit to the Engineer for review with such promptness as to cause no delay in work, all samples required by the contract documents. All samples will have been checked by and stamped with the approval of the Contractor, identified clearly as to material, manufacturer, any pertinent catalog numbers and the use for which intended.

5.8.4 Portions of the work requiring a shop drawing or product data or sample submissions shall not begin until the shop drawing, product data or sample submission has been reviewed by the Engineer. A copy of each shop drawing or product data submittal and each approved sample shall be kept in good order by the Contractor at the site and shall be available to the Engineer.

5.9 SUBSTITUTIONS - Whenever a material, article or piece of equipment is identified on the drawings or specifications by reference to brand name or catalog number, it shall be understood that this is referenced for the purpose of defining the performance or other salient requirements and that other products of equal capacities, quality and function shall be considered. The Contractor may recommend the substitution of a material, article, or piece of equipment of equal substance and function for those referred to in the contract documents by reference to brand name or catalog number, and if, in the opinion of the Engineer, such material, article, or piece of equipment is of equal substance and function to that specified, the Engineer may approve its substitution and use by the Contractor. Any cost differential shall be deductible from the contract price and the contract documents shall be appropriately modified by change order. The Contractor warrants that if substitutes are approved, no major changes in the function or

general design of the project will result. Incidental changes or extra component parts required to accommodate the substitute will be made by the Contractor without a change in the contract price or contract time.

## 5.10 CHANGES IN THE WORK

5.10.1 CHANGE ORDERS - The Owner may at any time, as the need arises, order changes without invalidating the agreement. If such changes increase or decrease the amount due under the contract documents, or in the time required for performance of the work, an equitable adjustment shall be authorized by change order.

5.10.2 FIELD ORDERS - The Engineer, also, may at any time, by issuing a field order, make changes in the details of the work. The Contractor shall proceed with the performance of any changes in the work so requested by the Engineer unless the Contractor believes that such field order entitles him to a change in contract price or time, or both in which event he shall give the Owner written notice thereof within seven (7) days after the receipt of the requested change. Thereafter the Contractor shall document the basis for the change in contract price or time within thirty (30) days. The Contractor shall not execute such changes pending the receipt of an executed change order or further instruction from the Owner.

5.10.3 CHANGES IN CONTRACT PRICE - The contract price may be changed only by a change order. The value of any work covered by a change order or of any claim for increase or decrease in the contract price shall be determined by one or more of the following methods in the order of precedence listed below:

- (a) Unit prices previously approved.
- (b) An agreed lump sum.
- (c) The actual cost for labor, direct overhead, materials, supplies, equipment, and other services necessary to complete the work. In addition there shall be added an amount to be agreed upon but not to exceed fifteen (15) percent of the actual cost of the work to cover the cost of general overhead and profit.

## 5.11 PAYMENTS TO CONTRACTOR

5.11.1 PARTIAL PAY ESTIMATE - At least fifteen (15) days before each progress payment falls due (but not more than once a month) the Engineer will prepare a periodic estimate of partial payment based on in-place quantities agreed upon between the Contractor and Engineer at the site. The Engineer will forward one copy to the Owner and one copy to the Contractor.

5.11.2 CONTRACTOR'S STATEMENT - Upon receipt of periodic estimate of partial payment from the Engineer, the Contractor shall forward a statement to the Owner in care of the Engineer requesting payment in the amounts listed on the periodic estimate of partial payment.

5.11.3 ENGINEER'S RECOMMENDATION - Upon receipt of the Contractor's statement, the Engineer will forward same to the Owner recommending payment to the Contractor and clarifying or explaining any of the amounts due.

5.11.4 OWNER'S PAYMENT - Upon receipt of the Engineer's recommendation, the Owner shall within thirty (30) days forward payment directly to the Contractor minus any specified retainage.

5.11.5 BASIS FOR PAYMENT - payment will be made on the basis of completed work only. No payment will be made of stored materials, either at the site or elsewhere.

5.11.6 RETAINAGE - An amount equivalent to ten (10) percent of the amount shown to be due the Contractor on each estimate shall be withheld on the first fifty (50) percent due the Contractor. Thereafter, the Owner shall make all remaining payments without retainage if in the opinion of the Owner and Engineer, satisfactory progress is being made in the work.

5.11.7 WARRANTY OF TITLE - The Contractor warrants that title to all work, materials and equipment covered by an partial payment will pass to the Owner at the time of payment free and clear of all liens, claims, security interests and encumbrances.

## ARTICLE 6 - CONTRACT CLOSE OUT

### 6.1 TIME FOR COMPLETION AND LIQUIDATED DAMAGES

6.1.1 The date of beginning and the time for completion of the work are essential conditions of the contract documents and the work shall be commenced on a date specified in the notice to proceed.

6.1.2 The Contractor will proceed with the work at such rate of progress to insure full completion within the contract time. It is expressly understood and agreed, by and between the Contractor and the Owner, that the contract time for the completion of the work described herein is a reasonable time, taking into consideration the average climatic and economic conditions and other factors prevailing in the locality of the work.

6.1.3 If the Contractor shall fail to complete the work within the Contract Time, or extension of time granted by the Owner, then the Contractor will pay to the Owner the amount for liquidated damages as specified in the bid for each calendar day that the Contractor shall be in default after the time stipulated in the Contract Documents.

6.1.4 The Contractor shall not be charged with liquidated damages or any excess cost when the delay in completion of the work is due to the following, and the Contractor has promptly given written notice of such delay to the Owner or Engineer:

- a) To any preference, priority or allocation order duly issued by the Owner.
- b) To unforeseeable causes beyond the control and without the fault or negligence of the Contractor, including but not restricted to, acts of God; or the public enemy; acts of the Owner; acts of another Contractor in the performance of a contract with the owner; fires; floods; epidemics; quarantine restrictions; strikes; freight embargoes; any abnormal and unforeseeable weather; and
- c) To any delays of Subcontractors occasioned by any of the causes listed above.

### 6.2 FINAL PAYMENT TO CONTRACTOR

6.2.1 Upon completion and acceptance of the work, the Engineer shall issue a statement attached

to the final estimate for partial payment that the work has been reviewed by him and to the best of his knowledge, information and belief the contract documents have been compiled with. The entire balance found to be due the Contractor including the retained percentages but except such sums as may be lawfully retained by the Owner shall be paid to the Contractor within thirty (30) days of completion and acceptance of the work.

6.2.2 Final payment will not be made until after publication of notice of Contractor's settlement or receipt of lien waivers from the Contractor, Subcontractors, and material suppliers as is determined to be applicable by the Engineer.

6.2.3 In the case of publicly funded projects, the project will be advertised for final settlement using the following procedure:

Upon completion the project shall be advertised in accordance with the notice of Contractor's settlement, by two publications of notice, the last publication appearing at least ten (10) days prior to the time of final settlement.

On the date of final settlement thus advertised, and after the Contractor has submitted a written notice to the Owner that no claims have been filed, final payment and settlement shall be made in full.

If any unpaid claim for labor, materials, supplies or equipment is filed before payment in full of all sums due to the Contractor, the Owner shall withhold from the Contractor sufficient funds to insure the payment of such claim, until the same shall have been paid or withdrawn, such payment or withdrawal to be evidenced by filing a notarized receipt in full or notarized order for withdrawal signed by the claimant or his duly authorized agent or assignee.

6.2.4 If the work shall be completed, but final completion thereof shall be prevented through delay or correction of minor defects or unavailability of materials, or other causes beyond the control of the Contractor, the Owner at his discretion may release to the Contractor such amounts as may be in excess of three times the cost of completing the unfinished work or the cost of correcting the defective work.

6.2.5 The Contractor will indemnify and save the Owner or the Owner's agents harmless from all claims growing out of the lawful demands of Subcontractors, laborers, workmen, mechanics, materialmen, and furnishers of machinery and parts thereof, equipment, tools, and all supplies, incurred in the furtherance of the performance of the work. The Contractor shall, at the Owner's request, furnish satisfactory evidence that all obligations of the nature designated above have been paid, discharged, or waived. If the Contractor fails to do so the Owner may, after having notified the Contractor, either pay unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged whereupon payment to the Contractor shall be resumed, in accordance with the terms of the Contract Documents, but in no event shall the provisions of this sentence be construed to impose any obligations upon the Owner to either the Contractor, his Surety, or any third party. In paying any unpaid bills of the Contractor, any payment so made by the Owner shall be considered as a payment made under the Contract Documents by the Owner to the Contractor and the Owner shall not be liable to the Contractor for any such payments made in good faith.

6.3 ACCEPTANCE OF FINAL PAYMENT AS RELEASE - The acceptance by the Contractor of final payment shall be and shall operate as a release to the Owner of all claims and all liability to the Contractor other than claims in stated amounts as may be specifically excepted by the Contractor for all things done or furnished in connection with this work and for every act and neglect of the Owner and others relating to or arising out of this work. Any payment, however, final or otherwise, shall not release the Contractor or his Sureties from an obligations under the Contract Documents or Performance Bond.

6.4 FINAL PAPERWORK - neither the final payment nor the remaining retained percentage shall become due until the Contractor submits to the Owner: 1) an affidavit that all payrolls, bills for materials and equipment, and other indebtedness connected with the work for which

the Owner or his property might in anyway be responsible, have been paid or otherwise satisfied, 2) consent of Surety, 3) other data establishing payment or satisfaction of all such obligations, such as receipts, release and waivers of liens arising out of the Contract, to the extent and in such form as may be designated by the owner, 4) all guarantees and warranties, 5) all statements to support sales and use tax refunds, if applicable, 6) bound copies of operating and maintenance manuals, 7) identification lists of materials and equipment and 8) set of record documents; and the Contractor demonstrates to the Owner the proper operation and maintenance of all equipment.

## ARTICLE 7 - MISCELLANEOUS PROVISIONS

### 7.1 SUSPENSION OF WORK, TERMINATION AND DELAY

7.1.1 The Owner may suspend the Work or any portions thereof for a period of not more than ninety (90) days or such further time as agreed upon by the Contractor, by Written Notice to the Contractor and the Engineer which notice shall fix the date on which Work shall be resumed. The Contractor will resume that Work on the date so fixed. The Contractor will be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to any suspension.

7.1.2 If the Contractor is adjudged a bankrupt or insolvent, or if he makes a general assignment for the benefit of his creditors, or if a trustee or receiver is appointed for the Contractor or for any of his property, or if he files a petition to take advantage of any debtor's act, or to reorganize under the bankruptcy or applicable laws, or if he repeatedly fails to supply sufficient skilled workmen or suitable materials or equipment, or if he repeatedly fails to make prompt payments to Subcontractors or for labor, materials or equipment or if he disregards laws, ordinances, rules, regulations or orders of any public body having jurisdiction of the Work or if he disregards the authority of the Engineer, or if he otherwise violates any provision of the Contract Documents, then the Owner may, without prejudice to any other right or remedy and after giving the

Contractor and his Surety a minimum of ten (10) days from delivery of a Written Notice, terminate the services of the Contractor and take possession of the Project and of all materials, equipment, tools, construction equipment and machinery thereon owned by the Contractor, and finish the work by whatever method he may deem expedient. In such case the Contractor shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds the direct and indirect costs of completing the Project, including compensation for additional professional services, such excess shall be paid to the Contractor. If such costs exceed such unpaid balance, the Contractor will pay the difference to the Owner. Such costs incurred by the Owner will be determined by the Engineer and incorporated in a Change Order.

7.1.3 Where the Contractor's services have been so terminated by the Owner, said termination shall not affect any right of the Owner against the Contractor then existing or which may thereafter accrue. any retention or payment of monies by the Owner due the Contractor will not release the Contractor from compliance with the Contract Documents.

7.1.4 After ten (10) days from delivery of a Written Notice to the Contractor and the Engineer, the Owner may, without cause and without prejudice to any other right or remedy, elect to abandon the Project and terminate the Contract. In such case, the Contractor shall be paid for all Work executed any expense sustained plus reasonable profit.

7.1.5 If, through no act or fault of the Contractor, the Work is suspended for a period of more than ninety (90) days by the Owner or under an order of court or other public authority, or the Engineer fails to act on any request for payment within thirty (30) days after it is submitted, or the Owner fails to pay the Contractor substantially the sum recommended by the Engineer or awarded by arbitrators within thirty (30) days of its approval and presentation, then the Contractor may, after ten (10) days from delivery of a Written Notice to the Owner and the Engineer, terminate the Contract and recover from the owner payment for all Work executed and all expenses sustained. In



addition and in lieu of termination the Contract, if the Engineer has failed to act on a request for payment or if the Owner has failed to make any payment as aforesaid, the Contractor may, upon ten (10) days after written notice to the Owner and the Engineer, stop the Work until he has been paid all amounts then due, in which event and upon resumption of the Work, Change Orders shall be issued for adjusting the Contract Price or extending the Contract Time or both to compensate for the costs and delays attributable to the stoppage of the Work.

7.1.6 If the performance of all or any portion of the Work is suspended, delayed, or interrupted as a result of a failure of the Owner or Engineer to act within the time specified in the Contract Documents, or if no time is specified, within a reasonable time, an adjustment in the Contract Price or an extension of the Contract Time, or both, shall be made by Change Order to compensate the contractor for the costs and delays necessarily caused by the failure of the Owner or Engineer.

7.2 ASSIGNMENTS - Neither the Contractor nor the Owner shall sell, transfer, assign or otherwise dispose of the Contract or any portion thereof, or of his right, title or interest therein, or his obligations thereunder, without written consent of the other party.

7.3 INTEREST ON PAYMENTS - If the Owner fails to make payment within thirty (30) days following recommendation by the Engineer and following Written Notice to the Owner from the Contractor, there shall be added to each such payment interest at the maximum legal rate commencing the first day after said payment is due and continuing until the payment is received by the Contractor. This procedure shall be in addition to any other remedies available to the Contractor.

#### 7.4 INDEMNIFICATION

7.4.1 The Contractor will indemnify and hold harmless the Owner and the Engineer and their agents and employees from and against all claims, damages, losses and expenses including attorneys' fees arising out of or resulting from the performance of the Work, provided that any such claims, damage, loss or expense is attributable to

bodily injury, sickness, disease or death, or to injury to or destruction of tangible property including the loss of use resulting therefrom; and is caused in whole or in part by any negligent or willful act or omission of the Contractor, and Subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable.

7.4.2 In any and all claims against the Owner or the Engineer, or any of their agents or employees, by any employee of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, the indemnification obligation shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the Contractor or any Subcontractor under workmen's compensation acts, disability benefit acts or other employee benefits acts.

7.4.3 The obligation of the Contractor under this paragraph shall not extend to the liability of the Engineer, his agents or employees arising out of the preparation or approval of maps, Drawings, opinions, reports, surveys, Change Orders, designs or Specifications.

#### 7.5 WARRANTY

7.5.1 The Contractor shall warrant all materials and equipment furnished and Work performed for a period of one (1) year from the date of Substantial Completion. The Contractor warrants and guarantees for a period of one (1) year from the date of Substantial Completion that all work is free from all defects due to faulty materials or workmanship and the Contractor shall promptly make such corrections as may be necessary by reason of such defects including the repairs of any damage to other parts of the work resulting from such defects. The Owner will give notice of observed defects with reasonable promptness. In the event that the Contractor should fail to make such repairs, adjustments, or other Work that may be made necessary by such defects, the Owner may do so and charge the Contractor the cost thereby incurred. The Performance Bond shall remain in full force and effect through the Warranty period.

7.5.2 The Owner shall file a final review and acceptance letter with the Contractor and Engineer thirty (30) days prior to the expiration of the one year warranty requesting that a warranty inspection be made. Failure of the Owner to file such a letter shall relieve the Contractor and Engineer of all responsibility for making an inspection of the Work prior to expiration of the one year warranty.

## 7.6 ARBITRATION

7.6.1 All claims, disputes and other matters in question arising out of, or relating to, the Contract Documents or the breach thereof, except for claims which have been waived by the making and acceptance of final payment as provided, shall be decided by arbitration in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association. This agreement to arbitrate shall be specifically enforceable under the prevailing arbitration law. The award rendered by the arbitrators shall be final, and judgment may be entered upon it in any court having jurisdiction thereof.

7.6.2 Notice of the demand for arbitration shall be filed in writing with the other party to the Contract Documents and with the American Arbitration Association, and a copy shall be filed with the Engineer. Demand for arbitration shall in no event be made on any claim, dispute or other matter in question which would be barred by the applicable statute of limitations.

7.6.3 The Contractor will carry on the Work and maintain the progress schedule during any arbitration proceedings, unless otherwise mutually agreed in writing.

END OF SECTION

SECTION 00800

SUPPLEMENTARY CONDITIONS

1.1 GENERAL

The following supplements modify, change, delete from or add to the "General Conditions" bound with this Project Manual. Where any portion of the General Conditions is modified by these supplements, the unaltered provisions of that article shall remain in effect.

All divisions and sections of these specifications shall be subject to the requirements of the General and Supplementary Conditions.

1.2 MODIFICATIONS TO ARTICLES

A. ARTICLE 1 - DEFINITIONS

No changes.

B. ARTICLE 2 - CONTRACT DOCUMENTS

2.1.1 Add the following: The following form a part of the Contract Documents:

Drawings: CV1.0 through P2.0 dated October 20, 2017

Project Manual: Project Manual dated November 21<sup>st</sup>, 2017

Addenda: All Addenda issued prior to bidding.

C. ARTICLE 3 - RESPONSIBILITIES AND AUTHORITY OF OWNER, ENGINEER AND CONTRACTORS

3.1.6 Add the following: The Contractor and all applicable subcontractors shall be fully familiar with the contents of these documents and shall consider and evaluate them in the performance of their contracts.

D. ARTICLE 4 - PRECONSTRUCTION REQUIREMENTS

Add the following:

4.2.2 Insurance shall include the specific coverages and be written with not less than the limits of liability, coverages, and additional insureds provided on enclosed sample Certificate of Insurance. Both owner and Engineer shall be listed as additionally insured.

4.2.3 Contractor shall provide the following, as required by the jurisdiction:

- Traffic Control Plan to be used for onsite, hauling operations
- State Storm Water Permit
- Grading Permit
- Any other associated permits to complete construction (as required)

E. ARTICLE 5 - CONSTRUCTION PHASE REQUIREMENTS

No changes.

F. ARTICLE 6 - CONTRACT CLOSEOUT

No changes.

G. ARTICLE 7 - MISCELLANEOUS PROVISIONS

No changes.

1.3 ADDITIONS TO ARTICLES

H. ARTICLE 8 - LEGAL ACTIONS

As a condition precedent to, and as additional consideration for, the award of any contract or subcontract pursuant to these specifications, the Contractor and all subcontractors, suppliers, engineers, and other parties to the performance of the work required by these specifications, do agree that in the event any party institutes a suit against any other party because of any alleged failure to perform properly hereunder, or any alleged error, omission, breach of warranty, negligence, or malpractice hereunder, and if such suit is not successfully prosecuted to a judgment in favor of the party plaintiff, or if it is dismissed, or if a judgment is rendered for any defendant or defendants, the party instituting the suit hereby agrees to pay in full all actual costs of defense, including but not limited to attorney fees, expert witness fees, costs of investigations in preparation for trial, professional time expended by principals and employees of the prevailing party, and that the same shall be taxed as cost in said action and judgment entered thereon.

I. ARTICLE 9 - ARBITRATION

It is specifically understood and agreed that all references to arbitration apply only to disputes between the Contractor and his subcontractors, and do not apply to the Owner. Delete all references to arbitration in which the Owner is involved. Any unresolved disputes or claims involving the Owner shall be resolved by procedures provided by statute.

END OF SECTION

## SECTION 01 1010

### SUMMARY OF WORK

#### 1.1 CONDITIONS AND REQUIREMENTS

Division 1 - General Requirements shall govern work under all divisions of the specifications.

#### 1.2 EXAMINATION OF SITE

**Failure to visit site will in no way relieve Contractor from requirements for furnishing materials or performing work that may be required to complete work in accordance with drawings and specifications, or as directed by the Engineer.**

Contractor shall field locate existing installations to determine conflicts prior to the start of construction and at no cost to Owner.

Contractor is responsible for obtaining all jurisdictional permits necessary for construction including dewatering permits.

Contractor shall videotape all project sites prior to construction and provide the recorded videotape to engineer as a record of existing conditions.

#### 1.3 CONTRACTS

All work described by the Contract Documents will be executed under one prime contract between the Owner and the Contractor.

#### 1.4 WORK BY OTHERS

The Contractor shall be responsible for providing all temporary services.

#### 1.5 CONTRACTOR USE OF PREMISES

Operations of the Contractor shall be limited to areas where work is indicated on the drawings, easements, rights-of-way, and/or as provided in writing by Engineer. Contractor shall protect areas outside the limits of construction against damage due to snowmelt and/or rainfall runoff, pumping of water and equipment damage.

Damage to adjacent areas from equipment or construction will be the Contractor's responsibility. Repair or replacement of damaged areas shall be completed to the Engineer's, residents', State's and County's and any other agency's satisfaction.

#### 1.6 DELIVERY, STORAGE AND HANDLING

All materials to be installed for final payment by the Owner shall be handled, delivered, and stored in a manner to prevent breakage, damage, or actions which renders product unusable. Handling shall be in accordance with the manufacturer's recommended handling and storing procedures. Any products damaged and not meeting the requirements of these specifications

shall be rejected.

All materials required for submittal shall be submitted to Engineer for Review prior to construction.

#### 1.7 EXISTING UTILITIES

As required protect existing utilities from damage. Brace/support as required by utility owner and to facilitate improvements, coordination with affected utility companies may be required. Require all utility companies to field locate facilities prior to construction start. Require all utility poles be properly supported and braced during construction. Notify Engineer of utilities encountered, but not indicated and provide as-built locations. **Contractor shall provide Engineer two (2) copies of utility locate mapping prior to beginning construction.** Failure to provide these copies relinquishes all rights to any claims related to located utilities.

#### 1.8 CONTRACTOR'S STAKING NEEDS

The Contractor shall be responsible for all construction staking needs. Owner will furnish established benchmarks and baselines to facilitate staking when available.

#### 1.9 CONSTRUCTION PHASING REQUIREMENTS

The Contractor will be required to coordinate all work with other contractors who may be working in the area, including, but not limited to the City of Centennial.

#### 1.10 MATERIALS AND SOILS TESTING

The Owner will employ a qualified independent geotechnical testing agency. Contractor shall furnish testing agency access to work. Facilities and incidental labor required for testing. **Contractor is responsible for coordination and scheduling with the geotechnical testing agency in order to provide necessary testing for the project. Adequate testing to meet State of Colorado requirements must be provided.**

#### 1.11 SUBSTITUTIONS

Whenever a material, article, or piece of equipment is identified on the drawings or specifications by reference to brand name or catalog number, it shall be understood that this is referenced for the purpose of defining the performance or other salient requirements, and that other products of equal capacities, quality, and function shall be considered. The Contractor may recommend the substitution of a material, article, or piece of equipment of equal substance and function for those referred to in the Contract Documents by reference to brand name or catalog number, and if, in the opinion of the Engineer, such material, article, or piece of equipment is of equal substance and function to that specified, the Engineer may approve its substitution and use by the Contractor. Any cost differential shall be deductible from the Contract Price and the Contract Documents shall be appropriately modified by Change Order. The Contractor warrants that if substitutes are approved, no major changes in the function or general design of the Project will result. Incidental changes or extra component parts required to accommodate the substitute will be made by the Contractor without a change in the Contract Price or Contract Time.

END OF SECTION

## SECTION 01 1015

## ABBREVIATIONS AND SYMBOLS

## 1.1 RELATED REQUIREMENTS

- A. Drawings for Symbols
- B. Drawings or Schedules for Abbreviations

## 1.2 SPECIFIC LANGUAGE EXPLANATION

Specifications are of abbreviated, simplified or streamlined type and include incomplete sentences. Omissions of words or phrases such as "the Contractor shall", "in conformity therewith", "shall be", "as noted on the drawings", "a", "the", are intentional. Supply omitted words or phrases by inference in same manner as they are when "NOTE" occurs on drawings. Supply words "shall be" or "shall" by inference when colon is used within sentences or phrases. Supply words "on the drawings" by inference when "as indicated" is used with sentences or phrases.

## 1.3 ABBREVIATIONS

Reference in Contract Documents to trade associations, technical societies, recognized authorities and other institutions include following organizations, which are sometimes referred to only by corresponding abbreviations:

AASHTO	American Association of State Highway and Transportation Officials (Note: AASHTO "T" references for compaction shall mean maximum density at optimum moisture.)
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturers' Association
AGA	American Gas Association
AGMA	American Gear Manufacturers' Association
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWPI	American Wood Preservers' Institute
AWWA	American Water Works Association
AWS	American Welding Society
AWPA	American Wood Preservers' Association
BIA	Brick Institute of America (Successor to SCPI)
CBMA	Certified Ballast Manufacturers' Association
CDPHE	Colorado Department of Public Health and Environment
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standard (U.S. Department of Commerce)

CSI	Construction Specifications Institute
DFPA	Douglas Fir Plywood Association (APA)
FS	Federal Specification
IEEE	Institute of Electrical and Electronics Engineers, Inc.
IPCEA	Insulated Power Cable Engineers' Association
JIC	Joint Industry Conferences of Hydraulic Manufacturers
MIL	Military Specification
NBFU	National Board of Fire Underwriters
NEC	National Electric Code (of NFPU)
NEMA	National Electrical Manufacturers' Association
NESC	National Electric Safety Code
NFPA	National Forest Products Association
NFPA	National Fire Protection Association
NLMA	National Lumber Manufacturers' Association
OECI	Overhead Electrical Crane Institute
OSHA	Occupational Safety and Health Administration
PS	Product Standard (U.S. Department of Commerce)
RLM	RLM Standards Institute, Inc.
SPR	Simplified Practice Recommendation (U.S. Dept of Commerce)
SSPC	Steel Structures Painting Council
TEMA	Tubular Exchanger Manufacturers' Association
UBC	Uniform Building Code
UL	Underwriters' Laboratories, Inc.

END OF SECTION



**SECTION 01 1025 ADDENDUM 3 REVISION No.1**

**MEASUREMENT AND PAYMENT**

**PART 1 - GENERAL**

**1.01 DESCRIPTION**

**A. General:**

1. All measurements and payments will be based on work completed in strict accordance with the plans and specifications for the project.
2. The method of measurement and basis of payment described are for the work itemized in the Bid Form and in the sections of the specifications. Items may include work within a single section or in more than one section.
3. The Contract Sum is stated in the Contract Documents and, including authorized changes and adjustments, the total amount payable by the Owner to the Contractor.

**B. Measurement:**

1. Unless otherwise specified, all longitudinal measurements will be made horizontally, and computations will be based on the dimensions shown on drawings and details.
2. Quantities will be rounded off to the nearest whole number.
3. The Contractor shall, in the presence of the Owner or Owner's Representative, verify all measurements and quantities required for payment by the unit price method.
4. The Contractor shall, in the presence of the Owner or Owner's Representative, measure all "Removal" items prior to undertaking the "Removal" items.
5. Contractor shall provide necessary equipment, workers, and survey personnel as required for measurements.

**C. Units**

1. Measurement by Volumes: Measurement by cubic dimension using mean length, width and height or thickness. Longitudinal measurements will be made horizontally.
2. Measurements by Area: Measured by square dimensions using mean length and width or radius, measured horizontally.
3. Linear Measurement: Measured by linear dimension at the item centerline or mean chord.
4. Measured by Lump Sum or Per Each: Item inclusion as specified by the bid item description.
5. Measured by weight: Measured by certified scales at the source of material.

**D. Payment:**

1. Unit bid prices, as quoted in the Bid Schedule, shall constitute full compensation for labor, materials, equipment, rentals, overhead, profit and incidentals to complete all work for each

pay item and for all risk, loss, damage, or expense of whatever nature arising from the nature of the work or prosecution thereof.

2. Work or materials that are essential to the work, but for which there are no pay items, will not be measured and paid for separately, but shall be included in other items of work.
3. Payment for work listed as lump sum bid items completed under this contract shall be paid for on a lump sum fixed price basis. A schedule of values shall be provided to the Owner prior to construction on an item measured as a lump sum. The schedule of values shall clearly detail the Work item for partial payments.
4. At least ten (10) days before each progress payment falls due (but not more often than once a month), the Contractor will submit to the Owner's Representative a partial payment estimate filled out and signed by the Contractor covering the work performed during the period covered by the partial payment estimate and supported by such data as the Owner's Representative may reasonably require. If payment is requested on the basis of materials and equipment not incorporated in the work but delivered and suitably stored at or near the site, the partial payment estimate shall also be accompanied by such supporting data, satisfactory to the Owner, as will establish the Owner's title to the material and equipment and protect his interest therein, including applicable insurance. The Owner's Representative will, within ten (10) days after receipt of each partial payment estimate, either indicate in writing his approval of payment and present the partial payment estimate to the Owner, or return the partial payment estimate to the Contractor indicating in writing his reasons for refusing to approve payment. In the latter case, the Contractor may make the necessary corrections and resubmit the partial payment estimate. The Owner will, within fifteen (15) days of presentation to him of an approved partial payment estimate, pay the Contractor a progress payment on the basis of the approved partial payment estimate.
  - a. On a daily basis, the Contractor shall measure all unit price work which cannot be readily measured in the field after the work has been completed. No less than weekly, the Contractor shall submit an itemized list of all such work with backup data to the Owner's Representative for review. No payment shall be made for any such work unless the procedure in this paragraph as been followed.
  - b. The request for payment may also include an allowance for the cost of such major materials and equipment which are suitably stored either at or near the site.
5. At least ninety percent of the calculated value of any work completed shall not be paid until fifty percent of the work required by the contract has been performed. Thereafter, the Owner shall pay any of the remaining installments without retaining additional funds if, in the opinion of the Owner, satisfactory progress is being made in the work. The withheld percentage of the contract price of any such work, improvement, or construction shall be retained until the contract is completed satisfactorily and finally accepted by the Owner.
6. If the Owner fails to make payment thirty (30) days after approval by the Owner's Representative, in addition to other remedies available to the Contractor, there shall be added to each such payment interest at the maximum legal rate commencing on the first day after said payment is due and continuing until the payment is received by the Contractor.
7. The Owner's Representative's recommendation of any payment requested in an application for payment will constitute a representation by Owner's Representative to Owner based on Owner's Representative's review of the application for payment and the accompanying data and schedules that the work has progressed to the point indicated; that, to the best of Owner's Representative's knowledge, information and belief, the quality of the work is in accordance with the contract documents (subject to an evaluation of the work as a

functioning project upon substantial completion, to the results of any subsequent tests called for in the contract documents and any qualifications stated in the recommendation) and the Contractor is entitled to payment of the amount recommended. However, by recommending any such payment Owner's Representative will not thereby be deemed to have represented that exhaustive or continuous on-site inspections have been made to check the quality or the quantity of the work, or that the means, methods, techniques, sequences, and procedures of construction have been reviewed or that any examination has been made to ascertain how or for what purpose Contractor has used the moneys paid or to be paid to Contractor on account of the contract prices, or that title to any work, materials, or equipment has passed to Owner free and clear of any liens.

8. The Owner's Representative may refuse to recommend the whole or any part of any payment if, in his opinion, it would be incorrect to make such representations to Owner. He may also refuse to recommend any such payment, or, because of subsequently discovered evidence or the results of subsequent inspections or test, nullify any such payment previously recommended to such extent as may be necessary in Owner's Representative's opinion to protect Owner from loss because:
  - a. The work is defective, or completed work has been damaged requiring correction or replacement;
  - b. Written claims have been made against Owner or liens have been filed in connection with the work;
  - c. The contract price has been reduced because of modifications;
  - d. Owner has been required to correct defective work or complete the work;
  - e. Of Contractor's unsatisfactory prosecution of the work in accordance with the contract documents, or;
  - f. Contractor's failure to make payment to subcontractors or for labor, materials or equipment.
9. When the Contractor considers the entire work ready for its intended use Contractor shall, in writing to Owner and Owner's Representative, certify that the entire work is substantially complete and request that Owner's Representative issue a certificate of substantial completion. Within a reasonable time thereafter, Owner, Contractor, and Owner's Representative shall make an inspection of the work to determine the status of completion.
  - a. If the inspection reveals deficiencies on the project, the Contractor shall immediately remedy all deficiencies as listed on a punch list provided by the Owner and Owner's Representative. Upon completion of the punch list items the Contractor shall repeat the procedure in the above paragraph. The process shall be repeated until the Owner issues a letter of preliminary acceptance for the project.
  - b. Upon receiving the letter of preliminary acceptance the Owner's Representative will issue a certificate of substantial completion and recommend final project payment. Conditions may be attached to the certificate to include withholding enough money to cover the cost of any deficiencies. The date of the letter of preliminary acceptance begins the one-year warranty. It is important to receive the letter of preliminary acceptance in the same construction season as the work was performed. Inspection and acceptance by the Owner after November 16 may be made only by special request and only if weather allows.
  - c. Final payment to the Contractor will not be made, the one-year warranty will not begin,

and the Contractor shall remain liable for maintenance of the project until the letter of preliminary acceptance is issued.

- d. One month prior to the expiration of the one-year warranty period the Contractor shall request in writing a final inspection and final acceptance. The Owner will conduct the final inspection. If this inspection reveals deficiencies in the materials or workmanship, the Contractor shall make any repairs necessary under the one-year warranty. If any deficiencies are due to normal wear and tear, the Owner may request that repairs be done on a time and materials basis as negotiated with the Contractor.
  - e. The Owner will issue a letter of final project acceptance if the final inspection reveals no deficiencies and all warranty work has been satisfactorily completed. Effective on the date of the letter of final project acceptance, Contractor shall be relieved of all warranty except for a one-year warranty on items repaired under the one-year warranty.
- 10. Final payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities accepted by the Owner multiplied by the unit price for Work which is incorporated in or made necessary by the Work.
  - 11. Upon completion and acceptance of the work, the Owner's Representative shall issue a certificate attached to the final payment request that the work has been accepted by him under the conditions of the contract documents. The entire balance found to be due the Contractor, including the retained percentages, but except such sums as may be lawfully retained by the Owner, shall be paid to the Contractor within thirty (30) days of completion and acceptance of the work.
  - 12. Prior to the substantial completion, the Owner, with the approval of the Owner's Representative and with the concurrence of the Contractor, may use any completed or substantially completed portions of the work. Such use shall not constitute an acceptance of such portions of the work.
  - 13. Neither recommendation of a progress or final payment by Owner's Representative, nor the issuance of a certificate of substantial completion, nor any payment by Owner to Contractor under the contract documents, nor any use of occupancy of the work or any part thereof by Owner, nor any act of acceptance by Owner nor any failure to do so, nor the issuance of a notice of acceptability by Owner's Representative, nor any correction of defective work by Owner shall constitute an acceptance of work not in accordance with the contract documents or a release of Contractor's obligation to perform the work in accordance with the contract documents.
  - 14. The Contractor will indemnify and save the Owner or the Owner's agents harmless from all claims growing out of the lawful demands of subcontractors, laborers, workmen, mechanics, material men, and furnishers of machinery and parts thereof, equipment tools and all supplies, incurred in the furtherance of the performance of the work. The Contractor shall, at the Owner's request, furnish satisfactory evidence that all obligations of the nature designated above have been paid, discharged or waived. If the Contractor fails to do so the Owner may, after having notified the Contractor, either pay unpaid bills or withhold from the Contractor's unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged whereupon payment to the Contractor shall be resumed, in accordance with the terms of the contract documents, but in no event shall the provisions of this sentence be construed to impose any obligations upon the Owner to either the Contractor, his surety, or any third party. In paying any unpaid bills of the Contractors, any payment so made by the Owner shall be considered as a payment made under the contract documents by the Owner to the Contractor, and the Owner shall not be liable to the Contractor for any such payments made in good faith.

E. Partial Utilization: Use by Owner of completed portions of the Work may be accomplished prior to Substantial Completion of all the Work subject to the following:

1. Owner at any time may request Contractor in writing to permit Owner to use any part of the Work which Owner believes to be substantially complete and which may be so used without significant interference with construction of the other parts of the Work. If Contractor agrees, Contractor will certify to Owner and Owner's Representative that said part of the Work is substantially complete. Within a reasonable time thereafter, Owner, Contractor and Owner's Representative shall make an inspection of that part of the Work to determine its status of completion. Prior to Owner's use, Owner's Representative will deliver to Owner and Contractor a written recommendation as to the division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, maintenance, utilities, insurance and correction periods for that part of the Work which is binding upon Owner and Contractor as to that part of the Work, unless Owner and Contractor shall have otherwise agreed in writing or shall object to the Owner's Representative in writing within fifteen (15) days of receiving Owner's Representative recommendations. Owner shall have the right to exclude Contractor from any part of the Work which Owner uses, but Owner shall allow Contractor reasonable access to complete or correct items on the tentative list.
2. In lieu of the provisions of paragraph 1.01E.1. above, Owner may take over operation of a facility constituting part of the Work whether or not it is substantially complete if such facility is functionally and separately useable; provided that prior to any such takeover, Owner and Contractor have agreed as to the division of responsibilities between Owner and Contractor for security, operation, safety, maintenance, correction period, heat, utilities and insurance with respect to such facility.
3. No occupancy of part of the Work or taking over of operations of a facility will be accomplished prior to acknowledgment from the insurers providing the property insurance on the Work that notice of such occupancy has been received and that said insurers, in writing, have effected the changes in coverage necessitated thereby. The insurers providing the property insurance shall consent to such use or occupancy by endorsement on the policy or policies, but the property insurance shall not be canceled or lapse on account of any such partial use or occupancy.
4. Unless otherwise agreed upon, partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

F. Substantial Completion

1. Substantial Completion is the point in the progress of the Work when the Work or a designated portion of the Work is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.
2. When Contractor considers the entire Work ready for its intended use, Contractor shall, in writing to Owner, certify that the entire Work is substantially complete and request that Owner's Representative issue a Certificate of Substantial Completion. The Contractor's request shall include a punch list of items to be completed or corrected prior to final payment. Within a reasonable time thereafter, Owner, Owner's Representative, and Contractor shall make an inspection of the Work to determine the status of completion and amend the punch list if necessary. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. If Owner's Representative does not consider the Work substantially complete, Owner's Representative will notify Contractor in writing with his reasons.
3. If the Owner's Representative considers the Work substantially complete, the Owner's Representative will prepare and deliver to Owner a tentative Certificate of Substantial Completion. There will be attached to the Certificate a punch list of items to be completed or

corrected before Project completion and final payment. The Certificate of Substantial Completion shall establish the date of Substantial Completion, the responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall fix the time within which the Contractor shall finish all items on the list accompanying the Certificate.

4. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.
  5. The Certificate of Substantial Completion shall be signed by the Owner and Contractor of their written acceptance of the responsibilities in the Certificate. Upon signing, the Owner will make payment of retainage applying to the Work identified in the Certificate, with appropriate adjustments for uncompleted or work not in accordance with the Contract Documents.
- G. Final Inspection: Upon written notice from Contractor that the Work is complete and that all items on the punch list have been completed, Owner's Representative will make a final inspection with Owner and Contractor 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 remedy such deficiencies.
- H. Final Application for Payment: After Contractor has completed all such corrections to the satisfaction of Owner's Representative and delivered all maintenance and operating instructions, schedules, guarantees, Bonds, certificates of inspection, marked-up record documents and other documents all as required by the Contract Documents, and after Owner's Representative has indicated that the Work is in accordance with the Contract Documents, Contractor may make application for final payment following the procedure for progress payments. The final Application for Payment shall be accompanied by all documentation called for in the Contract Documents and such other data and schedules as Owner's Representative may reasonably require, together with complete and legally effective releases or waivers (satisfactory to Owner) of all Claims arising out of or filed in connection with the Work. In lieu thereof and as approved by Owner, Contractor may furnish receipts or releases in full; an affidavit of Contractor that the releases and receipts include all labor, services, material and equipment for which a Claim could be filed, and that all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner or its property might in any way be responsible, have been paid or otherwise satisfied; and consent of the Surety, if any, to final payment. If any Subcontractor, manufacturer, fabricator, supplier or distributor fails to furnish a release or receipt in full, Contractor may furnish a Bond or other collateral satisfactory to Owner to indemnify Owner against any Claim.
- I. Final Payment and Acceptance
1. If, on the basis of Owner's Representative observation of the Work during construction and final inspection, and Owner's Representative review of the final Application for Payment and accompanying documentation all as required by the Contract Documents, Owner's Representative is satisfied that the Work has been completed and Contractor has fulfilled all of his obligations under the Contract Documents, Owner's Representative will, within ten (10) days after receipt of the final Application for Payment, indicate in writing his recommendation of payment and present the Application to Owner for payment. Thereupon Owner's Representative will give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of the Waiver of Claims below. Otherwise, Owner's Representative will return the Application to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application. If the Application and accompanying documentation are appropriate as to form and substance, and acceptable to Owner, Owner shall, within thirty (30) days thereof, cause publication to commence of Notice of Final Settlement, in accordance with statutory requirements applicable to Owner. In the event no claims are made against Contractor in response to said publication, Owner shall pay Contractor the amount of final payment

recommended, including any retainage, by the Owner's Representative in accordance with the Notice of Final Settlement. In the event any claim is made against Contractor, Owner may withhold up to twice the amount of any asserted claim against Contractor until said claim has been resolved together with other amounts permitted by the Contract; however, Owner shall pay Contractor the balance of the final payment net of the withheld amount.

2. If, through no fault of Contractor, final completion of the Work is significantly delayed and if Owner's Representative so confirms, Owner shall, upon receipt of Contractor's final Application for Payment and recommendation of Owner's Representative, and without terminating the Agreement, 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 Contract Documents, and if Bonds have been furnished, 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 Owner's Representative with the Application for such payment. Payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.
3. The acceptance by the Contractor of final payment shall be and shall operate as a release to the Owner of all claims and all liability to the Contractor other than claims in stated amounts as may be specifically excepted by the Contractor for all things done or finished in connection with this work and for every act and neglect of the Owner and other relating to or arising out of this work. Any payment, however, final or otherwise, shall not release the Contractor or his sureties from any obligations under the contract documents or the performance bond and payment bonds.

J. Waiver of Claims: The making and acceptance of final payment shall constitute:

1. A waiver of all claims by Owner against Contractor, except claims arising from unsettled Claims, from defective Work appearing from final inspection pursuant to the Contract Documents or from failure to comply with the Contract Documents or the terms of any special guarantee specified therein; however, it shall not constitute a waiver by Owner of any rights in respect of 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 writing and identified by the Contractor as unsettled at the time of the Final Application for Payment.

BID SCHEDULE:
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DIVISION NO. – BID ITEM NO.

010000 – 1      GENERAL CONDITIONS

MOBILIZATION

- A. Measurement: Mobilization will be a single lump sum item that shall include all the Contractor's costs including labor, material, and any incidental work and equipment necessary for mobilization and demobilization of personnel, equipment and supplies at the project site. This item shall also include the establishment of the Contractor's field office facilities, portable toilets and other necessary temporary facilities, temporary paving, including provisions for providing at-grade manholes, inlets, and other protrusions to the temporary street grade while temporary pavement is used, grading and restoration of staging areas, and all other costs incurred of labor and operations which must be performed prior to beginning the other items under this contract. Also include

repair and restoration of any damage to pavement or landscape areas caused by construction access, repairs due to vandalism, job site security, and coordination with others performing work on the site. The removal of the Contractor's equipment, supplies, excess materials, and cleanup of the site is also included in this item. The cost for staging near the project site shall be included in Mobilization.

- B. Payment: Partial payments for mobilization will be made once each month as the work progresses. These partial payments will be made as follows:

1. When 3% of the original contract amount is earned, 15 percent of the amount bid for mobilization will be paid.
2. When 10% of the original contract amount is earned, 50 percent of the amount bid for mobilization will be paid.
3. When 25% of the original contract amount is earned, 60 percent of the amount bid for mobilization will be paid.
4. When 50% of the original contract amount is earned, 95 percent of the amount bid for mobilization will be paid.
5. Upon completion of all work on the project, 100 percent of the amount bid for mobilization will be paid.
6. The total sum of all payments shall not exceed the original contract bid for the item, regardless of the fact that the Contractor, may have, for any reason, shut down the work on the project or moved equipment away from the project and then back again.

For the purpose of this Section the term "original contract amount" as used above shall mean the amount bid for the construction items in the Contract not including the amount bid for mobilization. Payment for stockpiled material will not be included as a percent of the original contract amount earned until materials are incorporated into the work.

#### STAGING

- A. Measurement: Measurement will be made of the actual work performed as required by the owner of the Thunderhead property up to the amount of \$10,000. Invoices shall be submitted documenting work performed for the Owners Representative review prior to payment.
- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete.

#### UTILITY POTHOLING

- A. Measurement: Measurement will be made of the actual number of utility locating potholes performed. A pothole is defined as an exploratory excavation in an undisturbed location to locate a group of subsurface utilities or for other subsurface investigation. The plans show the locations where potholing may be needed due to possible utility conflicts. Potholing shall not begin without approval by the Owner's Representative.
- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete.

#### CONSTRUCTION SURVEYING

- A. Measurement: Measurement for construction surveying shall be a single lump sum item. Percentages paid shall coincide with percentages complete, as submitted by contractor and as



approved by Owner's Representative.

- B. Payment: Payment will be made at the lump sum price bid and shall include all of the Contractor's costs including labor, materials, and incidental work and equipment necessary to complete the construction surveying work.

#### TEMPORARY CONSTRUCTION FENCING

- A. Measurement: Measurement for temporary construction fencing shall be a single lump sum item. Percentages paid shall coincide with percentages complete, as submitted by contractor and as approved by Owner's Representative.
- B. Payment: Payment will be made at the lump sum price bid and shall include all of the Contractor's costs, including maintenance and resetting of fencing as needed through the duration of the project. This item also includes removal of temporary fencing and restoration of the site to match adjacent condition.

#### TEMPORARY UTILITIES

- A. Measurement: Measurement for temporary utilities, including temporary street lighting, electrical, telephone shall be a single lump sum item. Percentages paid shall coincide with percentages complete, as submitted by contractor and as approved by Owner's Representative.
- B. Payment: Payment will be made at the lump sum price bid and shall include all of the Contractor's costs including labor, materials, and incidental work and equipment necessary to complete the temporary utility work.

#### DUST CONTROL

- A. Measurement: Measurement for dust control shall be a single lump sum item. Percentages paid shall coincide with percentages complete, as submitted by contractor and as approved by Owner's Representative.
- B. Payment: Payment will be made at the lump sum price bid and shall include all of the Contractor's costs including labor, materials, and incidental work and equipment necessary to complete the dust control work.

#### EROSION CONTROL

- A. Measurement: Measurement for erosion control shall be a single lump sum item. Percentages paid shall coincide with percentages complete, as submitted by contractor and as approved by Owner's Representative.
- B. Payment: Payment will be made at the lump sum price bid and shall include all of the Contractor's costs including labor, materials, and incidental work and equipment necessary to complete the erosion control work.

#### WATER CONTROL

- A. Measurement: Measurement for water control shall be a single lump sum item. Percentages paid shall coincide with percentages complete, as submitted by contractor and as approved by Owner's Representative.
- B. Payment: Payment will be made at the lump sum price bid and shall include all of the Contractor's costs including labor, materials, and incidental work and equipment necessary to complete the water control work.

#### 312000 - 2 EXCAVATION & BACKFILL (EDGE OF GARAGE) - COMPLETE IN PLACE

- A. Measurement: Excavation shall not be measured but will be the quantity in cubic yards designated in the bid schedule. Excavation shall include all work necessary to complete the item including construction of embankments, unclassified excavation, borrow, compaction, compaction of bases of cuts and fills, all work in available material pits, and disposal of excess excavated material. All

costs associated with reducing the size of the claystone particles, and disposal of the oversized particles will not be paid for separately but shall be included in the work. Percentages paid shall coincide with percentages complete, as submitted by contractor and as approved by Owner's Representative. Any discrepancy in Earthwork quantity found by the contractor shall be submitted in writing to the Owner's Representative prior to excavation.

- B. Payment: Payment shall include all equipment, excavation, loading, transporting, stockpiling, disposing, hauling off, re-transporting to fill locations (from locations of excavation or from on-site or off-site stockpiles), watering, compaction, subgrade preparation, measuring of subgrade to bring within tolerances, backfilling, dust control, mud control, rough grading and fine grading as required to bring the site to the required lines and grades.
- 312000 - 3 EXCAVATION & HAUL (OVER GARAGE)
- A. Measurement: Measurement for off site hauling and disposal of unsuitable excavated materials shall be made of the actual number of cubic yards of unsuitable excavated material removed, hauled off and disposed of if encountered in the subgrade to the depth determined by the Owner's Representative in areas not part of utility service or trench placement and construction. The Contractor is to assume that all material excavated for utility trenches will be removed and replaced with suitable material and that removal and replacement will be included in the cost of that utility work. Owners Representative must authorize payment for all unsuitable material to be disposed of. The Contractor and Owners Representative shall measure excavated area and agree upon the dimensions for payment.
  - B. Payment: Payment for this bid item shall be at the unit price bid and shall include all materials, labor and equipment necessary to complete off site hauling, and disposal of unsuitable excavated material as shown on the drawings and in accordance with the specifications.
- 312000 - 4 EXCAVATION FOR HOT TUB & PREP FOR NEW HOT TUP
- A. Measurement: Measurement for offsite hauling and disposal of unsuitable excavated materials shall be a single lump sum item. Percentages paid shall coincide with percentages complete, as submitted by contractor and as approved by Owner's Representative.
  - B. Payment: Payment will be made at the lump sum price bid and shall include all materials, labor and equipment necessary to complete off site hauling, and disposal of unsuitable excavated material as shown on the drawings and in accordance with the specifications.
- 311000 - 5 REMOVALS - CONCRETE PAVEMENT
- 311000 - 6 REMOVALS - CONCRETE PAVEMENT (OVER STRUCTURE)
- A. Measurement: Measurement for removal of concrete pavement shall be made of the actual square feet of concrete removed as shown on the drawings and in accordance with the specifications.
  - B. Payment: Payment for this item shall be at the unit price bid and shall include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 31100 - 7 REMOVALS - CONCRETE UNIT PAVERS
- A. Measurement: Measurement for pavement removal shall be made of the actual number of square feet of concrete unit pavers sawcut, demolished, removed, from the site and disposed of where indicated and as directed by the Owner's Representative.
  - C. Payment: The unit price bid for this item shall include all of the Contractor's costs, including labor, materials, and incidental work and equipment necessary to complete the work as shown on the drawings and as indicated in the specifications. No payment will be made for the removal of any material that is damaged by the Contractor beyond the limits of the project
- 311000 - 8 REMOVALS - LANDSCAPE

- 311000 - 9      **REMOVALS - LANDSCAPE (OVER STRUCTURE)**
- A.      Measurement: Measurement for landscape removals shall be of the actual number of square feet of landscape removed. Percentages paid shall coincide with percentages complete, a schedule of values shall be submitted by the Contractor showing all removal items as listed on sheet DM1.0 for approval by the Owner's Representative. Payment for landscape is planting landscape only. No extra payment is being made for native landscape. Native landscape is paid for in excavation.
- B.      Payment: Payment for this item shall be at the unit price bid and include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 311000 - 10      **REMOVALS - TREE**
- A.      Measurement: Measurement for removal of trees shall be made of the actual number of trees cut down and removed from site and disposed of regardless of size including any stump grinding or removal.
- B.      Payment: Payment for this bid item shall be at the unit price bid and shall include all materials, labor and equipment necessary to complete the removal of trees as shown on the drawings and in accordance with the specifications.
- 311000 - 11      **REMOVALS - EXISTING CONCRETE WALL**
- A.      Measurement: Measurement for removal shall be made of the actual number of linear feet of wall sawcut, demolished, removed, from the site and disposed of, regardless of thickness including all associated foundation materials.
- B.      Payment: The unit price bid for this item shall include all of the Contractor's costs, including labor, materials, and incidental work and equipment necessary to complete the work as shown on the drawings and as indicated in the specifications. No payment will be made for the removal of any material that is damaged by the Contractor beyond the limits of the project.
- 311000 - 12      **REMOVALS - LIGHT POLE AND BASE**
- A.      Measurement: Measurement for light pole and base (foundation) removal shall be made of the actual number of light poles and bases removed from site. The unit price bid shall include salvage, removal, and stockpiling of light poles, light fixtures, and signage at location designated by Owner's Representative. The unit price shall include any repairs/rewiring to maintain service to existing light fixtures and electrical services to remain.
- B.      Payment: Payment for this bid item shall be at the unit price bid and shall include all materials, labor and equipment necessary to complete the removal of light poles and bases and their appurtenances as shown on the drawings and in accordance with the specifications.
- 311000 - 13      **REMOVALS - STORM SEWER INLET**
- A.      Measurement: Measurement for payment for removal of storm sewer inlet shall be made of the actual number of inlets and associated vault structures removed and disposed of as shown on the drawings and in accordance with the specifications.
- B.      Payment: Payment for this bid item shall be at the unit price bid and shall include all materials, labor and equipment necessary to complete the removal as shown on the drawings and in accordance with the specifications.
- 311000 - 14      **REMOVALS - STORM SEWER PIPE**
- A.      Measurement: Measurement for removal of storm sewer pipe shall be made of the actual number of linear feet of storm sewer pipe excavated, plugged, demolished removed from the site and disposed of, regardless of size including all associated materials and backfill.
- B.      Payment: Payment for this bid item shall be at the unit price bid and shall include all materials,

labor and equipment necessary to complete the excavation, removal, plugging and backfill of storm sewer pipe as shown on the drawings and in accordance with the specifications.

- 071413 - 15 REMOVE EXISTING WATERPROOFING - HORIZONTAL
- 071413 - 16 REMOVE EXISTING WATERPROOFING - HORIZONTAL
- A. Measurement: Measurement for removal of existing waterproofing shall be made of the actual number of square feet of waterproofing removed including all associated material.
- B. Payment: Payment will be made at the unit price bid and shall include labor and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 311000 - 17 REMOVE & RESET CONCRETE UNIT PAVERS
- A. Measurement: Measurement for removal, storing, and reset pavers shall be made of the actual number of square feet of concrete unit pavers removed, salvaged and reset including sand setting bed and joint sand, placed and accepted in accordance with the drawings and as directed by the Owner's Representative.
- B. Payment: Payment will be made at the unit price bid and shall include sand, equipment, labor and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 311000 - 18 REMOVE & RESET FIRE PIT
- A. Measurement: Measurement for removal, storing, and reset of fire pit shall be a single lump sum item and shall include all materials labor and equipment necessary to any existing utilities temporary off line, relocate & store fire pit, and reset fire pit to operate as in existing conditions prior to construction and in accordance with the drawings and as directed by the Owner's Representative.
- B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 311000 - 19 REMOVE & RESET RELOCATE PERENNIALS & ORNAMENTAL GRASSES
- A. Measurement: Measurement for removal, storing, and reset of perennials and ornamental grasses shall be made of the actual number of square feet of planting beds removed, salvaged and planted and accepted in accordance with the drawings and as directed by the Owner's Representative.
- B. Payment: Payment will be made at the unit price bid and shall include excavation of plants, storing containers, transportation, planting, equipment, labor and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 311000 - 20 REMOVE & RESET EXISTING BOLLARD LIGHTS
- A. Measurement: Measurement for bollard light and base (foundation) removal & reset shall be made of the actual number of bollard lights and bases removed & reset from the site. The unit price bid shall include salvage, removal, stockpiling of bollard lights, reset of bollards lights with base (foundation), utility modifications at location designated by Owner's Representative. The unit price shall include any repairs/rewiring to maintain service to existing bollard light fixtures and electrical services to remain.
- B. Payment: Payment for this bid item shall be at the unit price bid and shall include all materials, labor and equipment necessary to complete the removal and reset of bollard lights and bases and their appurtenances as shown on the drawings and in accordance with the specifications.
- 311000 - 21 SAWCUT EXISTING CONCRETE
- A. Measurement: Measurement for sawcut of existing concrete shall be made of the actual number of linear feet of concrete sawcut at the site and as directed by the Owner's Representative.

- B. Payment: The unit price bid for this item shall include all of the Contractor's costs, including labor, materials, and incidental work and equipment necessary to complete the work as shown on the drawings and as indicated in the specifications. No payment will be made for the removal of any material that is damaged by the Contractor beyond the limits of the project.
- 311000 - 22 TREE PROTECTION
- A. Measurement: Measurement for tree protection shall be made of the actual number of trees protected in accordance with the drawings, and as directed by the Owner's Representative.
- B. Payment: Payment for this bid item shall be at the unit price bid and shall include all materials, labor and equipment necessary to complete tree protection as shown on the drawings and in accordance with the specifications.
- 311000 - 23 HOT TUB REMOVAL - (4) TOTAL
- A. Measurement: Measurement for the removal of (4) hot tubs shall be a single lump sum item and shall include all materials labor and equipment necessary to be demolished removed from the site and disposed of. All temporary relocations of utilities related to the removal of hot tubs shall be included with this item. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
- B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- S0.1 to S2.5-24 INJECT LEAKS AT INVERTED TEE BEAMS
- A. Measurement: Measurement for injecting leaks at the inverted tee beams within the precast structure shall be made of the actual number of linear feet of leaks including all associated materials.
- B. Payment: Payment for this item shall be at a unit price bid and shall include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- S0.1 to S2.2-25 INJECT LEAKING WALL CRACKS WITH HYDROPHOBIC GROUT
- A. Measurement: Measurement for injecting leaking wall crack with hydrophobic grout shall be made of the actual number of linear feet of cracks including all associated materials.
- B. Payment: Payment for this item shall be at a unit price bid and shall include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- S0.1 to S2.2-26 INJECT LEAKS AT DOUBLE TEES
- A. Measurement: Measurement for injecting leaks at the double tee flanges within the precast structure shall be made of the actual number of linear feet of leaks including all associated materials.
- B. Payment: Payment for this item shall be at a unit price bid and shall include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- S0.1 to S2.2-27 REPAIR & SEAL PIPE PENETRATIONS
- A. Measurement: Measurement for the repair and resealing of the pipe penetrations shall be made of the actual number of pipe penetrations repaired and sealed including all associated materials.
- C. Payment: Payment for this item shall be at a unit price bid and shall include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- ~~S0.1 to S2.2-28 CLEAN THE WALLS OF ALL ACTIVATED URETHANE GROUT~~
- ~~A. Measurement: Measurement for the cleaning of the walls of all activated urethane grout will be a single lump sum item and shall include all materials labor and equipment necessary. Percentages~~

~~paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.~~

- ~~B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.~~

S0.1 to S2.2-29 REPAIR DAMAGED CONCRETE SURFACE

- A. Measurement: Measurement for repairing the damaged concrete surface shall be made of the actual number of square feet of damaged concrete repaired including all associated materials.
- C. Payment: Payment for this item shall be at a unit price bid and shall include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.

~~S0.1 to S2.2 30 REMOVAL OF EFFLORESCENCE & STAINING ON WALLS & OVERHEAD PRECAST~~

- ~~A. Measurement: Measurement for the removal of efflorescence & staining on the walls & overhead precast structure will be a single lump sum item and shall include all materials labor and equipment necessary. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.~~
- ~~B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.~~

071413-31 SURFACE PREPERATION

- A. Measurement: Measurement for surface preparation for the waterproofing shall be made of the actual number of square feet of the surface prepared including all associated materials.
- B. Payment: Payment for this item shall be at a unit price bid and shall include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.

071413-32 WATERPROOFING MEMBRANE (WALLS - VERTICAL)

- A. Measurement: Measurement for waterproofing the walls shall be made of the actual number of square feet of the walls waterproofed including all associated materials.
- B. Payment: Payment for this item shall be at a unit price bid and shall include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.

071413-33 WATERPROOFING MEMBRANE (GARAGE DECK - HORIZONTAL)

- A. Measurement: Measurement for waterproofing the garage deck shall be made of the actual number of square feet of the garage deck waterproofed including all associated materials.
- B. Payment: Payment for this item shall be at a unit price bid and shall include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.

~~S0.1 to S2.2 34 PROVIDE EXTERIOR WALL CLADDING AND FINISH TO MATCH EXISTING~~

- ~~A. Measurement: Measurement for the providing exterior wall cladding and finish to match the existing will be a single lump sum item and shall include all materials labor and equipment necessary. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.~~
- ~~B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.~~

~~S0.1 to S2.2 35 LAP NEW WATERPROOFING SYSTEM TO EXISTING WATERPROOFING SYSTEM~~

- ~~A. Measurement: Measurement for lap of the new waterproofing system to the existing system shall~~

be made of the actual number of linear feet of the lapped waterproofing including all associated materials.

- B. ~~Payment: Payment for this item shall be at a unit price bid and shall include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.~~

~~S0.1 to S2.2 36 PROVIDE ISOLATION BOARD AND COVE JOINT SEALANT BETWEEN NEW PAVING AND EXISTING SIDEWALK OR WALL~~

- A. ~~Measurement: Measurement for the isolation board and cove joint sealant shall be made of the actual number of linear feet seled including all associated materials.~~

- B. ~~Payment: Payment for this item shall be at a unit price bid and shall include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.~~

~~S0.1 to S2.2 37 INJECT CRACKS IN FOUNDATION WALLS~~

- A. ~~Measurement: Measurement for injecting leaking wall crack with hydrophobic grout shall be made of the actual number of linear feet of cracks including all associated materials.~~

- C. ~~Payment: Payment for this item shall be at a unit price bid and shall include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.~~

~~S0.1 to S2.2 38 PROVIDE FULL DEPTH CURTAINWALL URETHANE INJECTION WHERE ACCESS FROM OPPOSITE SIDE IS PROHIBITED~~

- A. ~~Measurement: Measurement for providing a full depth curtainwall shall be made of the actual number of square feet of covered including all associated materials.~~

- B. ~~Payment: Payment for this item shall be at a unit price bid and shall include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.~~

~~S0.1 to S2.2 39 CLEAN THE WALLS OF ALL ACTIVATED URETHANE GROUT~~

- A. ~~Measurement: Measurement for the cleaning of the walls of all activated urethane grout will be a single lump sum item and shall include all materials labor and equipment necessary. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.~~

- B. ~~Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.~~

022210-40 4" SDR 35 PVC SANITARY SEWER LINE

- A. Measurement: Measurement will be made of each linear foot of sanitary sewer line furnished and installed in accordance with the contract documents. Work shall include the furnishing and installing of all materials, equipment, and labor necessary for the sanitary sewer construction including pipe, excavation, pipe bedding, backfill, in accordance with the Contract Documents and in accordance with Mt. Werner Water and Sewer District standards.

- B. Payment: Payment will be made of each linear foot of sanitary sewer line furnished and installed in accordance with the contract documents. Payment shall include the furnishing and installing of all materials, equipment, and labor necessary for the storm sewer line construction including sewer pipe, excavation, pipe bedding, backfill, and tracer wire in accordance with the Contract Documents.

022210-41 4" SDR PVC SANITARY SEWER TIE/IN CONNECTION

- A. Measurement: Measurement will be made for each connection to the sanitary sewer system. Work shall include excavation, furnishing and installing of all materials, equipment, and labor for the connection, pipe and necessary materials connection to the sanitary sewer. Excavation, pipe bedding, and backfill required to complete the sanitary sewer connections in accordance with the Contract Documents and in accordance with Mt. Werner Water and Sewer District standards

- B. Payment: Payment will be made for each sanitary sewer pipe connected to the sanitary sewer main complete in place. Payment shall include but not limited to the excavation, the furnishing and installing of all materials, equipment and labor for the connection, pipe, necessary materials for the sanitary sewer. Excavation, pipe bedding, and backfill required to complete the sanitary sewer connections shall be included with this pay item and will not be paid for separately.
- 022210-42 SANITARY SEWER CLEANOUT
- A. Measurement: Measurement will be made for each cleanout installed and connected to the constructed sanitary sewer system. Work shall include excavation, the furnishing and installing of all materials, equipment, and labor for the connection, pipe and necessary materials for main connection (sanitary main will be paid by linear foot including length across connection). Excavation, pipe bedding, and backfill required in accordance with the Contract Documents and in accordance with Mt. Werner Water and Sewer District standards to complete the installation of the cleanouts shall be included with this pay item and will not be measured separately.
- B. Payment: Payment will be made for each cleanout connected to the new storm main complete in place. Payment shall include but not limited to the excavation, the furnishing and installing of all materials, equipment and labor for the connection, pipe, necessary materials for main connection (storm main will be paid by linear foot including length across connection). Excavation, pipe bedding, and backfill required to complete the cleanout connections shall be included with this pay item and will not be paid for separately.
- 022210-43 4" HDPE PERFORATED DRAIN LINE
- 022210-44 4" HDPE STORM SEWER LINE
- 022210-45 6" HDPE STORM SEWER LINE
- 022210-46 8" HDPE STORM SEWER LINE
- 022210-47 10" HDPE STORM SEWER LINE
- A. Measurement: Measurement will be made of each linear foot of storm pipe furnished and installed in accordance with the contract documents. Work shall include the furnishing and installing of all materials, all connections to existing pipes, equipment, and labor necessary for the storm sewer construction including pipe, pipe fittings, excavation, pipe bedding, and backfill, in accordance with the Contract Documents.
- B. Payment: Payment will be made of each linear foot of storm sewer line furnished and installed in accordance with the contract documents. Payment shall include the furnishing and installing of all materials, equipment, and labor necessary for the storm sewer line construction including pipe, pipe fittings (elbows), excavation, pipe bedding, and backfill in accordance with the Contract Documents.
- 022210-48 6" NYLOPLAST WYE FITTING
- A. Measurement: Measurement will be made of each linear foot of storm pipe furnished and installed in accordance with the contract documents. Work shall include the furnishing and installing of all materials, all connections to existing pipes, equipment, and labor necessary for the storm sewer construction including pipe, pipe fittings, excavation, pipe bedding, and backfill, in accordance with the Contract Documents.
- B. Payment: Payment will be made of each linear foot of storm sewer line furnished and installed in accordance with the contract documents. Payment shall include the furnishing and installing of all materials, equipment, and labor necessary for the storm sewer line construction including pipe, pipe fittings (elbows), excavation, pipe bedding, and backfill in accordance with the Contract Documents.
- 022210-49 8" NYLOPLAST INLINE DRAIN
- 022210-50 12" NYLOPLAST DRAIN BASIN W/SOLID COVER
- 022210-51 12" NYLOPLAST DRAIN BASIN
- 022210-52 15" NYLOPLAST DRAIN BASIN W/SOLID COVER
- 022210-53 15" NYLOPLAST DRAIN BASIN



- 022210-54 18" NYLOPLAST DRAIN BASIN W/SOLID COVER  
 022210-55 18" NYLOPLAST DRAIN BASIN  
 022210-56 24" NYLOPLAST DRAIN BASIN W/SOLID COVER  
 022210-57 24" NYLOPLAST DRAIN BASIN
- A. Measurement will be made of each drain basin furnished and installed in accordance with the contract documents. Work shall include the furnishing and installing the drain basin, the connection of storm sewer pipes and drains to the structure, sealing all voids with non shrink grout around the junction, inlet frames and grates, grout around frame connection(s). Excavation, bedding and backfill required to complete the drain basin construction shall be included with this pay item and will not be measured separately and in accordance with the Contract Documents.
- B. Payment: Payment will be made of each drain basin furnished and installed in accordance with the contract documents. Payment shall include the furnishing and installing the drain basin, the connection of storm sewer pipes and drains to the structure, sealing all voids with non shrink grout around the junction, inlet frames and grates, grout around frame connection(s). Excavation, bedding and backfill required to complete the structure construction shall be included with this pay item and will not be measured separately.
- 022210-58 NYLOPLAST REDUCER TO 12" INLET OR SOLID COVER
- A. Measurement: Measurement will be made as a lump sum of the structure furnished and installed in accordance with the contract documents. Work shall include the furnishing and installing the concrete structures, the connection of existing 48-inch manhole riser to the structure, sealing all voids with non shrink grout around the junction, trash racks, frames and grates, anchor bolts, spacers, connection hardware, and grout around frame connection(s). Excavation, bedding and backfill required to complete the structure construction shall be included with this pay item and will not be measured separately.
- B. Payment: Payment will be made as a lump sum of the structure furnished and installed in accordance with the contract documents. Work shall include the furnishing and installing the concrete structures, the connection of existing 48-inch manhole riser to the structure, sealing all voids with non shrink grout around the junction, trash racks, frames and grates, anchor bolts, spacers, connection hardware, and grout around frame connection(s). Excavation, bedding and backfill required to complete the structure construction shall be included with this pay item and will not be measured separately.
- 334416 - 59 ACO K-100 TRENCH DRAIN
- A. Measurement: Measurement will be made of actual linear feet of trench drain furnished and installed in accordance with the contract documents. Work shall include the forming and installation of the precast frames, the connection of storm sewer pipes and drains to the structure, colored concrete placement as shown in the details, and frames or catch basin frames and grates, Excavation, bedding and backfill required to complete the structure construction shall be included with this pay item and will not be measured separately.
- B. Payment: Payment will be made of actual linear feet of trench drain furnished and installed in accordance with the contract documents. Payment shall include the forming and installation of the precast frames, the connection of storm sewer pipes and drains to the structure, colored concrete placement as shown in the details, and frames or catch basin frames and grates, Excavation, bedding and backfill required to complete the structure construction shall be included with this pay item and will not be measured separately.
- 022210-60 TRENCH DRAIN TIE/IN CONNECTION
- A. Measurement: Measurement will be made for each trench drain that is connected to the storm sewer system or daylighted. Work shall include excavation, furnishing and installing of all materials, equipment, and labor for the connection, pipe and necessary materials connection to the storm sewer or daylighted. Excavation, pipe bedding, and backfill required to complete the trench drain connections shall be included with this pay item and will not be measured separately.

- B. Payment: Payment will be made for each trench drain connected to the storm sewer or daylighted complete in place. Payment shall include but not limited to the excavation, the furnishing and installing of all materials, equipment and labor for the connection, pipe, necessary materials for the storm sewer or daylighting. Excavation, pipe bedding, and backfill required to complete the trench drain connections shall be included with this pay item and will not be paid for separately.
- C1.0 to C2.0-61 ROOF DRAIN TIE/IN CONNECTION
- A. Measurement: Measurement will be made for each roof drain that is disconnected from the existing roof drain at the building and realigned to connect to the constructed storm sewer system. Work shall include excavation, removal, and disposal of existing roof drain system; and the furnishing and installing of all materials, equipment, and labor for the connection piping at building, piping, PVC wye section for main connection (storm main will be paid by linear foot including length across wye), and cleanout section(s). Excavation, pipe bedding, and backfill required to complete the roof drain connections shall be included with this pay item and will not be measured separately.
- B. Payment: Payment will be made for each roof drain connected to the new storm main complete in place. Payment shall include but not limited to the excavation, removal, and disposal of existing roof drain system; and the furnishing and installing of all materials, equipment and labor for the connection piping at building, piping, PVC wye section for main connection (storm main will be paid by linear foot including length across wye), and cleanout section(s). Excavation, pipe bedding, and backfill required to complete the roof drain connections shall be included with this pay item and will not be paid for separately.
- 022210-62 6" NYLOPLAST CLEANOUT
- A. Measurement: Measurement will be made for each cleanout installed and connected to the constructed storm sewer system. Work shall include excavation, the furnishing and installing of all materials, equipment, and labor for the connection, pipe and necessary materials for main connection (storm main will be paid by linear foot including length across connection). Excavation, pipe bedding, and backfill required to complete the installation of the cleanouts shall be included with this pay item and will not be measured separately.
- B. Payment: Payment will be made for each cleanout connected to the new storm main complete in place. Payment shall include but not limited to the excavation, the furnishing and installing of all materials, equipment and labor for the connection, pipe, necessary materials for main connection (storm main will be paid by linear foot including length across connection). Excavation, pipe bedding, and backfill required to complete the cleanout connections shall be included with this pay item and will not be paid for separately.
- 321123 - 64 COLLOIDAL CONCRETE OR WASED NO. 57 STONE
- A. Measurement: Colloidal Concrete or Washed No. 57 Stone shall not be measured but will be the quantity of cubic yards designated in the bid schedule. Material will be placed in accordance with the construction documents for pavement subgrade, foundations, and pavement surfacing. Work shall include the preparing subgrade, furnishing and installing geotextile fabric, and furnishing, placing, grading, and compaction.
- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 321313 – 65 CONCRETE SUBGRADE SLAB (6" DEPTH)
- A. Measurement: Measurement for concrete subgrade slab will be made of the actual number square feet of concrete pavement placed and accepted including the furnishing and installation of materials; subgrade preparation; formwork; cast in place concrete, reinforcing; dowels; finishing; joints; curing; sweeping; washing; cleanup at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications.

- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 321123 - 66 CLASS 6 AGGREGATE BASE COURSE (2" DEPTH)  
 321123 - 67 CLASS 6 AGGREGATE BASE COURSE (6" DEPTH)  
 321123 - 68 CLASS 6 AGGREGATE BASE COURSE (12" DEPTH)
- A. Measurement: Aggregate base course (Class 6) shall not be measured but will be the quantity of cubic yards designated in the bid schedule. Material will be placed in accordance with the construction documents for pavement subgrade, foundations, and pavement surfacing. Work shall include the preparing subgrade, furnishing and installing geotextile fabric, and furnishing, placing, grading, and compaction.
- B. Payment: Payment will be made per cubic yard furnished and placed in accordance with the contract documents. Aggregate Base Course used for utility and/or pipe bedding will not be paid for separately but shall be paid for as part of the particular pipe construction pay item. Aggregate Base Course used for creek structures will not be paid for separately but shall be paid for as part of the particular creek structure construction pay item, as listed in the drawings.
- 321313 - 69 COLORED CONCRETE VALLEY PAN (ON & OFF STRUCTURE)
- A. Measurement: Measurement for concrete valley pan shall be made of the actual number of square feet including the furnishing and installation of materials; subgrade preparation; formwork; cast in place concrete, reinforcing; dowels; finishing; joints; curing; sweeping; washing; and cleanup at the locations shown placed and accepted in accordance with the drawings and as directed by the Owner's Representative.
- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications. Scope of work shall include subgrade preparation.
- 321313 - 70 CONCRETE PAVEMENT (6" THICKNESS)
- A. Measurement: Measurement for concrete pavement shall be made of the actual number of square feet of concrete pavement including the furnishing and installation of materials; subgrade preparation; formwork; cast in place concrete, reinforcing; dowels; finishing; joints; curing; joint sealer, sweeping; washing; and cleanup at the locations shown placed and accepted in accordance with the drawings and as directed by the Owner's Representative.
- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications. Scope of work shall include subgrade preparation.
- 321413 - 71 CONCRETE UNIT PAVERS - (PRIMARY COLOR) - VEHICULAR  
 321413 - 72 CONCRETE UNIT PAVERS - (PRIMARY COLOR) - PEDESTRIAN  
 321413 - 73 CONCRETE UNIT PAVERS - (TYPE B) - POOL  
 321413 - 74 CONCRETE UNIT PAVERS - (SECONDARY COLOR)  
 321413 - 75 PRECAST CONCRETE POOL COPING
- A. Measurement: Measurement for concrete unit pavers shall be made of the actual number of square feet of concrete unit pavers or precast concrete pool coping placed and accepted in accordance with the drawings and as directed by the Owner's Representative.
- B. Payment: Payment shall be made at the unit price bid, and shall include all materials including sand, geotextile fabric below the aggregate base course, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications. Scope of work shall include subgrade preparation including sand bed and finishing.
- 033000 - 76 COLORED CONCRETE BAND ON-STRUCTURE (6" WIDTH)

- 033000 – 77      COLORED CONCRETE BAND OFF-STRUCTURE (6" WIDTH)
- A.      Measurement: Measurement for concrete bands shall be made of the actual number of linear feet including the furnishing and installation of materials; subgrade preparation; formwork; cast in place concrete, reinforcing; dowels; finishing; joints; curing; sweeping; washing; and cleanup at the locations shown placed and accepted in accordance with the drawings and as directed by the Owner's Representative.
- B.      Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications. Scope of work shall include subgrade preparation.
- 033000 – 78      COLORED CONCRETE STAIRS - 1 TREAD
- A.      Measurement: Measurement will be made of the actual number of square feet of steps placed and accepted including furnishing and installation of materials; formwork; cast in place concrete, reinforcing; dowels; cheek walls; finishing; joints; curing; sweeping; washing; cleanup at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications.
- B.      Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 044100 - 79      STONE VENEER SEAT WALL (1'-6" width x 2'-0" height)
- A.      Measurement: Measurement will be made of the actual number of linear feet for each stone veneer site wall placed and accepted including furnishing and installation of materials; formwork; stone veneer; cast in place concrete, reinforcing; dowels; finishing; joints; curing; sweeping; washing; cleanup at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications. Schedule of values to be submitted prior to starting work.
- B.      Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 044100 – 80      RAW SILOAM STONE – PREMIUM SIZE SLABS
- A.      Measurement: Measurement will be made of the actual ton of raw stone including delivery to be used at the stacked stone slab walls. Stone shall be selected by the quarry representative based on the sizes, dimensions and quantities shown on the plans and in accordance with the specifications. Placement of stone is paid for separately.
- B.      Payment: Payment shall be made at the unit price bid, and shall include delivery of the stone in accordance with the specifications. Certified scale tickets for the stone from the supplier will be required for payment.
- 044100 - 81      STACKED STONE SLAB WALL - PLACEMENT
- A.      Measurement: Measurement will be made of the actual number of linear feet of stone placed and accepted including the installation of materials; subgrade preparation; finishing; joints; curing; sweeping; washing; cleanup at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications. ***Stone and aggregate base are paid for separately and are not included in the work.***
- B.      Payment: Payment shall be made at the unit price bid, and shall include grout, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 02925 – 82      TOPSOIL (4" AT PLANTING BEDS)
- A.      Measurement: Measurement will be made of the actual number of cubic feet of top soil placed and

accepted at the locations within the limit of work as shown on the drawings or as directed the Owner's Representative, and in accordance with the specifications. No separate measurement will be made for areas disturbed outside the limit of work. These disturbed areas will be top soiled at the Owner's Representative's discretion and at the contractor's own expense.

- B. Payment: Payment for this item will include all the Contractor's costs of whatever nature to complete the placement of topsoil in accordance with the Specifications. Payment shall include soil testing, preparation, importing, discing, and raking, spreading, and fine grading.

073363 – 83 LIGHTWEIGHT SOIL

- A. Measurement: Measurement will be made of the actual number of cubic feet of lightweight soil placed and accepted at the locations within the limit of work as shown on the drawings or as directed the Owner's Representative, and in accordance with the specifications.

- B. Payment: Payment for this item will include all the Contractor's costs of whatever nature to complete the placement of lightweight soil in accordance with the Specifications. Payment shall include freight, materials, equipment, labor, soil analytics, preparation, importing, discing, and raking, spreading, fine grading, organic mulch, and other items necessary to complete the work as shown on the drawings or in accordance with specifications.

073363 – 84 INTENSIVE PLANT ASSEMBLY - GARDEN DRAIN GR50

- A. Measurement: Measurement will be made of the actual number of square feet of Gardendrain GR 50 filled with lightweight aggregate along with the Systemfilter and Hydroflex 30/Root Stop HD placed and accepted at the locations within the limit of work as shown on the drawings or as directed the Owner's Representative, and in accordance with the specifications.

- B. Payment: Payment shall be made at the unit price bid, and include all freight, materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.

328000 – 85 IRRIGATION SYSTEM - COMPLETE

- A. Measurement: Measurement will be a lump sum amount for the entire irrigation system, as per the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications. Percentages paid shall coincide with percentages complete, as submitted by contractor and as approved by Owner's Representative.

- B. Payment: Payment shall be made at the unit price bid and shall include, but not limited to furnishing and installing irrigation heads, backflow preventers, valves, pipes, meter pits, controllers, wires, and sleeving. It also shall include all related hardware, backfill and compaction, testing and making all necessary adjustments to achieve complete and uniform coverage, and all other work and materials required to install the items in accordance with the Drawings and Specifications.

329300 – 86 DECIDIOUS TREE, ASPEN, 4" CLUMP

329300 – 87 CONIFEROUS TREE, 8' HT

329300 – 88 SHRUBS, #5 CONT.

329300 – 89 ORNAMENTAL GRASSES

329300 – 90 PERENNIALS, #1 CONT.

- A. Measurement: Measurement will be made of the actual number of plants and trees placed and accepted including excavation, backfill, construction of dishes, staking, guying, fertilizing, and mulching at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications.

- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.

- XXXXXX – 91 LANDSCAPE REPLACEMENT/REPAIR
- A. Measurement: Measurement will be made of the actual square footage of landscape repair excavation, backfill, mulching, seeding, planting, irrigation repairs and fertilizing placed and accepted at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications.
  - B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 328000 – 92 POOL SIDE PLANTER IRRIGATION SYSTEM
- A. Measurement: Measurement will be a lump sum amount for the pool side planter irrigation system, as per the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications. Percentages paid shall coincide with percentages complete, as submitted by contractor and as approved by Owner's Representative.
  - C. Payment: Payment shall be made at the unit price bid and shall include, but not limited to furnishing and installing irrigation heads, backflow preventers, valves, pipes, meter pits, controllers, wires, and sleeving. It also shall include all related hardware, backfill and compaction, testing and making all necessary adjustments to achieve complete and uniform coverage, and all other work and materials required to install the items in accordance with the Drawings and Specifications.
- XXXXXX – 93 POOL SIDE PLANTER MULCH
- XXXXXX – 94 POOL SIDE PLANTER SOIL
- XXXXXX – 95 POOL SIDE PLANTER WASHED ROCK
- A. Measurement: Measurement will be made of the actual number of cubic yards of material placed and accepted at the locations within the limit of work as shown on the drawings or as directed the Owner's Representative, and in accordance with the specifications. No separate measurement will be made for areas disturbed outside the limit of work. These disturbed areas will be top soiled at the Owner's Representative's discretion and at the contractor's own expense.
  - B. Payment: Payment for this item will include all the Contractor's costs of whatever nature to complete the placement of material in accordance with the Specifications. Payment shall include soil testing, preparation, importing, discing, and raking, spreading, and fine grading.
- XXXXXX – 96 POOL SIDE PLANTER WATERPROOFING MEMBRANE
- XXXXXX – 97 POOL SIDE PLANTER FILTER FABRIC
- A. Measurement: Measurement will be made of the actual square footage of material placed and accepted at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications.
  - B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.
- XXXXXX – 98 POOL SODE PLANTER CORE DRILL HOLES
- XXXXXX – 99 POOL SIDE PLANTER DRAIN COVERS
- A. Measurement: Measurement will be made of the actual number of items placed and accepted including at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications.
  - B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.

230000 – 101 SNOW MELT BOILERS

- A. Measurement: The snow melt boilers as described and detailed in the specifications and plans will not be measured, but will be paid lump sum for a complete and working system. Documentation of labor and material (bill of material or schedule of values) used in the construction of the snow melt boilers shall be submitted with the bid. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
- B. Payment: Payment for this bid item shall be based on the bill of material (schedule of values) provided with the bid for the lump sum price and payment shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.

230000 – 102 SNOWMELT PUMPS & HYDRONIC SPECIALTIES

- A. Measurement: The snow melt pumps as described and detailed in the specifications and plans will not be measured, but will be paid lump sum for a complete and working system. Documentation of labor and material (bill of material or schedule of values) used in the construction of the snow melt boilers shall be submitted with the bid. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
- A. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.

230000 – 103 SNOWMELT PIPING IN THE BOILER ROOM

- A. Measurement: The snowmelt piping in the boiler room as detailed in the plans will be paid lump sum in accordance with in the drawings and specifications. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
- B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.

230000 – 104 GAS PIPING FROM METER TO BOILERS

- A. Measurement: The gas piping in the boiler room will be paid lump sum in accordance with in the drawings and specifications. All gas piping required for a full operating system shall be included. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
- B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.

230000 – 105 BOILER ROOM PLUMBING

- A. Measurement: The gas piping in the boiler room will be paid lump sum in accordance with in the drawings and specifications. All gas piping required for a full operating system shall be included. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
- B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.

230000 – 106 SNOWMELT PIPING (LOWER LEVEL)

230000 – 107 SNOWMELT PIPING (MID LEVEL)

- A. Measurement: Measured horizontally in place for each size and material installed at the depths and locations as shown on the drawings and in accordance with the specifications. No overrun in quantities will be paid for re-routing of tubing without approval by the owners representative.

- B. Payment: Payment will be made at the unit price bid and shall include installation of pipe and related fittings.
- 230000 – 108 SNOWMELT MANIFOLD WITH MANIFOLD ENCLOSURE
- A. Measurement: Measurement will be made of each snowmelt manifold with box furnished and installed in accordance with the contract documents. Work shall include the furnishing and installing the snowmelt manifold with box. The connection to snowmelt main, excavation, bedding and backfill required to complete the box construction shall be included with this pay item and will not be measured separately.
- B. Payment: Payment will be made for each snowmelt manifold with box furnished and installed in accordance with the contract documents. Payment shall include the furnishing and installing the snowmelt manifold with box. The concrete box as shown in the Contract documents will be placed below the pavers at this time. Excavation, bedding and backfill required to complete the installation of the snowmelt manifold with box shall be included with this pay item and will not be measured separately.
- 230000 – 109 SNOWMELT ZONE CONTROL VALVE
- A. Measurement: Measurement will be made of each zone control valve furnished and installed in accordance with the contract documents. Work shall include the furnishing and installing the zone control valve. All connections to the snowmelt system, excavation, bedding and backfill required to complete shall be included with this pay item and will not be measured separately.
- B. Payment: Payment will be made for each zone control valve furnished and installed in accordance with the contract documents. Work shall include the furnishing and installing the zone control valve. All connections to the snowmelt system, excavation, bedding and backfill required to complete shall be included with this pay item and will not be measured separately.
- 230000 – 110 ¾" SNOWMELTSYSTEM CONDUIT
- 230000 – 110 1" SNOWMELTSYSTEM CONDUIT
- 230000 – 110 1.25" SNOWMELTSYSTEM CONDUIT
- 230000 – 110 1.5" SNOWMELTSYSTEM CONDUIT
- 230000 – 110 2" SNOWMELTSYSTEM CONDUIT
- A. Measurement: Measured horizontally in place for each size and material installed at the depths and locations as shown on the drawings and in accordance with the specifications.
- B. Payment: Payment will be made at the unit price bid and shall include installation of pipe and related fittings.
- 230000 – 111 SNOWMELT SYSTEM CONTROLS
- A. Measurement: The snowmelt system controls as described and detailed in the specifications and plans and will not be measured, but will be paid lump sum for a complete and working system. Documentation of labor and material (bill of material or schedule of values) used in the construction of the snowmelt system controls shall be submitted with the bid. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
- B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 230000 – 112 TEST AND BALANCE SNOWMELT SYSTEM
- A. Measurement: The snowmelt system testing and balancing as described and detailed in the specifications and plans will not be measured, but will be paid lump sum for a complete and working system. Documentation of labor and material (bill of material or schedule of values) used in the construction of the snowmelt system controls shall be submitted with the bid. Percentages paid shall



coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.

- B Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications
- 230000 – 113 **BOILER ROOM BASEBOARD HEAT**
  - A. Measurement: The baseboard heat as detailed in the plans and specifications will be measured each, and paid for as a complete and working system. Documentation of labor and material (bill of material or schedule of values) used in the construction of the snowmelt system controls shall be submitted with the bid. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
  - B Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications
- 230000 – 114 **CONNECTION OF LOWER PLAZA TO EXISTING SYSTEM**
  - A. Measurement: The connection of the lower plaza to the existing system as detailed in the plans and specifications will be measured each, and paid for as a complete and working system. Documentation of labor and material (bill of material or schedule of values) used in the construction of the snowmelt system controls shall be submitted with the bid. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
  - B Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 230000 – 115 **MAINLINE STUB-OUT FOR FUTURE SNOWMELT**
  - A. Measurement: The mainline stub-out for future snowmelt as detailed in the plans and specifications will be measured each, and paid for as a complete and working system. Documentation of labor and material (bill of material or schedule of values) used in the construction of the snowmelt system controls shall be submitted with the bid. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
  - B Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 230000 – 116 **GAS & SANITARY STUB-OUT FOR FUTURE KITCHEN**
  - A. Measurement: The gas and sanitary stub-out for future kitchen as detailed in the plans and specifications will be measured each, and paid for as a complete and working system. Documentation of labor and material (bill of material or schedule of values) used in the construction of the snowmelt system controls shall be submitted with the bid. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
  - B Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 260000 – 117 **PEDESTRIAN LIGHT POLE (CUSTOM)**
  - A. Measurement: Measurement shall be made of the actual number of light poles/fabricated/event receptacles and installed. Work shall include fabrication of light pole and banner, installation of

pole/fixture/lamp, lighting control and installation of ballast, placed and accepted at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications.

- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specific. Payment will not be made until light pole/fixture has been operational for ten (10) days.

260000 – 118 WALL LIGHT AT STONE VENEER WALL

260000 – 119 LED STRIP LIGHT

- A. Measurement: Measurement shall be made of the actual number of lights installed. Work shall include installation of light, lamp and box including all work and coordination needed for the installation of conduit between stones to light location, modifications of the stone (cutting or chipping) as required and shown in the detail, and lighting control, placed and accepted at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications. Payment will not be made until light fixture has been operational for ten (10) days.

- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the Specifications. Payment will not be made until light fixture has been operational for ten (10) days.

260000 – 120 EXIT SIGN

- A. Measurement: Measurement shall be made of the actual number of exit signs installed. Work shall include installation of sign, lamp and box including all work and coordination needed for the installation of conduit, modifications as required and shown in the detail, placed and accepted at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications. Payment will not be made until exit sign has been operational for ten (10) days.

- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the Specifications. Payment will not be made until light fixture has been operational for ten (10) days.

260000 – 121 HOLIDAY/EVENT POWER RECEPTACLES

- A. Measurement: Measurement shall be made of the actual number of holiday lighting/event power receptacles installed as indicated on the construction plans, placed and accepted at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications.

- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.

260000 – 122 3/4" CONDUIT

260000 – 122 1" CONDUIT

260000 – 122 2" CONDUIT

260000 – 122 4" CONDUIT

- A. Measurement: Measurement shall be made of the linear footage of conduit and trenching to the panel board as indicated on the construction plans, including the number of pull boxes shown on plans and any other locations necessary for construction, installed placed and accepted at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications.

- B. Payment: Payment shall be made at the unit price bid, and shall include all trenching, materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 260000 – 123 WIRING
  - A. Measurement: System wiring shall be a single lump sum item, for an operational system as per circuit schedule shown on the Drawings. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
  - B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 260000 – 124 PANELBOARD "BP"
  - A. Measurement: Measurement will be made of the actual number of panel boards installed including all CT cabinets, mounting structures, meters, feeders, trenching, conduit, disconnecting means, and concrete foundation placed and accepted at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications. Conduits within utility corridor will be measured and paid for separately.
  - B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 260000 – 125 HEAT TAPE
  - A. Measurement: Heat tape shall be a single lump sum item, for an operational system as shown on the Drawings. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
  - B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- L1.0 to L4.1-127 DECK REPLACEMENT
  - A. Measurement: Measurement will be made of the actual square footage of deck removed and replaced including excavation, backfill, foundations, posts, joists, fasteners, decking and accepted at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications.
  - B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.
- L1.0 to L4.1-128 CABANA STRUCTURES @ DECK
  - A. Measurement: The Cabana Structure at the pool area deck as described and detailed in the plans will not be measured, but will be paid lump sum for a complete structure. Documentation of labor and material (bill of material or schedule of values) used in the construction of the structure, including cedar posts, cedar beams, cedar joists, joist hangers, concrete footings, and all other associated materials and labor necessary for construction, shall be submitted with the bid. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
  - B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all excavation, materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- L1.0 to L4.1-129 POOL PLANTERS

- A. Measurement: Measurement shall be made of the number of pool planters installed as indicated on the construction plans, including the amended soil, waterproof membrane, drainage gravel, filter fabric, mulch, and irrigation and all other associated labor and materials necessary for construction, installed placed and accepted at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the plans.
- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.

L1.0 to L4.1-130 POOL FENCE REPAIR/REPLACE

- A. Measurement: Measurement shall be made of the linear footage pool fence repaired and replaced as indicated on the construction plans installed placed and accepted at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the plans.
- B. Payment: Payment shall be made at the unit price bid, and shall include all excavating, materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.

L1.0 to L4.1-131 POOL GATE

- A. Measurement: Measurement shall be made of the number of pool fence gates installed as indicated on the construction plans, including the number of pool gate locks, gate hinges, steel I-beams, rectangular steel tubes, steel angles, cedar planks, embed plates, concrete footers, and all other associated materials necessary for construction, installed placed and accepted at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the plans.
- B. Payment: Payment shall be made at the unit price bid, and shall include all excavating, materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.

L1.0 to L4.1-132 SCREEN FENCE

- A. Measurement: The screen fencing as described and detailed in the plans will not be measured, but will be paid lump sum for a complete structure. Documentation of labor and material (bill of material or schedule of values) used in the construction of the structure, including hinges, cedar posts, cedar slats, drop rod, anchor bolts, angle iron, concrete footings, and all other associated materials and labor necessary for construction, shall be submitted with the bid. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
- B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all excavation, materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.

**END OF SECTION**

## SECTION 01 1010

### SUMMARY OF WORK

#### 1.1 CONDITIONS AND REQUIREMENTS

Division 1 - General Requirements shall govern work under all divisions of the specifications.

#### 1.2 EXAMINATION OF SITE

**Failure to visit site will in no way relieve Contractor from requirements for furnishing materials or performing work that may be required to complete work in accordance with drawings and specifications, or as directed by the Engineer.**

Contractor shall field locate existing installations to determine conflicts prior to the start of construction and at no cost to Owner.

Contractor is responsible for obtaining all jurisdictional permits necessary for construction including dewatering permits.

Contractor shall videotape all project sites prior to construction and provide the recorded videotape to engineer as a record of existing conditions.

#### 1.3 CONTRACTS

All work described by the Contract Documents will be executed under one prime contract between the Owner and the Contractor.

#### 1.4 WORK BY OTHERS

The Contractor shall be responsible for providing all temporary services.

#### 1.5 CONTRACTOR USE OF PREMISES

Operations of the Contractor shall be limited to areas where work is indicated on the drawings, easements, rights-of-way, and/or as provided in writing by Engineer. Contractor shall protect areas outside the limits of construction against damage due to snowmelt and/or rainfall runoff, pumping of water and equipment damage.

Damage to adjacent areas from equipment or construction will be the Contractor's responsibility. Repair or replacement of damaged areas shall be completed to the Engineer's, residents', State's and County's and any other agency's satisfaction.

#### 1.6 DELIVERY, STORAGE AND HANDLING

All materials to be installed for final payment by the Owner shall be handled, delivered, and stored in a manner to prevent breakage, damage, or actions which renders product unusable. Handling shall be in accordance with the manufacturer's recommended handling and storing procedures. Any products damaged and not meeting the requirements of these specifications

shall be rejected.

All materials required for submittal shall be submitted to Engineer for Review prior to construction.

#### 1.7 EXISTING UTILITIES

As required protect existing utilities from damage. Brace/support as required by utility owner and to facilitate improvements, coordination with affected utility companies may be required. Require all utility companies to field locate facilities prior to construction start. Require all utility poles be properly supported and braced during construction. Notify Engineer of utilities encountered, but not indicated and provide as-built locations. **Contractor shall provide Engineer two (2) copies of utility locate mapping prior to beginning construction.** Failure to provide these copies relinquishes all rights to any claims related to located utilities.

#### 1.8 CONTRACTOR'S STAKING NEEDS

The Contractor shall be responsible for all construction staking needs. Owner will furnish established benchmarks and baselines to facilitate staking when available.

#### 1.9 CONSTRUCTION PHASING REQUIREMENTS

The Contractor will be required to coordinate all work with other contractors who may be working in the area, including, but not limited to the City of Centennial.

#### 1.10 MATERIALS AND SOILS TESTING

The Owner will employ a qualified independent geotechnical testing agency. Contractor shall furnish testing agency access to work. Facilities and incidental labor required for testing. **Contractor is responsible for coordination and scheduling with the geotechnical testing agency in order to provide necessary testing for the project. Adequate testing to meet State of Colorado requirements must be provided.**

#### 1.11 SUBSTITUTIONS

Whenever a material, article, or piece of equipment is identified on the drawings or specifications by reference to brand name or catalog number, it shall be understood that this is referenced for the purpose of defining the performance or other salient requirements, and that other products of equal capacities, quality, and function shall be considered. The Contractor may recommend the substitution of a material, article, or piece of equipment of equal substance and function for those referred to in the Contract Documents by reference to brand name or catalog number, and if, in the opinion of the Engineer, such material, article, or piece of equipment is of equal substance and function to that specified, the Engineer may approve its substitution and use by the Contractor. Any cost differential shall be deductible from the Contract Price and the Contract Documents shall be appropriately modified by Change Order. The Contractor warrants that if substitutes are approved, no major changes in the function or general design of the Project will result. Incidental changes or extra component parts required to accommodate the substitute will be made by the Contractor without a change in the Contract Price or Contract Time.

END OF SECTION

## SECTION 01 1015

## ABBREVIATIONS AND SYMBOLS

## 1.1 RELATED REQUIREMENTS

- A. Drawings for Symbols
- B. Drawings or Schedules for Abbreviations

## 1.2 SPECIFIC LANGUAGE EXPLANATION

Specifications are of abbreviated, simplified or streamlined type and include incomplete sentences. Omissions of words or phrases such as "the Contractor shall", "in conformity therewith", "shall be", "as noted on the drawings", "a", "the", are intentional. Supply omitted words or phrases by inference in same manner as they are when "NOTE" occurs on drawings. Supply words "shall be" or "shall" by inference when colon is used within sentences or phrases. Supply words "on the drawings" by inference when "as indicated" is used with sentences or phrases.

## 1.3 ABBREVIATIONS

Reference in Contract Documents to trade associations, technical societies, recognized authorities and other institutions include following organizations, which are sometimes referred to only by corresponding abbreviations:

AASHTO	American Association of State Highway and Transportation Officials (Note: AASHTO "T" references for compaction shall mean maximum density at optimum moisture.)
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturers' Association
AGA	American Gas Association
AGMA	American Gear Manufacturers' Association
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWPI	American Wood Preservers' Institute
AWWA	American Water Works Association
AWS	American Welding Society
AWPA	American Wood Preservers' Association
BIA	Brick Institute of America (Successor to SCPI)
CBMA	Certified Ballast Manufacturers' Association
CDPHE	Colorado Department of Public Health and Environment
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standard (U.S. Department of Commerce)

CSI	Construction Specifications Institute
DFPA	Douglas Fir Plywood Association (APA)
FS	Federal Specification
IEEE	Institute of Electrical and Electronics Engineers, Inc.
IPCEA	Insulated Power Cable Engineers' Association
JIC	Joint Industry Conferences of Hydraulic Manufacturers
MIL	Military Specification
NBFU	National Board of Fire Underwriters
NEC	National Electric Code (of NFPU)
NEMA	National Electrical Manufacturers' Association
NESC	National Electric Safety Code
NFPA	National Forest Products Association
NFPA	National Fire Protection Association
NLMA	National Lumber Manufacturers' Association
OECI	Overhead Electrical Crane Institute
OSHA	Occupational Safety and Health Administration
PS	Product Standard (U.S. Department of Commerce)
RLM	RLM Standards Institute, Inc.
SPR	Simplified Practice Recommendation (U.S. Dept of Commerce)
SSPC	Steel Structures Painting Council
TEMA	Tubular Exchanger Manufacturers' Association
UBC	Uniform Building Code
UL	Underwriters' Laboratories, Inc.

END OF SECTION



## SECTION 01 1025

### MEASUREMENT AND PAYMENT

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

###### A. General:

1. All measurements and payments will be based on work completed in strict accordance with the plans and specifications for the project.
2. The method of measurement and basis of payment described are for the work itemized in the Bid Form and in the sections of the specifications. Items may include work within a single section or in more than one section.
3. The Contract Sum is stated in the Contract Documents and, including authorized changes and adjustments, the total amount payable by the Owner to the Contractor.

###### B. Measurement:

1. Unless otherwise specified, all longitudinal measurements will be made horizontally, and computations will be based on the dimensions shown on drawings and details.
2. Quantities will be rounded off to the nearest whole number.
3. The Contractor shall, in the presence of the Owner or Owner's Representative, verify all measurements and quantities required for payment by the unit price method.
4. The Contractor shall, in the presence of the Owner or Owner's Representative, measure all "Removal" items prior to undertaking the "Removal" items.
5. Contractor shall provide necessary equipment, workers, and survey personnel as required for measurements.

###### C. Units

1. Measurement by Volumes: Measurement by cubic dimension using mean length, width and height or thickness. Longitudinal measurements will be made horizontally.
2. Measurements by Area: Measured by square dimensions using mean length and width or radius, measured horizontally.
3. Linear Measurement: Measured by linear dimension at the item centerline or mean chord.
4. Measured by Lump Sum or Per Each: Item inclusion as specified by the bid item description.
5. Measured by weight: Measured by certified scales at the source of material.

###### D. Payment:

1. Unit bid prices, as quoted in the Bid Schedule, shall constitute full compensation for labor, materials, equipment, rentals, overhead, profit and incidentals to complete all work for each

pay item and for all risk, loss, damage, or expense of whatever nature arising from the nature of the work or prosecution thereof.

2. Work or materials that are essential to the work, but for which there are no pay items, will not be measured and paid for separately, but shall be included in other items of work.
3. Payment for work listed as lump sum bid items completed under this contract shall be paid for on a lump sum fixed price basis. A schedule of values shall be provided to the Owner prior to construction on an item measured as a lump sum. The schedule of values shall clearly detail the Work item for partial payments.
4. At least ten (10) days before each progress payment falls due (but not more often than once a month), the Contractor will submit to the Owner's Representative a partial payment estimate filled out and signed by the Contractor covering the work performed during the period covered by the partial payment estimate and supported by such data as the Owner's Representative may reasonably require. If payment is requested on the basis of materials and equipment not incorporated in the work but delivered and suitably stored at or near the site, the partial payment estimate shall also be accompanied by such supporting data, satisfactory to the Owner, as will establish the Owner's title to the material and equipment and protect his interest therein, including applicable insurance. The Owner's Representative will, within ten (10) days after receipt of each partial payment estimate, either indicate in writing his approval of payment and present the partial payment estimate to the Owner, or return the partial payment estimate to the Contractor indicating in writing his reasons for refusing to approve payment. In the latter case, the Contractor may make the necessary corrections and resubmit the partial payment estimate. The Owner will, within fifteen (15) days of presentation to him of an approved partial payment estimate, pay the Contractor a progress payment on the basis of the approved partial payment estimate.
  - a. On a daily basis, the Contractor shall measure all unit price work which cannot be readily measured in the field after the work has been completed. No less than weekly, the Contractor shall submit an itemized list of all such work with backup data to the Owner's Representative for review. No payment shall be made for any such work unless the procedure in this paragraph as been followed.
  - b. The request for payment may also include an allowance for the cost of such major materials and equipment which are suitably stored either at or near the site.
5. At least ninety percent of the calculated value of any work completed shall not be paid until fifty percent of the work required by the contract has been performed. Thereafter, the Owner shall pay any of the remaining installments without retaining additional funds if, in the opinion of the Owner, satisfactory progress is being made in the work. The withheld percentage of the contract price of any such work, improvement, or construction shall be retained until the contract is completed satisfactorily and finally accepted by the Owner.
6. If the Owner fails to make payment thirty (30) days after approval by the Owner's Representative, in addition to other remedies available to the Contractor, there shall be added to each such payment interest at the maximum legal rate commencing on the first day after said payment is due and continuing until the payment is received by the Contractor.
7. The Owner's Representative's recommendation of any payment requested in an application for payment will constitute a representation by Owner's Representative to Owner based on Owner's Representative's review of the application for payment and the accompanying data and schedules that the work has progressed to the point indicated; that, to the best of Owner's Representative's knowledge, information and belief, the quality of the work is in accordance with the contract documents (subject to an evaluation of the work as a

functioning project upon substantial completion, to the results of any subsequent tests called for in the contract documents and any qualifications stated in the recommendation) and the Contractor is entitled to payment of the amount recommended. However, by recommending any such payment Owner's Representative will not thereby be deemed to have represented that exhaustive or continuous on-site inspections have been made to check the quality or the quantity of the work, or that the means, methods, techniques, sequences, and procedures of construction have been reviewed or that any examination has been made to ascertain how or for what purpose Contractor has used the moneys paid or to be paid to Contractor on account of the contract prices, or that title to any work, materials, or equipment has passed to Owner free and clear of any liens.

8. The Owner's Representative may refuse to recommend the whole or any part of any payment if, in his opinion, it would be incorrect to make such representations to Owner. He may also refuse to recommend any such payment, or, because of subsequently discovered evidence or the results of subsequent inspections or test, nullify any such payment previously recommended to such extent as may be necessary in Owner's Representative's opinion to protect Owner from loss because:
  - a. The work is defective, or completed work has been damaged requiring correction or replacement;
  - b. Written claims have been made against Owner or liens have been filed in connection with the work;
  - c. The contract price has been reduced because of modifications;
  - d. Owner has been required to correct defective work or complete the work;
  - e. Of Contractor's unsatisfactory prosecution of the work in accordance with the contract documents, or;
  - f. Contractor's failure to make payment to subcontractors or for labor, materials or equipment.
9. When the Contractor considers the entire work ready for its intended use Contractor shall, in writing to Owner and Owner's Representative, certify that the entire work is substantially complete and request that Owner's Representative issue a certificate of substantial completion. Within a reasonable time thereafter, Owner, Contractor, and Owner's Representative shall make an inspection of the work to determine the status of completion.
  - a. If the inspection reveals deficiencies on the project, the Contractor shall immediately remedy all deficiencies as listed on a punch list provided by the Owner and Owner's Representative. Upon completion of the punch list items the Contractor shall repeat the procedure in the above paragraph. The process shall be repeated until the Owner issues a letter of preliminary acceptance for the project.
  - b. Upon receiving the letter of preliminary acceptance the Owner's Representative will issue a certificate of substantial completion and recommend final project payment. Conditions may be attached to the certificate to include withholding enough money to cover the cost of any deficiencies. The date of the letter of preliminary acceptance begins the one-year warranty. It is important to receive the letter of preliminary acceptance in the same construction season as the work was performed. Inspection and acceptance by the Owner after November 16 may be made only by special request and only if weather allows.
  - c. Final payment to the Contractor will not be made, the one-year warranty will not begin,

and the Contractor shall remain liable for maintenance of the project until the letter of preliminary acceptance is issued.

- d. One month prior to the expiration of the one-year warranty period the Contractor shall request in writing a final inspection and final acceptance. The Owner will conduct the final inspection. If this inspection reveals deficiencies in the materials or workmanship, the Contractor shall make any repairs necessary under the one-year warranty. If any deficiencies are due to normal wear and tear, the Owner may request that repairs be done on a time and materials basis as negotiated with the Contractor.
  - e. The Owner will issue a letter of final project acceptance if the final inspection reveals no deficiencies and all warranty work has been satisfactorily completed. Effective on the date of the letter of final project acceptance, Contractor shall be relieved of all warranty except for a one-year warranty on items repaired under the one-year warranty.
- 10. Final payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities accepted by the Owner multiplied by the unit price for Work which is incorporated in or made necessary by the Work.
  - 11. Upon completion and acceptance of the work, the Owner's Representative shall issue a certificate attached to the final payment request that the work has been accepted by him under the conditions of the contract documents. The entire balance found to be due the Contractor, including the retained percentages, but except such sums as may be lawfully retained by the Owner, shall be paid to the Contractor within thirty (30) days of completion and acceptance of the work.
  - 12. Prior to the substantial completion, the Owner, with the approval of the Owner's Representative and with the concurrence of the Contractor, may use any completed or substantially completed portions of the work. Such use shall not constitute an acceptance of such portions of the work.
  - 13. Neither recommendation of a progress or final payment by Owner's Representative, nor the issuance of a certificate of substantial completion, nor any payment by Owner to Contractor under the contract documents, nor any use of occupancy of the work or any part thereof by Owner, nor any act of acceptance by Owner nor any failure to do so, nor the issuance of a notice of acceptability by Owner's Representative, nor any correction of defective work by Owner shall constitute an acceptance of work not in accordance with the contract documents or a release of Contractor's obligation to perform the work in accordance with the contract documents.
  - 14. The Contractor will indemnify and save the Owner or the Owner's agents harmless from all claims growing out of the lawful demands of subcontractors, laborers, workmen, mechanics, material men, and furnishers of machinery and parts thereof, equipment tools and all supplies, incurred in the furtherance of the performance of the work. The Contractor shall, at the Owner's request, furnish satisfactory evidence that all obligations of the nature designated above have been paid, discharged or waived. If the Contractor fails to do so the Owner may, after having notified the Contractor, either pay unpaid bills or withhold from the Contractor's unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged whereupon payment to the Contractor shall be resumed, in accordance with the terms of the contract documents, but in no event shall the provisions of this sentence be construed to impose any obligations upon the Owner to either the Contractor, his surety, or any third party. In paying any unpaid bills of the Contractors, any payment so made by the Owner shall be considered as a payment made under the contract documents by the Owner to the Contractor, and the Owner shall not be liable to the Contractor for any such payments made in good faith.

E. Partial Utilization: Use by Owner of completed portions of the Work may be accomplished prior to Substantial Completion of all the Work subject to the following:

1. Owner at any time may request Contractor in writing to permit Owner to use any part of the Work which Owner believes to be substantially complete and which may be so used without significant interference with construction of the other parts of the Work. If Contractor agrees, Contractor will certify to Owner and Owner's Representative that said part of the Work is substantially complete. Within a reasonable time thereafter, Owner, Contractor and Owner's Representative shall make an inspection of that part of the Work to determine its status of completion. Prior to Owner's use, Owner's Representative will deliver to Owner and Contractor a written recommendation as to the division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, maintenance, utilities, insurance and correction periods for that part of the Work which is binding upon Owner and Contractor as to that part of the Work, unless Owner and Contractor shall have otherwise agreed in writing or shall object to the Owner's Representative in writing within fifteen (15) days of receiving Owner's Representative recommendations. Owner shall have the right to exclude Contractor from any part of the Work which Owner uses, but Owner shall allow Contractor reasonable access to complete or correct items on the tentative list.
2. In lieu of the provisions of paragraph 1.01E.1. above, Owner may take over operation of a facility constituting part of the Work whether or not it is substantially complete if such facility is functionally and separately useable; provided that prior to any such takeover, Owner and Contractor have agreed as to the division of responsibilities between Owner and Contractor for security, operation, safety, maintenance, correction period, heat, utilities and insurance with respect to such facility.
3. No occupancy of part of the Work or taking over of operations of a facility will be accomplished prior to acknowledgment from the insurers providing the property insurance on the Work that notice of such occupancy has been received and that said insurers, in writing, have effected the changes in coverage necessitated thereby. The insurers providing the property insurance shall consent to such use or occupancy by endorsement on the policy or policies, but the property insurance shall not be canceled or lapse on account of any such partial use or occupancy.
4. Unless otherwise agreed upon, partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

F. Substantial Completion

1. Substantial Completion is the point in the progress of the Work when the Work or a designated portion of the Work is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.
2. When Contractor considers the entire Work ready for its intended use, Contractor shall, in writing to Owner, certify that the entire Work is substantially complete and request that Owner's Representative issue a Certificate of Substantial Completion. The Contractor's request shall include a punch list of items to be completed or corrected prior to final payment. Within a reasonable time thereafter, Owner, Owner's Representative, and Contractor shall make an inspection of the Work to determine the status of completion and amend the punch list if necessary. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. If Owner's Representative does not consider the Work substantially complete, Owner's Representative will notify Contractor in writing with his reasons.
3. If the Owner's Representative considers the Work substantially complete, the Owner's Representative will prepare and deliver to Owner a tentative Certificate of Substantial Completion. There will be attached to the Certificate a punch list of items to be completed or

corrected before Project completion and final payment. The Certificate of Substantial Completion shall establish the date of Substantial Completion, the responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall fix the time within which the Contractor shall finish all items on the list accompanying the Certificate.

4. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.
  5. The Certificate of Substantial Completion shall be signed by the Owner and Contractor of their written acceptance of the responsibilities in the Certificate. Upon signing, the Owner will make payment of retainage applying to the Work identified in the Certificate, with appropriate adjustments for uncompleted or work not in accordance with the Contract Documents.
- G. Final Inspection: Upon written notice from Contractor that the Work is complete and that all items on the punch list have been completed, Owner's Representative will make a final inspection with Owner and Contractor 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 remedy such deficiencies.
- H. Final Application for Payment: After Contractor has completed all such corrections to the satisfaction of Owner's Representative and delivered all maintenance and operating instructions, schedules, guarantees, Bonds, certificates of inspection, marked-up record documents and other documents all as required by the Contract Documents, and after Owner's Representative has indicated that the Work is in accordance with the Contract Documents, Contractor may make application for final payment following the procedure for progress payments. The final Application for Payment shall be accompanied by all documentation called for in the Contract Documents and such other data and schedules as Owner's Representative may reasonably require, together with complete and legally effective releases or waivers (satisfactory to Owner) of all Claims arising out of or filed in connection with the Work. In lieu thereof and as approved by Owner, Contractor may furnish receipts or releases in full; an affidavit of Contractor that the releases and receipts include all labor, services, material and equipment for which a Claim could be filed, and that all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner or its property might in any way be responsible, have been paid or otherwise satisfied; and consent of the Surety, if any, to final payment. If any Subcontractor, manufacturer, fabricator, supplier or distributor fails to furnish a release or receipt in full, Contractor may furnish a Bond or other collateral satisfactory to Owner to indemnify Owner against any Claim.
- I. Final Payment and Acceptance
1. If, on the basis of Owner's Representative observation of the Work during construction and final inspection, and Owner's Representative review of the final Application for Payment and accompanying documentation all as required by the Contract Documents, Owner's Representative is satisfied that the Work has been completed and Contractor has fulfilled all of his obligations under the Contract Documents, Owner's Representative will, within ten (10) days after receipt of the final Application for Payment, indicate in writing his recommendation of payment and present the Application to Owner for payment. Thereupon Owner's Representative will give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of the Waiver of Claims below. Otherwise, Owner's Representative will return the Application to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application. If the Application and accompanying documentation are appropriate as to form and substance, and acceptable to Owner, Owner shall, within thirty (30) days thereof, cause publication to commence of Notice of Final Settlement, in accordance with statutory requirements applicable to Owner. In the event no claims are made against Contractor in response to said publication, Owner shall pay Contractor the amount of final payment

recommended, including any retainage, by the Owner's Representative in accordance with the Notice of Final Settlement. In the event any claim is made against Contractor, Owner may withhold up to twice the amount of any asserted claim against Contractor until said claim has been resolved together with other amounts permitted by the Contract; however, Owner shall pay Contractor the balance of the final payment net of the withheld amount.

2. If, through no fault of Contractor, final completion of the Work is significantly delayed and if Owner's Representative so confirms, Owner shall, upon receipt of Contractor's final Application for Payment and recommendation of Owner's Representative, and without terminating the Agreement, 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 Contract Documents, and if Bonds have been furnished, 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 Owner's Representative with the Application for such payment. Payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.
3. The acceptance by the Contractor of final payment shall be and shall operate as a release to the Owner of all claims and all liability to the Contractor other than claims in stated amounts as may be specifically excepted by the Contractor for all things done or finished in connection with this work and for every act and neglect of the Owner and other relating to or arising out of this work. Any payment, however, final or otherwise, shall not release the Contractor or his sureties from any obligations under the contract documents or the performance bond and payment bonds.

J. Waiver of Claims: The making and acceptance of final payment shall constitute:

1. A waiver of all claims by Owner against Contractor, except claims arising from unsettled Claims, from defective Work appearing from final inspection pursuant to the Contract Documents or from failure to comply with the Contract Documents or the terms of any special guarantee specified therein; however, it shall not constitute a waiver by Owner of any rights in respect of 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 writing and identified by the Contractor as unsettled at the time of the Final Application for Payment.

BID SCHEDULE:
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DIVISION NO. – BID ITEM NO.

010000 – 1      GENERAL CONDITIONS

MOBILIZATION

- A. Measurement: Mobilization will be a single lump sum item that shall include all the Contractor's costs including labor, material, and any incidental work and equipment necessary for mobilization and demobilization of personnel, equipment and supplies at the project site. This item shall also include the establishment of the Contractor's field office facilities, portable toilets and other necessary temporary facilities, temporary paving, including provisions for providing at-grade manholes, inlets, and other protrusions to the temporary street grade while temporary pavement is used, grading and restoration of staging areas, and all other costs incurred of labor and operations which must be performed prior to beginning the other items under this contract. Also include

repair and restoration of any damage to pavement or landscape areas caused by construction access, repairs due to vandalism, job site security, and coordination with others performing work on the site. The removal of the Contractor's equipment, supplies, excess materials, and cleanup of the site is also included in this item. The cost for staging near the project site shall be included in Mobilization.

- B. Payment: Partial payments for mobilization will be made once each month as the work progresses. These partial payments will be made as follows:

1. When 3% of the original contract amount is earned, 15 percent of the amount bid for mobilization will be paid.
2. When 10% of the original contract amount is earned, 50 percent of the amount bid for mobilization will be paid.
3. When 25% of the original contract amount is earned, 60 percent of the amount bid for mobilization will be paid.
4. When 50% of the original contract amount is earned, 95 percent of the amount bid for mobilization will be paid.
5. Upon completion of all work on the project, 100 percent of the amount bid for mobilization will be paid.
6. The total sum of all payments shall not exceed the original contract bid for the item, regardless of the fact that the Contractor, may have, for any reason, shut down the work on the project or moved equipment away from the project and then back again.

For the purpose of this Section the term "original contract amount" as used above shall mean the amount bid for the construction items in the Contract not including the amount bid for mobilization. Payment for stockpiled material will not be included as a percent of the original contract amount earned until materials are incorporated into the work.

#### STAGING

- A. Measurement: Measurement will be made of the actual work performed as required by the owner of the Thunderhead property up to the amount of \$10,000. Invoices shall be submitted documenting work performed for the Owners Representative review prior to payment.
- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete.

#### UTILITY POTHOLING

- A. Measurement: Measurement will be made of the actual number of utility locating potholes performed. A pothole is defined as an exploratory excavation in an undisturbed location to locate a group of subsurface utilities or for other subsurface investigation. The plans show the locations where potholing may be needed due to possible utility conflicts. Potholing shall not begin without approval by the Owner's Representative.
- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete.



#### CONSTRUCTION SURVEYING

- A. Measurement: Measurement for construction surveying shall be a single lump sum item. Percentages paid shall coincide with percentages complete, as submitted by contractor and as approved by Owner's Representative.
- B. Payment: Payment will be made at the lump sum price bid and shall include all of the Contractor's costs including labor, materials, and incidental work and equipment necessary to complete the construction surveying work.

#### TEMPORARY CONSTRUCTION FENCING

- A. Measurement: Measurement for temporary construction fencing shall be a single lump sum item. Percentages paid shall coincide with percentages complete, as submitted by contractor and as approved by Owner's Representative.
- B. Payment: Payment will be made at the lump sum price bid and shall include all of the Contractor's costs, including maintenance and resetting of fencing as needed through the duration of the project. This item also includes removal of temporary fencing and restoration of the site to match adjacent condition.

#### TEMPORARY UTILITIES

- A. Measurement: Measurement for temporary utilities, including temporary street lighting, electrical, telephone shall be a single lump sum item. Percentages paid shall coincide with percentages complete, as submitted by contractor and as approved by Owner's Representative.
- B. Payment: Payment will be made at the lump sum price bid and shall include all of the Contractor's costs including labor, materials, and incidental work and equipment necessary to complete the temporary utility work.

#### DUST CONTROL

- A. Measurement: Measurement for dust control shall be a single lump sum item. Percentages paid shall coincide with percentages complete, as submitted by contractor and as approved by Owner's Representative.
- B. Payment: Payment will be made at the lump sum price bid and shall include all of the Contractor's costs including labor, materials, and incidental work and equipment necessary to complete the dust control work.

#### EROSION CONTROL

- A. Measurement: Measurement for erosion control shall be a single lump sum item. Percentages paid shall coincide with percentages complete, as submitted by contractor and as approved by Owner's Representative.
- B. Payment: Payment will be made at the lump sum price bid and shall include all of the Contractor's costs including labor, materials, and incidental work and equipment necessary to complete the erosion control work.

#### WATER CONTROL

- A. Measurement: Measurement for water control shall be a single lump sum item. Percentages paid shall coincide with percentages complete, as submitted by contractor and as approved by Owner's Representative.
- B. Payment: Payment will be made at the lump sum price bid and shall include all of the Contractor's

costs including labor, materials, and incidental work and equipment necessary to complete the water control work.

- 312000 - 2      EXCAVATION & BACKFILL (EDGE OF GARAGE) - COMPLETE IN PLACE
- A.      Measurement: Excavation shall not be measured but will be the quantity in cubic yards designated in the bid schedule. Excavation shall include all work necessary to complete the item including construction of embankments, unclassified excavation, borrow, compaction, compaction of bases of cuts and fills, all work in available material pits, and disposal of excess excavated material. All costs associated with reducing the size of the claystone particles, and disposal of the oversized particles will not be paid for separately but shall be included in the work. Percentages paid shall coincide with percentages complete, as submitted by contractor and as approved by Owner's Representative. Any discrepancy in Earthwork quantity found by the contractor shall be submitted in writing to the Owner's Representative prior to excavation.
- B.      Payment: Payment shall include all equipment, excavation, loading, transporting, stockpiling, disposing, hauling off, re-transporting to fill locations (from locations of excavation or from on-site or off-site stockpiles), watering, compaction, subgrade preparation, measuring of subgrade to bring within tolerances, backfilling, dust control, mud control, rough grading and fine grading as required to bring the site to the required lines and grades.
- 312000 - 3      EXCAVATION & HAUL (OVER GARAGE)
- A.      Measurement: Measurement for off site hauling and disposal of unsuitable excavated materials shall be made of the actual number of cubic yards of unsuitable excavated material removed, hauled off and disposed of if encountered in the subgrade to the depth determined by the Owner's Representative in areas not part of utility service or trench placement and construction. The Contractor is to assume that all material excavated for utility trenches will be removed and replaced with suitable material and that removal and replacement will be included in the cost of that utility work. Owners Representative must authorize payment for all unsuitable material to be disposed of. The Contractor and Owners Representative shall measure excavated area and agree upon the dimensions for payment.
- B.      Payment: Payment for this bid item shall be at the unit price bid and shall include all materials, labor and equipment necessary to complete off site hauling and disposal of unsuitable excavated material as shown on the drawings and in accordance with the specifications.
- 312000 - 4      EXCAVATION FOR HOT TUB & PREP FOR NEW HOT TUP
- A.      Measurement: Measurement for off site hauling and disposal of unsuitable excavated materials shall be a single lump sum item. Percentages paid shall coincide with percentages complete, as submitted by contractor and as approved by Owner's Representative.
- B.      Payment: Payment will be made at the lump sum price bid and shall include all materials, labor and equipment necessary to complete off site hauling and disposal of unsuitable excavated material as shown on the drawings and in accordance with the specifications.
- 311000 - 5      REMOVALS - CONCRETE PAVEMENT
- 311000 - 6      REMOVALS - CONCRETE PAVEMENT (OVER STRUCTURE)
- A.      Measurement: Measurement for removal of concrete pavement shall be made of the actual square feet of concrete removed as shown on the drawings and in accordance with the specifications.
- B.      Payment: Payment for this item shall be at the unit price bid and shall include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.

- 31100 – 7      REMOVALS - CONCRETE UNIT PAVERS
- A.      Measurement: Measurement for pavement removal shall be made of the actual number of square feet of concrete unit pavers sawcut, demolished, removed, from the site and disposed of where indicated and as directed by the Owner's Representative.
  - B.      Payment: The unit price bid for this item shall include all of the Contractor's costs, including labor, materials, and incidental work and equipment necessary to complete the work as shown on the drawings and as indicated in the specifications. No payment will be made for the removal of any material that is damaged by the Contractor beyond the limits of the project
- 311000 - 8      REMOVALS - LANDSCAPE
- 311000 - 9      REMOVALS - LANDSCAPE (OVER STRUCTURE)
- A.      Measurement: Measurement for landscape removals shall be of the actual number of square feet of. landscape removed. Percentages paid shall coincide with percentages complete, a schedule of values shall be submitted by the Contractor showing all removal items as listed on sheet DM1.0 for approval by the Owner's Representative. Payment for landscape is planting landscape only. No extra payment is being made for native landscape. Native landscape is paid for in excavation.
  - B.      Payment: Payment for this item shall be at the unit price bid and include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 311000 – 10      REMOVALS - TREE
- A.      Measurement: Measurement for removal of trees shall be made of the actual number of trees cut down and removed from site and disposed of regardless of size including any stump grinding or removal.
  - B.      Payment: Payment for this bid item shall be at the unit price bid and shall include all materials, labor and equipment necessary to complete the removal of trees as shown on the drawings and in accordance with the specifications.
- 311000 – 11      REMOVALS - EXISTING CONCRETE WALL
- A.      Measurement: Measurement for removal shall be made of the actual number of linear feet of wall sawcut, demolished, removed, from the site and disposed of, regardless of thickness including all associated foundation materials.
  - B.      Payment: The unit price bid for this item shall include all of the Contractor's costs, including labor, materials, and incidental work and equipment necessary to complete the work as shown on the drawings and as indicated in the specifications. No payment will be made for the removal of any material that is damaged by the Contractor beyond the limits of the project.
- 311000 – 12      REMOVALS - LIGHT POLE AND BASE
- A.      Measurement: Measurement for light pole and base (foundation) removal shall be made of the actual number of light poles and bases removed from site. The unit price bid shall include salvage, removal, and stockpiling of light poles, light fixtures, and signage at location designated by Owner's Representative. The unit price shall include any repairs/rewiring to maintain service to existing light fixtures and electrical services to remain.
  - B.      Payment: Payment for this bid item shall be at the unit price bid and shall include all materials, labor and equipment necessary to complete the removal of light poles and bases and their appurtenances as shown on the drawings and in accordance with the specifications.

- 311000 – 13      **REMOVALS - METAL FENCE**  
 A.      Measurement: Measurement for removal of metal fence shall be made of the actual number of linear feet of metal fence and related connections, removed, demolished and removed from the site and legally disposed of. Salvage gate hardware for reuse.  
 B.      Payment: Payment for this bid item shall be at the unit price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 311000 – 14      **REMOVALS - STORM SEWER INLET**  
 A.      Measurement: Measurement for payment for removal of storm sewer inlet shall be made of the actual number of inlets and associated vault structures removed and disposed of as shown on the drawings and in accordance with the specifications.  
 B.      Payment: Payment for this bid item shall be at the unit price bid and shall include all materials, labor and equipment necessary to complete the removal as shown on the drawings and in accordance with the specifications.
- 311000 - 15      **REMOVALS - STORM SEWER PIPE**  
 A.      Measurement: Measurement for removal of storm sewer pipe shall be made of the actual number of linear feet of storm sewer pipe excavated, plugged, demolished removed from the site and disposed of, regardless of size including all associated materials and backfill.  
 B.      Payment: Payment for this bid item shall be at the unit price bid and shall include all materials, labor and equipment necessary to complete the excavation, removal, plugging and backfill of storm sewer pipe as shown on the drawings and in accordance with the specifications.
- 071413 - 16      **REMOVE EXISTING WATERPROOFING - HORIZONTAL**  
 071413 - 17      **REMOVE EXISTING WATERPROOFING - HORIZONTAL**  
 A.      Measurement: Measurement for removal of existing waterproofing shall be made of the actual number of square feet of waterproofing removed including all associated material.  
 B.      Payment: Payment will be made at the unit price bid and shall include labor and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 311000 - 18      **REMOVE & RESET CONCRETE UNIT PAVERS**  
 A.      Measurement: Measurement for removal, storing, and reset pavers shall be made of the actual number of square feet of concrete unit pavers removed, salvaged and reset including sand setting bed and joint sand, placed and accepted in accordance with the drawings and as directed by the Owner's Representative.  
 B.      Payment: Payment will be made at the unit price bid and shall include sand, equipment, labor and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 311000 - 19      **REMOVE & RESET FIRE PIT**  
 A.      Measurement: Measurement for removal, storing, and reset of fire pit shall be a single lump sum item and shall include all materials labor and equipment necessary to any existing utilities temporary off line, relocate & store fire pit, and reset fire pit to operate as in existing conditions prior to construction and in accordance with the drawings and as directed by the Owner's

Representative.

- B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 311000 - 20 REMOVE & RESET RELOCATE PERENNIALS & ORNAMENTAL GRASSES
- A. Measurement: Measurement for removal, storing, and reset of perennials and ornamental grasses shall be made of the actual number of square feet of planting beds removed, salvaged and planted and accepted in accordance with the drawings and as directed by the Owner's Representative.
- B. Payment: Payment will be made at the unit price bid and shall include excavation of plants, storing containers, transportation, planting, equipment, labor and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 311000 - 21 REMOVE & RESET EXISTING BOLLARD LIGHTS
- A. Measurement: Measurement for bollard light and base (foundation) removal & reset shall be made of the actual number of bollard lights and bases removed & reset from the site. The unit price bid shall include salvage, removal, stockpiling of bollard lights, reset of bollards lights with base (foundation), utility modifications at location designated by Owner's Representative. The unit price shall include any repairs/rewiring to maintain service to existing bollard light fixtures and electrical services to remain.
- B. Payment: Payment for this bid item shall be at the unit price bid and shall include all materials, labor and equipment necessary to complete the removal and reset of bollard lights and bases and their appurtenances as shown on the drawings and in accordance with the specifications.
- 311000 - 22 SAWCUT EXISTING CONCRETE
- A. Measurement: Measurement for sawcut of existing concrete shall be made of the actual number of linear feet of concrete sawcut at the site and as directed by the Owner's Representative.
- B. Payment: The unit price bid for this item shall include all of the Contractor's costs, including labor, materials, and incidental work and equipment necessary to complete the work as shown on the drawings and as indicated in the specifications. No payment will be made for the removal of any material that is damaged by the Contractor beyond the limits of the project.
- 311000 - 23 TREE PROTECTION
- A. Measurement: Measurement for tree protection shall be made of the actual number of trees protected in accordance with the drawings, and as directed by the Owner's Representative.
- B. Payment: Payment for this bid item shall be at the unit price bid and shall include all materials, labor and equipment necessary to complete tree protection as shown on the drawings and in accordance with the specifications.
- 311000 - 24 HOT TUB REMOVAL - (4) TOTAL
- A. Measurement: Measurement for the removal of (4) hot tubs shall be a single lump sum item and shall include all materials labor and equipment necessary to be demolished removed from the site and disposed of. All temporary relocations of utilities related to the removal of hot tubs shall be included with this item. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.

- B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- S0.1 to S2.5-25 INJECT LEAKS AT INVERTED TEE BEAMS
- A. Measurement: Measurement for injecting leaks at the inverted tee beams within the precast structure shall be made of the actual number of linear feet of leaks including all associated materials.
- B. Payment: Payment for this item shall be at a unit price bid and shall include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- S0.1 to S2.2-26 INJECT LEAKING WALL CRACKS WITH HYDROPHOBIC GROUT
- A. Measurement: Measurement for injecting leaking wall crack with hydrophobic grout shall be made of the actual number of linear feet of cracks including all associated materials.
- B. Payment: Payment for this item shall be at a unit price bid and shall include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- S0.1 to S2.2-27 INJECT LEAKS AT DOUBLE TEES
- A. Measurement: Measurement for injecting leaks at the double tee flanges within the precast structure shall be made of the actual number of linear feet of leaks including all associated materials.
- B. Payment: Payment for this item shall be at a unit price bid and shall include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- S0.1 to S2.2-28 REPAIR & SEAL PIPE PENETRATIONS
- A. Measurement: Measurement for the repair and resealing of the pipe penetrations shall be made of the actual number of pipe penetrations repaired and sealed including all associated materials.
- B. Payment: Payment for this item shall be at a unit price bid and shall include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- S0.1 to S2.2-29 REPAIR DAMAGED CONCRETE SURFACE
- A. Measurement: Measurement for repairing the damaged concrete surface shall be made of the actual number of square feet of damaged concrete repaired including all associated materials.
- B. Payment: Payment for this item shall be at a unit price bid and shall include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- S0.1 to S2.2-30 REPAIR SPANDRAL BEAM
- A. Measurement: Measurement for repairing the spandrel beam shall be made of the actual number of linear feet of the spandrel beam repaired including all associated materials.
- B. Payment: Payment for this item shall be at a unit price bid and shall include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 071413-31 SURFACE PREPERATION
- A. Measurement: Measurement for surface preparation for the waterproofing shall be made of the actual number of square feet of the surface prepared including all associated materials.

- B. Payment: Payment for this item shall be at a unit price bid and shall include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 071413-32 WATERPROOFING MEMBRANE (WALLS - VERTICAL)
- A. Measurement: Measurement for waterproofing the walls shall be made of the actual number of square feet of the walls waterproofed including all associated materials.
- B. Payment: Payment for this item shall be at a unit price bid and shall include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 071413-33 WATERPROOFING MEMBRANE (GARAGE DECK - HORIZONTAL)
- A. Measurement: Measurement for waterproofing the garage deck shall be made of the actual number of square feet of the garage deck waterproofed including all associated materials.
- B. Payment: Payment for this item shall be at a unit price bid and shall include labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 022210-34 4" SDR 35 PVC SANITARY SEWER LINE
- A. Measurement: Measurement will be made of each linear foot of sanitary sewer line furnished and installed in accordance with the contract documents. Work shall include the furnishing and installing of all materials, equipment, and labor necessary for the sanitary sewer construction including pipe, excavation, pipe bedding, backfill, in accordance with the Contract Documents and in accordance with Mt. Werner Water and Sewer District standards.
- B. Payment: Payment will be made of each linear foot of sanitary sewer line furnished and installed in accordance with the contract documents. Payment shall include the furnishing and installing of all materials, equipment, and labor necessary for the storm sewer line construction including sewer pipe, excavation, pipe bedding, backfill, and tracer wire in accordance with the Contract Documents.
- 022210-35 4" SDR PVC SANITARY SEWER TIE/IN CONNECTION
- A. Measurement: Measurement will be made for each connection to the sanitary sewer system. Work shall include excavation, furnishing and installing of all materials, equipment, and labor for the connection, pipe and necessary materials connection to the sanitary sewer. Excavation, pipe bedding, and backfill required to complete the sanitary sewer connections in accordance with the Contract Documents and in accordance with Mt. Werner Water and Sewer District standards
- B. Payment: Payment will be made for each sanitary sewer pipe connected to the sanitary sewer main complete in place. Payment shall include but not limited to the excavation, the furnishing and installing of all materials, equipment and labor for the connection, pipe, necessary materials for the sanitary sewer. Excavation, pipe bedding, and backfill required to complete the sanitary sewer connections shall be included with this pay item and will not be paid for separately.
- 022210-36 SANITARY SEWER CLEANOUT
- A. Measurement: Measurement will be made for each cleanout installed and connected to the constructed sanitary sewer system. Work shall include excavation, the furnishing and installing of all materials, equipment, and labor for the connection, pipe and necessary materials for main connection (sanitary main will be paid by linear foot including length across connection). Excavation, pipe bedding, and backfill required in accordance with the Contract Documents and in accordance with Mt. Werner Water and Sewer District standards to complete the installation of the cleanouts shall be included with this pay item and will not be measured separately.
- B. Payment: Payment will be made for each cleanout connected to the new storm main complete in place. Payment shall include but not limited to the excavation, the furnishing and installing of all

materials, equipment and labor for the connection, pipe, necessary materials for main connection (storm main will be paid by linear foot including length across connection). Excavation, pipe bedding, and backfill required to complete the cleanout connections shall be included with this pay item and will not be paid for separately.

022210-37 4" HDPE PERFORATED DRAIN LINE

022210-38 4" HDPE STORM SEWER LINE

022210-39 6" HDPE STORM SEWER LINE

022210-40 8" HDPE STORM SEWER LINE

022210-41 10" HDPE STORM SEWER LINE

A. Measurement: Measurement will be made of each linear foot of storm pipe furnished and installed in accordance with the contract documents. Work shall include the furnishing and installing of all materials, all connections to existing pipes, equipment, and labor necessary for the storm sewer construction including pipe, pipe fittings, excavation, pipe bedding, and backfill, in accordance with the Contract Documents.

B. Payment: Payment will be made of each linear foot of storm sewer line furnished and installed in accordance with the contract documents. Payment shall include the furnishing and installing of all materials, equipment, and labor necessary for the storm sewer line construction including pipe, pipe fittings (elbows), excavation, pipe bedding, and backfill in accordance with the Contract Documents.

022210-42 6" NYLOPLAST WYE FITTING

A. Measurement: Measurement will be made of each linear foot of storm pipe furnished and installed in accordance with the contract documents. Work shall include the furnishing and installing of all materials, all connections to existing pipes, equipment, and labor necessary for the storm sewer construction including pipe, pipe fittings, excavation, pipe bedding, and backfill, in accordance with the Contract Documents.

B. Payment: Payment will be made of each linear foot of storm sewer line furnished and installed in accordance with the contract documents. Payment shall include the furnishing and installing of all materials, equipment, and labor necessary for the storm sewer line construction including pipe, pipe fittings (elbows), excavation, pipe bedding, and backfill in accordance with the Contract Documents.

022210-43 8" NYLOPLAST INLINE DRAIN

022210-44 12" NYLOPLAST DRAIN BASIN W/SOLID COVER

022210-45 12" NYLOPLAST DRAIN BASIN

022210-46 15" NYLOPLAST DRAIN BASIN W/SOLID COVER

022210-47 15" NYLOPLAST DRAIN BASIN

022210-48 18" NYLOPLAST DRAIN BASIN W/SOLID COVER

022210-49 18" NYLOPLAST DRAIN BASIN

022210-50 24" NYLOPLAST DRAIN BASIN W/SOLID COVER

022210-51 24" NYLOPLAST DRAIN BASIN

A. Measurement will be made of each drain basin furnished and installed in accordance with the contract documents. Work shall include the furnishing and installing the drain basin, the connection of storm sewer pipes and drains to the structure, sealing all voids with non shrink grout around the junction, inlet frames and grates, grout around frame connection(s). Excavation, bedding and backfill required to complete the drain basin construction shall be included with this pay item and will not be measured separately and in accordance with the Contract Documents.

B. Payment: Payment will be made of each drain basin furnished and installed in accordance with the contract documents. Payment shall include the furnishing and installing the drain basin, the

Measurement and Payment

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connection of storm sewer pipes and drains to the structure, sealing all voids with non shrink grout around the junction, inlet frames and grates, grout around frame connection(s). Excavation, bedding and backfill required to complete the structure construction shall be included with this pay item and will not be measured separately.

022210-52 NYLOPLAST REDUCER TO 12" INLET OR SOLID COVER

- A. Measurement: Measurement will be made as a lump sum of the structure furnished and installed in accordance with the contract documents. Work shall include the furnishing and installing the concrete structures, the connection of existing 48-inch manhole riser to the structure, sealing all voids with non shrink grout around the junction, trash racks, frames and grates, anchor bolts, spacers, connection hardware, and grout around frame connection(s). Excavation, bedding and backfill required to complete the structure construction shall be included with this pay item and will not be measured separately.
- B. Payment: Payment will be made as a lump sum of the structure furnished and installed in accordance with the contract documents. Work shall include the furnishing and installing the concrete structures, the connection of existing 48-inch manhole riser to the structure, sealing all voids with non shrink grout around the junction, trash racks, frames and grates, anchor bolts, spacers, connection hardware, and grout around frame connection(s). Excavation, bedding and backfill required to complete the structure construction shall be included with this pay item and will not be measured separately.

334416 – 53 ACO K-100 TRENCH DRAIN

- A. Measurement: Measurement will be made of actual linear feet of trench drain furnished and installed in accordance with the contract documents. Work shall include the forming and installation of the precast frames, the connection of storm sewer pipes and drains to the structure, colored concrete placement as shown in the details, and frames or catch basin frames and grates, Excavation, bedding and backfill required to complete the structure construction shall be included with this pay item and will not be measured separately.
- B. Payment: Payment will be made of actual linear feet of trench drain furnished and installed in accordance with the contract documents. Payment shall include the forming and installation of the precast frames, the connection of storm sewer pipes and drains to the structure, colored concrete placement as shown in the details, and frames or catch basin frames and grates, Excavation, bedding and backfill required to complete the structure construction shall be included with this pay item and will not be measured separately.
- C.

022210-54 TRENCH DRAIN TIE/IN CONNECTION

- A. Measurement: Measurement will be made for each trench drain that is connected to the storm sewer system or daylighted. Work shall include excavation, furnishing and installing of all materials, equipment, and labor for the connection, pipe and necessary materials connection to the storm sewer or daylighted. Excavation, pipe bedding, and backfill required to complete the trench drain connections shall be included with this pay item and will not be measured separately.
- B. Payment: Payment will be made for each trench drain connected to the storm sewer or daylighted complete in place. Payment shall include but not limited to the excavation, the furnishing and installing of all materials, equipment and labor for the connection, pipe, necessary materials for the storm sewer or daylighting. Excavation, pipe bedding, and backfill required to complete the trench drain connections shall be included with this pay item and will not be paid for separately.

C1.0 to C2.0-55 ROOF DRAIN TIE/IN CONNECTION

- A. Measurement: Measurement will be made for each roof drain that is disconnected from the existing roof drain at the building and realigned to connect to the constructed storm sewer system. Work shall include excavation, removal, and disposal of existing roof drain system; and the furnishing and installing of all materials, equipment, and labor for the connection piping at building, piping, PVC wye section for main connection (storm main will be paid by linear foot including length across wye), and cleanout section(s). Excavation, pipe bedding, and backfill required to complete the roof drain connections shall be included with this pay item and will not be measured separately.
  - B. Payment: Payment will be made for each roof drain connected to the new storm main complete in place. Payment shall include but not limited to the excavation, removal, and disposal of existing roof drain system; and the furnishing and installing of all materials, equipment and labor for the connection piping at building, piping, PVC wye section for main connection (storm main will be paid by linear foot including length across wye), and cleanout section(s). Excavation, pipe bedding, and backfill required to complete the roof drain connections shall be included with this pay item and will not be paid for separately.
- 022210-56 6" NYLOPLAST CLEANOUT
- A. Measurement: Measurement will be made for each cleanout installed and connected to the constructed storm sewer system. Work shall include excavation, the furnishing and installing of all materials, equipment, and labor for the connection, pipe and necessary materials for main connection (storm main will be paid by linear foot including length across connection). Excavation, pipe bedding, and backfill required to complete the installation of the cleanouts shall be included with this pay item and will not be measured separately.
  - B. Payment: Payment will be made for each cleanout connected to the new storm main complete in place. Payment shall include but not limited to the excavation, the furnishing and installing of all materials, equipment and labor for the connection, pipe, necessary materials for main connection (storm main will be paid by linear foot including length across connection). Excavation, pipe bedding, and backfill required to complete the cleanout connections shall be included with this pay item and will not be paid for separately.
- 321123 - 58 COLLOIDAL CONCRETE OR WASHED NO. 57 STONE
- A. Measurement: Colloidal Concrete or Washed No. 57 Stone shall not be measured but will be the quantity of cubic yards designated in the bid schedule. Material will be placed in accordance with the construction documents for pavement subgrade, foundations, and pavement surfacing. Work shall include the preparing subgrade, furnishing and installing geotextile fabric, and furnishing, placing, grading, and compaction.
  - B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 321313 – 59 CONCRETE SUBGRADE SLAB (6" DEPTH)
- A. Measurement: Measurement for concrete subgrade slab will be made of the actual number square feet of concrete pavement placed and accepted including the furnishing and installation of materials; subgrade preparation; formwork; cast in place concrete, reinforcing; dowels; finishing; joints; curing; sweeping; washing; cleanup at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications.
  - B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 321123 - 60 CLASS 6 AGGREGATE BASE COURSE (2" DEPTH)

- 321123 - 61 CLASS 6 AGGREGATE BASE COURSE (6" DEPTH)  
 321123 - 62 CLASS 6 AGGREGATE BASE COURSE (12" DEPTH)
- A. Measurement: Aggregate base course (Class 6) shall not be measured but will be the quantity of cubic yards designated in the bid schedule. Material will be placed in accordance with the construction documents for pavement subgrade, foundations, and pavement surfacing. Work shall include the preparing subgrade, finishing and installing geotextile fabric, and furnishing, placing, grading, and compaction.
- B. Payment: Payment will be made per cubic yard furnished and placed in accordance with the contract documents. Aggregate Base Course used for utility and/or pipe bedding will not be paid for separately but shall be paid for as part of the particular pipe construction pay item. Aggregate Base Course used for creek structures will not be paid for separately but shall be paid for as part of the particular creek structure construction pay item, as listed in the drawings.
- 321313 - 63 COLORED CONCRETE VALLEY PAN (ON & OFF STRUCTURE)
- A. Measurement: Measurement for concrete valley pan shall be made of the actual number of square feet including the furnishing and installation of materials; subgrade preparation; formwork; cast in place concrete, reinforcing; dowels; finishing; joints; curing; sweeping; washing; and cleanup at the locations shown placed and accepted in accordance with the drawings and as directed by the Owner's Representative.
- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications. Scope of work shall include subgrade preparation.
- 321313 - 64 CONCRETE PAVEMENT (6" THICKNESS)
- A. Measurement: Measurement for concrete pavement shall be made of the actual number of square feet of concrete pavement including the furnishing and installation of materials; subgrade preparation; formwork; cast in place concrete, reinforcing; dowels; finishing; joints; curing; joint sealer, sweeping; washing; and cleanup at the locations shown placed and accepted in accordance with the drawings and as directed by the Owner's Representative.
- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications. Scope of work shall include subgrade preparation.
- 321413 - 65 CONCRETE UNIT PAVERS - (PRIMARY COLOR) - VEHICULAR  
 321413 - 66 CONCRETE UNIT PAVERS - (PRIMARY COLOR) - PEDESTRIAN  
 321413 - 67 CONCRETE UNIT PAVERS - (TYPE B) - POOL  
 321413 - 68 CONCRETE UNIT PAVERS - (SECONDARY COLOR)  
 321413 - 69 PRECAST CONCRETE POOL COPING
- A. Measurement: Measurement for concrete unit pavers shall be made of the actual number of square feet of concrete unit pavers or precast concrete pool coping placed and accepted in accordance with the drawings and as directed by the Owner's Representative.
- B. Payment: Payment shall be made at the unit price bid, and shall include all materials including sand, geotextile fabric below the aggregate base course, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications. Scope of work shall include subgrade preparation including sand bed and finishing.
- 033000 - 70 COLORED CONCRETE BAND ON-STRUCTURE (6" WIDTH)  
 033000 - 71 COLORED CONCRETE BAND OFF-STRUCTURE (6" WIDTH)

- A. Measurement: Measurement for concrete bands shall be made of the actual number of linear feet including the furnishing and installation of materials; subgrade preparation; formwork; cast in place concrete, reinforcing; dowels; finishing; joints; curing; sweeping; washing; and cleanup at the locations shown placed and accepted in accordance with the drawings and as directed by the Owner's Representative.
  - B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications. Scope of work shall include subgrade preparation.
- 033000 – 72      COLORED CONCRETE STAIRS - 1 TREAD
- A. Measurement: Measurement will be made of the actual number of square feet of steps placed and accepted including furnishing and installation of materials; formwork; cast in place concrete, reinforcing; dowels; cheek walls; finishing; joints; curing; sweeping; washing; cleanup at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications.
  - B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 044100 - 73      STONE VENEER SEAT WALL (1'-6" width x 2'-0" height)
- A. Measurement: Measurement will be made of the actual number of linear feet for each stone veneer site wall placed and accepted including furnishing and installation of materials; formwork; stone veneer; cast in place concrete, reinforcing; dowels; finishing; joints; curing; sweeping; washing; cleanup at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications. Schedule of values to be submitted prior to starting work.
  - B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 044100 – 74      RAW SILOAM STONE – PREMIUM SIZE SLABS
- A. Measurement: Measurement will be made of the actual ton of raw stone including delivery to be used at the stacked stone slab walls. Stone shall be selected by the quarry representative based on the sizes, dimensions and quantities shown on the plans and in accordance with the specifications. Placement of stone is paid for separately.
  - B. Payment: Payment shall be made at the unit price bid, and shall include delivery of the stone in accordance with the specifications. Certified scale tickets for the stone from the supplier will be required for payment.
- 044100 - 75      STACKED STONE SLAB WALL - PLACEMENT
- A. Measurement: Measurement will be made of the actual number of linear feet of stone placed and accepted including the installation of materials; subgrade preparation; finishing; joints; curing; sweeping; washing; cleanup at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications. ***Stone and aggregate base are paid for separately and are not included in the work.***
  - B. Payment: Payment shall be made at the unit price bid, and shall include grout, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.

- 02925 – 76 TOPSOIL (4" AT PLANTING BEDS)
- A. Measurement: Measurement will be made of the actual number of cubic feet of top soil placed and accepted at the locations within the limit of work as shown on the drawings or as directed the Owner's Representative, and in accordance with the specifications. No separate measurement will be made for areas disturbed outside the limit of work. These disturbed areas will be top soiled at the Owner's Representative's discretion and at the contractor's own expense.
  - B. Payment: Payment for this item will include all the Contractor's costs of whatever nature to complete the placement of topsoil in accordance with the Specifications. Payment shall include soil testing, preparation, importing, discing, and raking, spreading, and fine grading.
- 073363 – 77 LIGHTWEIGHT SOIL
- A. Measurement: Measurement will be made of the actual number of cubic feet of lightweight soil placed and accepted at the locations within the limit of work as shown on the drawings or as directed the Owner's Representative, and in accordance with the specifications.
  - B. Payment: Payment for this item will include all the Contractor's costs of whatever nature to complete the placement of lightweight soil in accordance with the Specifications. Payment shall include freight, materials, equipment, labor, soil analytics, preparation, importing, discing, and raking, spreading, fine grading, organic mulch, and other items necessary to complete the work as shown on the drawings or in accordance with specifications.
- 073363 – 78 INTENSIVE PLANT ASSEMBLY - GARDEN DRAIN GR50
- A. Measurement: Measurement will be made of the actual number of square feet of Gardendrain GR 50 filled with lightweight aggregate along with the Systemfilter and Hydroflex 30/Root Stop HD placed and accepted at the locations within the limit of work as shown on the drawings or as directed the Owner's Representative, and in accordance with the specifications.
  - B. Payment: Payment shall be made at the unit price bid, and include all freight, materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 328000 – 79 IRRIGATION SYSTEM - COMPLETE
- A. Measurement: Measurement will be a lump sum amount for the entire irrigation system, as per the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications. Percentages paid shall coincide with percentages complete, as submitted by contractor and as approved by Owner's Representative.
  - B. Payment: Payment shall be made at the unit price bid and shall include, but not limited to furnishing and installing irrigation heads, backflow preventers, valves, pipes, meter pits, controllers, wires, and sleeving. It also shall include all related hardware, backfill and compaction, testing and making all necessary adjustments to achieve complete and uniform coverage, and all other work and materials required to install the items in accordance with the Drawings and Specifications.
- 329300 – 80 DECIDIOUS TREE, ASPEN, 4" CLUMP
- 329300 – 81 CONIFEROUS TREE, 8' HT
- 329300 – 82 SHRUBS, #5 CONT.
- 329300 – 83 ORNAMENTAL GRASSES
- 329300 – 84 PERENNIALS, #1 CONT.
- A. Measurement: Measurement will be made of the actual number of plants and trees placed and accepted including excavation, backfill, construction of dishes, staking, guying, fertilizing, and

mulching at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications.

- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.

XXXXX – 85 LANDSCAPE REPLACEMENT/REPAIR

- A. Measurement: Measurement will be made of the actual square footage of landscape repair excavation, backfill, mulching, seeding, planting, irrigation repairs and fertilizing placed and accepted at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications.
- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.

230000 – 87 SNOW MELT BOILERS

- A. Measurement: The snows melt boilers as described and detailed in the specifications and plans will not be measured, but will be paid lump sum for a complete and working system. Documentation of labor and material (bill of material or schedule of values) used in the construction of the snow melt boilers shall be submitted with the bid. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
- B. Payment: Payment for this bid item shall be based on the bill of material (schedule of values) provided with the bid for the lump sum price and payment shall coincide with with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.

230000 – 88 SNOWMELT PUMPS & HYDRONIC SPECIALTIES

- A. Measurement: The snow melt pumps as described and detailed in the specifications and plans will not be measured, but will be paid lump sum for a complete and working system. Documentation of labor and material (bill of material or schedule of values) used in the construction of the snow melt boilers shall be submitted with the bid. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
- A. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.

230000 – 89 SNOWMELT PIPING IN THE BOILER ROOM

- A. Measurement: The snowmelt piping in the boiler room as detailed in the plans will be paid lump sum in accordance with in the drawings and specifications. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
- B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.

230000 – 90 GAS PIPING FROM METER TO BOILERS

- A. Measurement: The gas piping in the boiler room will be paid lump sum in accordance with in the drawings and specifications. All gas piping required for a full operating system shall be included. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
  - B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
  
- 230000 – 91 BOILER ROOM PLUMBING
  - A. Measurement: The gas piping in the boiler room will be paid lump sum in accordance with in the drawings and specifications. All gas piping required for a full operating system shall be included. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
  - B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
  
- 230000 – 92 SNOWMELT PIPING (LOWER LEVEL)
- 230000 – 93 SNOWMELT PIPING (MID LEVEL)
  - A. Measurement: Measured horizontally in place for each size and material installed at the depths and locations as shown on the drawings and in accordance with the specifications. No overrun in quantities will be paid for re-routing of tubing without approval by the owners representative.
  - B. Payment: Payment will be made at the unit price bid and shall include installation of pipe and related fittings.
  
- 230000 – 94 SNOWMELT MANIFOLD WITH MANIFOLD ENCLOSURE
  - A. Measurement: Measurement will be made of each snowmelt manifold with box furnished and installed in accordance with the contract documents. Work shall include the furnishing and installing the snowmelt manifold with box. The connection to snowmelt main, excavation, bedding and backfill required to complete the box construction shall be included with this pay item and will not be measured separately.
  - B. Payment: Payment will be made for each snowmelt manifold with box furnished and installed in accordance with the contract documents. Payment shall include the furnishing and installing the snowmelt manifold with box. The concrete box as shown in the Contract documents will be placed below the pavers at this time. Excavation, bedding and backfill required to complete the installation of the snowmelt manifold with box shall be included with this pay item and will not be measured separately.
  
- 230000 – 95 SNOWMELT ZONE CONTROL VALVE
  - A. Measurement: Measurement will be made of each zone control valve furnished and installed in accordance with the contract documents. Work shall include the furnishing and installing the zone control valve. All connections to the snowmelt system, excavation, bedding and backfill required to complete shall be included with this pay item and will not be measured separately.
  - B. Payment: Payment will be made for each zone control valve furnished and installed in accordance with the contract documents. Work shall include the furnishing and installing the zone control valve. All connections to the snowmelt system, excavation, bedding and backfill required to complete shall be included with this pay item and will not be measured separately.

- 230000 – 96 ¾" SNOWMELTSYSTEM CONDUIT  
 230000 – 96 1" SNOWMELTSYSTEM CONDUIT  
 230000 – 96 1.25" SNOWMELTSYSTEM CONDUIT  
 230000 – 96 1.5" SNOWMELTSYSTEM CONDUIT  
 230000 – 96 2" SNOWMELTSYSTEM CONDUIT
- A. Measurement: Measured horizontally in place for each size and material installed at the depths and locations as shown on the drawings and in accordance with the specifications.
- B. Payment: Payment will be made at the unit price bid and shall include installation of pipe and related fittings.
- 230000 – 97 SNOWMELT SYSTEM CONTROLS
- A. Measurement: The snowmelt system controls as described and detailed in the specifications and plans and will not be measured, but will be paid lump sum for a complete and working system. Documentation of labor and material (bill of material or schedule of values) used in the construction of the snowmelt system controls shall be submitted with the bid. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
- B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 230000 – 98 TEST AND BALANCE SNOWMELT SYSTEM
- A. Measurement: The snowmelt system testing and balancing as described and detailed in the specifications and plans will not be measured, but will be paid lump sum for a complete and working system. Documentation of labor and material (bill of material or schedule of values) used in the construction of the snowmelt system controls shall be submitted with the bid. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
- B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications
- 230000 – 99 BOILER ROOM BASEBOARD HEAT
- A. Measurement: The baseboard heat as detailed in the plans and specifications will be measured each, and paid for as a complete and working system. Documentation of labor and material (bill of material or schedule of values) used in the construction of the snowmelt system controls shall be submitted with the bid. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
- B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 230000 – 100 CONNECTION OF LOWER PLAZA TO EXISTING SYSTEM
- A. Measurement: The connection of the lower plaza to the existing system as detailed in the plans and specifications will be measured each, and paid for as a complete and working system. Documentation of labor and material (bill of material or schedule of values) used in the construction of the snowmelt system controls shall be submitted with the bid. Percentages paid shall coincide



with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.

- B Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 230000 – 101 MAINLINE STUB-OUT FOR FUTURE SNOWMELT
- A. Measurement: The mainline stub-out for future snowmelt as detailed in the plans and specifications will be measured each, and paid for as a complete and working system. Documentation of labor and material (bill of material or schedule of values) used in the construction of the snowmelt system controls shall be submitted with the bid. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
- B Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 230000 – 102 GAS & SANITARY STUB-OUT FOR FUTURE KITCHEN
- A. Measurement: The gas and sanitary stub-out for future kitchen as detailed in the plans and specifications will be measured each, and paid for as a complete and working system. Documentation of labor and material (bill of material or schedule of values) used in the construction of the snowmelt system controls shall be submitted with the bid. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
- B Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 260000 – 103 PEDESTRIAN LIGHT POLE (CUSTOM)
- A. Measurement: Measurement shall be made of the actual number of light poles/fabricated/event receptacles and installed. Work shall include fabrication of light pole and banner, installation of pole/fixture/lamp, lighting control and installation of ballast, placed and accepted at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications.
- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specific. Payment will not be made until light pole/fixture has been operational for ten (10) days.
- 260000 – 104 WALL LIGHT AT STONE VENEER WALL
- 260000 – 105 POOL FENCE LIGHT
- 260000 – 106 LED STRIP LIGHT
- A. Measurement: Measurement shall be made of the actual number of lights installed. Work shall include installation of light, lamp and box including all work and coordination needed for the installation of conduit between stones to light location, modifications of the stone (cutting or chipping) as required and shown in the detail, and lighting control, placed and accepted at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications. Payment will not be made until light fixture has been operational for ten (10) days.

- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the Specifications. Payment will not be made until light fixture has been operational for ten (10) days.
- 260000 – 107 EXIT SIGN
- A. Measurement: Measurement shall be made of the actual number of exit signs installed. Work shall include installation of sign, lamp and box including all work and coordination needed for the installation of conduit, modifications as required and shown in the detail, placed and accepted at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications. Payment will not be made until exit sign has been operational for ten (10) days.
- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the Specifications. Payment will not be made until light fixture has been operational for ten (10) days.
- 260000 – 108 HOLIDAY/EVENT POWER RECEPTACLES
- A. Measurement: Measurement shall be made of the actual number of holiday lighting/event power receptacles installed as indicated on the construction plans, placed and accepted at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications.
- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 260000 – 109 3/4" CONDUIT
- 260000 – 109 1" CONDUIT
- 260000 – 109 2" CONDUIT
- 260000 – 109 4" CONDUIT
- A. Measurement: Measurement shall be made of the linear footage of conduit and trenching to the panel board as indicated on the construction plans, including the number of pull boxes shown on plans and any other locations necessary for construction, installed placed and accepted at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications.
- B. Payment: Payment shall be made at the unit price bid, and shall include all trenching, materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 260000 – 110 WIRING
- A. Measurement: System wiring shall be a single lump sum item, for an operational system as per circuit schedule shown on the Drawings. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
- B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.
- 260000 – 111 PANELBOARD "BP"

- A. Measurement: Measurement will be made of the actual number of panel boards installed including all CT cabinets, mounting structures, meters, feeders, trenching, conduit, disconnecting means, and concrete foundation placed and accepted at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications. Conduits within utility corridor will be measured and paid for separately.
- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.

260000 – 112 HEAT TAPE

- A. Measurement: Heat tape shall be a single lump sum item, for an operational system as shown on the Drawings. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
- B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.

L1.0 to L4.1-114 DECK REPLACEMENT

- A. Measurement: Measurement will be made of the actual square footage of deck removed and replaced including excavation, backfill, foundations, posts, joists, fasteners, decking and accepted at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the Specifications.
- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.

L1.0 to L4.1-115 CABANA STRUCTURES @ DECK

- A. Measurement: The Cabana Structure at the pool area deck as described and detailed in the plans will not be measured, but will be paid lump sum for a complete structure. Documentation of labor and material (bill of material or schedule of values) used in the construction of the structure, including cedar posts, cedar beams, cedar joists, joist hangers, concrete footings, and all other associated materials and labor necessary for construction, shall be submitted with the bid. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
- B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all excavation, materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.

L1.0 to L4.1-116 POOL PLANTERS

- A. Measurement: Measurement shall be made of the number of pool planters installed as indicated on the construction plans, including the amended soil, waterproof membrane, drainage gravel, filter fabric, mulch, and irrigation and all other associated labor and materials necessary for construction, installed placed and accepted at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the plans.
- B. Payment: Payment shall be made at the unit price bid, and shall include all materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.

L1.0 to L4.1-117 POOL FENCE

- A. Measurement: Measurement shall be made of the linear footage pool fence as indicated on the construction plans, including the number of steel I-beams, steel angles, cedar planks, embed plates, concrete footers, and all other associated materials necessary for construction, installed placed and accepted at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the plans.
- B. Payment: Payment shall be made at the unit price bid, and shall include all excavating, materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.

L1.0 to L4.1-118 POOL GATE

- A. Measurement: Measurement shall be made of the number of pool fence gates installed as indicated on the construction plans, including the number of pool gate locks, gate hinges, steel I-beams, rectangular steel tubes, steel angles, cedar planks, embed plates, concrete footers, and all other associated materials necessary for construction, installed placed and accepted at the locations shown on the Drawings or as directed by the Owner's Representative, and in accordance with the plans.
- B. Payment: Payment shall be made at the unit price bid, and shall include all excavating, materials, equipment, labor, and other items necessary to complete the work as shown on the drawings and in accordance with the specifications.

L1.0 to L4.1-119 SCREEN FENCE

- A. Measurement: The screen fencing as described and detailed in the plans will not be measured, but will be paid lump sum for a complete structure. Documentation of labor and material (bill of material or schedule of values) used in the construction of the structure, including hinges, cedar posts, cedar slats, drop rod, anchor bolts, angle iron, concrete footings, and all other associated materials and labor necessary for construction, shall be submitted with the bid. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
- B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all excavation, materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.

L1.0 to L4.1-120 GATEWAY FOOTERS

- A. Measurement: The gateway footer as described and detailed in the plans will not be measured, but will be paid lump sum for a complete structure. Documentation of labor and material (bill of material or schedule of values) used in the construction of the structure, stone veneer, cast in place concrete piers, cast in place concrete bases, reinforcement, conduit in the base, anchor plates and bolts, and all other associated materials and labor necessary for construction, shall be submitted with the bid. Percentages paid shall coincide with percentages complete, as submitted by the Contractor and as approved by Owner's Representative.
- B. Payment: Payment for this bid item shall be at the lump sum price bid and shall include all excavation, materials, labor and equipment necessary to complete the work as shown on the drawings and in accordance with the specifications.

**END OF SECTION**

## **SECTION 024113**

### **SELECTIVE SITE DEMOLITION**

#### **PART 1 - GENERAL**

##### **1.00 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1-Specification sections, apply to work of this section.

- 1.01 **DESCRIPTION:** Procedures shall provide for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, and a disconnection schedule of utility services (if necessary). The work includes demolition and removal of all construction indicated or specified. Remove rubbish and debris from the project daily unless otherwise directed; do not allow accumulations outside the project. Store material that cannot be removed daily in areas specified by the Owner.

- 1.02 **DUST CONTROL:** Take appropriate action to check the spread of dust to occupied portions of the building and to avoid the creation of a nuisance in the surrounding area.

##### **1.03 PROTECTION**

- A. **Existing Work:** Protect existing work that is to remain in place, that is to be reused, or that is to remain the property of the Owner by temporary covers, shoring, bracing, and supports. Items which are to remain and which are to be salvaged and which are damaged during performance of the work shall be repaired to their original condition or replaced with new, to the satisfaction of the Owner. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal work.
- B. **Weather Protection:** For portions of the plaza to remain, protect all materials and equipment from the weather at all times. Where removal of the existing plaza material is necessary to accomplish work, have materials and workmen ready to provide adequate and approved temporary waterproofing of exposed areas. Temporary coverings shall be attended, as necessary, to insure effectiveness and to prevent displacement.
- C. **Facilities:** Protect all electrical and mechanical services and utilities. Where removal of existing utilities is necessary, provide approved barricades and temporary covering of exposed areas.

#### **PART 2 - EXECUTION**

##### **2.01 REMOVAL**

- A. Remove plaza materials without damaging the substrate.
- B. **Utilities and Services**
  - 1. Temporarily terminate any utilities necessary (after approval of Engineer and notification of the Owner) in a manner conforming to the nationally recognized code covering the specific utility and satisfactory to the Engineers. Replace in a code conforming manner after work is completed.
  - 2. Provide temporary services or connections for electrical and mechanical utilities.

2.02 DISPOSITION OF MATERIAL

- A. Title to Materials: Except where indicated otherwise or specifically specified otherwise in other sections, all materials and equipment removed and not reused, shall become the property of the Contractor and shall be removed from Owner's property.
- B. Reuse of Materials and Equipment: Carefully remove and store materials and equipment to be reused or relocated to prevent damage, and reinstall as the work progresses.

2.03 CLEANUP

- A. Debris and Rubbish: Remove and transport debris and rubbish in a manner that will prevent spillage on streets or adjacent areas. Clean up spillage from streets and adjacent areas.
- B. Regulations: Comply with Federal, State, and local hauling and disposal regulations.

**END OF SECTION**

## **SECTION 026020**

### **WASTEWATER AND WATER SYSTEM MANHOLES**

#### **PART 1: GENERAL**

- 1.0 **RELATED DOCUMENTS:** The General Contract Conditions, Drawings and other Division-1 Specification sections apply to Work of this Section. All work shall conform to Mount Werner Water Standard Specifications, April 2009, or latest edition.
- 1.1 **DESCRIPTION:** Work included: Manholes for wastewater and water system specialty valves or meters, and other installations when specifically called out.
- 1.2 **RELATED SECTIONS:**
- A. Excavating, Backfilling and Compacting – Section 022210
  - B. Wastewater Piping and Appurtenances – Section 026150
- 1.3 **QUALITY ASSURANCE:** Work shall meet Colorado Department of Public Health and Environment requirements for installations of wastewater and potable water systems.
- The Contractor shall guarantee all water and wastewater manholes to be leak free for one year from the date of substantial completion of the entire project, or for two years if the Owner elects to require an extended warranty because of low spring runoff conditions.
- 1.4 **SUBMITTALS/SUBSTITUTIONS:** Submittals are required for the work in this section unless waived by the Engineer. If the Contractor proposes not to provide submittals on portions of this work, the Contractor must submit a “clarification request” formally requesting a waiver.
- 1.5 **PRODUCT DELIVERY, STORAGE AND HANDLING:** Pre-cast units shall be carefully handled and stored so that the concrete does not crack and the joints are not damaged, which shall be cause for rejection.

#### **PART 2: PRODUCTS**

##### **2.1 MATERIALS**

###### **A. MANHOLES:**

1. **CONCRETE:** Per ASTM C 478. 4,000 psi with a minimum of 470 pounds of Type II Portland Cement per cubic yard of concrete, and a water cement ratio not to exceed 0.53.
2. **BASE, RISER, AND CONICAL TOP SECTIONS:** Per ASTM C 478. The Conical top section shall have a 24-inch diameter access opening at its top. The base, riser, and bottom of the conical top section shall be 48-inch inside diameter unless called out otherwise on the plans or in the Special Provisions. Pre-cast base slabs or floors shall have a minimum thickness of 6-inches for 48-inch diameter risers and 8-inches for larger diameter risers.
3. **FLAT SLAB TOPS:** Per ASTM C 478. Access opening shall be 24-inch diameter. Minimum slab thickness 6-inch for risers up to 48-inch diameter, and 8-inch for larger riser diameters. Design for H-20 live load, and dead load based upon the amount and type of fill to be placed on the slab and the weight of the riser supported by the slab.
4. **GRADE RINGS:** Pre-cast concrete. Per ASTM C 478.
5. **JOINT AND JOINT SEALANT:**

- a. Between Manhole Sections To Include Pre-case Base Riser, Conical Sections, And Flat Slab Tops.

Per ASTM C 478 made with male and female ends and sealed with RUB'R-NEK or equal flexible gasket-type sealant of partially vulcanized butyl rubber per Federal Specification SS-S-210A. Two gaskets are required per joint. Gasket size shall be as recommended by the manufacturer based upon the annular space to be sealed. If the minimum cross sectional area equivalent of the gasket is less than one-inch diameter, confirm suitability with Engineer before proceeding.

- b. Between Cast-in-place Base and Riser.

Flat bottom riser placed on a flat formed base and sealed with two flexible gaskets per (a) above.

- c. Pipe To Manhole Seal:

- 1) Pre-cast Base: Flexible rubber boot in a cored hole per ASTM C 923. Connectors shall be KOR-N-Seal, A-Lok or approved equal.
- 2) Cast-in-place Base: Two elastomeric seals minimum per pipe (O ring water stops) per ASTM F477.

- d. Between Grade Rings, and Between Flat Slab Top or Conical Section and Grade Rings.

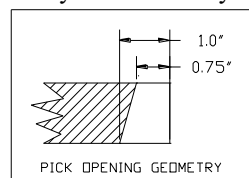
- 1) Bed in mortar and point with mortar.

- e. Between Cast Iron Frame and Concrete Surfaces.

- 1) RUB'R-NEK or equal flexible gasket-type sealant of partially vulcanized butyl rubber per Federal Specification SS-S-210A. One gasket with a minimum cross sectional area equivalent to one inch in diameter is required per joint.

6. STEPS: Per ASTM C 478 modified as follows. Type PS-2PF or PS-2PFS 1/2 inch diameter Grade 60 steel reinforcing rod completely encapsulated in Copolymer Polypropylene as manufactured by M.A. Industries, Inc. The step shall be installed so that the distance from the wall of the riser or cone, measured from the point of embed to the outside face of the rung is 6 inches. The distance from the top of the final cover elevation to the first step shall be 20 to 26 inches. Steps must be capable of carrying a load of 1,000 pounds when projected six inches from the wall without causing permanent deformation.

7. FRAMES AND LIDS (RINGS AND COVERS): Heavy duty castings, designed for H-20 traffic loading, or gray cast iron per ASTM A 48 of uniform quality, free from cracks, holes, swells, and cold shuts, and having a smooth workman like finish. Neenah Foundry Catalog No. R-1706 (Lid OD = 23.875", Frame ID = 24.25"), or equal, 410 lb., 8-inch frame with solid lid and one pick slot. The pick opening is to be the "City of Aurora" style slot as shown below.



All metal bearing surfaces between the ring and cover will be machined or fabricated to insure good seating.



Waterproof lids shall be Neenah “Self-sealing” lids.

Lids shall be lettered “SEWER” or “WATER” depending upon application.

8. ADJUSTING RINGS (EXTENSION RINGS): Gray cast iron, ASTM A 48, Class 25, Neenah R-1979-0141 (1½”) or R-1979-0143 (2”) or equal to match lid opening.
9. EXTERIOR COATING: THOROSEAL Foundation Coating or equal.
10. GROUT: Non-shrink, non-metallic either cement or epoxy based as recommended by the manufacturer for the application.
11. MORTAR: Masonry cement per ASTM C91. Aggregate per AASHTO M 45. Proportion by volume shall be one part masonry cement to three parts aggregate (maximum).

### PART 3: EXECUTION

3.1 GENERAL: Manholes shall be installed level and plumb.

#### 3.2 INSTALLATION

##### A. CONNECTING TO EXISTING MANHOLES:

1. Connecting to existing manholes with cast-in-place bases is not allowed.
2. Connecting to existing manholes with pre-cast bases is allowed but the finished work must conform as nearly as practical to the essential requirements specified for new manholes.

##### B. BASES:

1. Pre-cast Bases: Install pre-cast bases unless specific connection requirements dictate a cast-in-place structure or authorized by Mount Werner Water.
2. Cast-in-Place Bases: The use of cast-in-place bases must be authorized by the Engineer prior to installation.
3. Cure cast-in-place base for a minimum of 24 hours at no less than 40 degrees Fahrenheit prior to placement of pre-cast rings. Provide insulation for curing whenever the temperature is less than 45 degrees.

- C. INVERTS: Invert channels are required in all wastewater manholes unless called out otherwise on the Drawings or in the Special Provision. Where invert channels are required they shall be smooth and semi-circular in shape conforming to the inside of the incoming and outgoing lines. Changes in the direction of flow shall be made with a smooth curve as large a radius as the size of manhole will permit. Changes in size and elevation shall be made with smooth, uniform transitions.

The change in elevation between the invert-in and invert-out must be between 0.1 and 0.2 feet.

Inverts for pre-cast bases may be formed monolithically with the base section. Deflecting pipes to meet inlet and outlet openings in manholes will not be permitted.

All inverts shall be constructed to allow Mount Werner Water televising equipment to be inserted both up and down stream. Such equipment is approximately 6-inches in diameter and 30-inches in length.

- D. **STUBOUTS FOR FUTURE CONNECTIONS:** Stubouts shall consist of a section of the specified wastewater pipe with bell end. The end of the stub shall extend 6 inches beyond the outside edge of the manhole base, and shall be plugged with a manufactured watertight plug compatible with the stubout pipe used. The stubout shall be bedded in and fully supported with imported bedding material.
- E. **FLAT SLAB TOPS:** Substitute a riser section and flat slab top for the cone section in all manholes where the vertical distance between the top of the cone section and invert is 5 feet or less.
- F. **GRADE RINGS:** A maximum of 6 vertical inches of grade rings may be installed to bring the frame and lid to final elevation.
- G. **FRAMES AND LIDS (RINGS AND COVERS):**
1. **IN PAVED AREAS:** Frames and lids shall be installed to match the slope of paved areas by shimming the grade rings with mortar. Where no grade rings are installed shimming with mortar between the top section and frame will be permitted. A two inch adjusting ring is required between the frame and lid in all paved areas. Set the lid 1/2 inch below the pavement surface.
  2. **IN GRAVEL AREAS:** Frames and lids shall be installed plumb and level. Set the lid 2 to 4 inches below the gravel surface.
  3. **IN GRAVEL AREAS TO BE PAVED:** Frames and lids shall be installed to match the slope of the future pavement. Set the lid 2-inches below the gravel surface.
  4. **IN OPEN FIELDS OR PLACES OTHER THAN PAVED OR GRAVEL AREAS:** Final grade shall be as shown on the Drawings or stated in the Special Provision. If the final grade is not indicated submit a clarification request to the Engineer for establishment of the final grade.
  5. **GENERAL:** The Contractor shall make all adjustments to manholes necessary to achieve the above requirements in phased construction where traffic or plowing will be allowed on the partially completed work.
- H. **SEALING:** Manholes for water and wastewater systems shall be watertight. All necessary precautions shall be taken to assure that water will not infiltrate into the manhole. All visible running leaks shall be permanently sealed.

In connections to existing manholes, the holes are to be core bored and a flexible rubber boot is to be used to seal the pipe into the hole. Connectors shall be KOR-N-Seal, A-Lok or approved equal. The annular space between the pipe and hole shall be grouted water tight per the manufacturer's instructions.

Install one coat of exterior coating on the outside of all buried concrete surfaces in accordance with the manufacturer's instructions. The application rate shall be 2 pounds per square yard of surface area coated.

Install waterproof lids in all locations noted on the Drawings or called out in the Special Provisions.

- I. **PAVEMENT TRANSITIONS:** When located in pavement it is preferred that the manhole cover be installed completely within the pavement area. If the manhole is located such that it is partially within the pavement, the pavement shall be widened to extend around the manhole cover a minimum of 1 foot with a 20-foot transition to normal pavement width on either side. In each case the Contractor shall coordinate with the Engineer prior to installing manhole covers partially within a paved area and prior to constructing the pavement transition to clarify exactly how to proceed.

- J. DROP MANHOLES: Drop manholes shall be outside drops constructed as shown on the drawings. An in-line wye fitting shall be provided to initiate the drop. The wye fitting shall be provided when the slope of the incoming wastewater line is steep. Additional bends may be necessary along the drop to provide proper drop alignment.

All fittings shall be securely anchored to prevent movement during placement of flowable fill around the drop.

Drop manhole locations shall be identified on the Drawings or may be required by the Engineer to facilitate field changes in grade or alignment.

- K. FOLLOW-UP INSPECTION/EXTENDED WARRANTY: All manholes for water wastewater systems will be inspected for leakage by the Owner during spring runoff in the year following installation. All leaks or other defects noted during the inspection will be corrected under the Contractor's warranty. The Contractor shall provide personnel necessary to assist in these inspections if requested by the Owner.

In the event that an abnormally dry winter occurs resulting in low spring run-off and a low groundwater table, the Owner at his sole option may elect to re-inspect the manholes for leakage the next following spring. The Owner will notify the Contractor of his decision to re-inspect the manholes for leakage prior to the end of the normal of one year warranty period. The Contractor shall automatically extend his warranty for leak free manholes for one additional year at no additional expense to the Owner upon receipt of Owner's notice.

**END OF SECTION**

**SECTION 026150**

**WASTEWATER SYSTEM PIPING AND APPURTENANCES**

**PART 1: GENERAL**

- 1.0 **RELATED DOCUMENTS:** The General Contract Conditions, Drawings and other Division-1 Specification sections apply to Work of this Section. All wastewater system construction shall conform to Mount Werner Water Standard Specifications for Water and Wastewater Utilities, April 2009, or latest edition thereof.
- 1.1 **DESCRIPTION:** Wastewater collection main lines, laterals, services and other related appurtenances to include flushing and testing.
- 1.2 **RELATED SECTIONS:**
- A. Excavating, Backfilling and Compacting – Section 022210
  - B. Water and Wastewater Line Crossings – Section 026200
  - C. Wastewater and Water System Manholes – Section 026020
- 1.3 **QUALITY ASSURANCE:** Installation shall meet Colorado Department of Public Health and Environment requirements and manufacturer's recommendations.
- 1.4 **SUBMITTALS/SUBSTITUTIONS:** No substitutes will be considered for items listed by manufacturer's name and/or model number in this section unless the words "or equal" are included as a part of the description.
- Submittals are required for all proposed substitutions and all items not specifically listed by manufacturer's name and model number.
- 1.5 **PRODUCT DELIVERY, STORAGE AND HANDLING:** All Material: Use proper implements tools and facilities as necessary to safely and efficiently handle all material, and to avoid shock, abrasion or other damage. Under no circumstances shall any materials be dropped. Extra care shall be taken when the temperature approaches or is below freezing.
- Pipe shall be stacked per the manufacturer's recommendations but shall not be stacked higher than five feet. Evenly support the barrel of all stored pipe. In distributing material at the work site do not interfere with access to private property, parking, or traffic. It is recommended that only as much pipe as is expected to be laid during the day be strung out along the ditch.
- PVC Material: Do not store PVC materials in direct sunlight for prolonged periods. The Engineer may reject PVC material that have scratches, cuts or evidence of excessive exposure to direct sunlight, all of which can reduce the strength and longevity of the materials. The Contractor is urged to take precautions to avoid abrading or cutting the pipe.
- Defective or Damaged Material: All such material shall be rejected and removed from the job site immediately.
- 1.6 **PROJECT CONDITIONS:**
- A. Weather: See cold weather Addendum at the end of this section for all work between November 1 and May 1.

**PART 2: PRODUCTS**

## 2.1 MATERIALS:

- A. POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS:
  - 1. 4-inch to 15-inch inside diameter: ASTM D 3034, SDR35
  - 2. 18-inch to 27-inch inside diameter: ASTM F 679, Wall thickness T-1
  - 3. Joints: ASTM D 3212, rubber gasketed bell and spigot type with integral bell.
- B. DUCTILE IRON PIPE (DIP):
  - 1. Pipe: ANSI A21.51
  - 2. Cement lining: ANSI A21.4
  - 3. Push-on or Mechanical Joints: ANSI A21.11
  - 4. Wall Thickness: Class 50 minimum
- C. SADDLES: for 4-inch or 6-inch diameter service line connections to existing lines shall be of the gasketed wye-type with stainless steel bands and specifically made for the size and type main being connected to. A submittal is required. Solvent weld type saddles are not acceptable.
- D. CLEANOUTS:
  - 1. Pipe and Fittings: Shall be the same as the wastewater line.
  - 2. Cover: Neenah #R-1970 or approved equal
- E. ENCASEMENTS:
  - 1. CONCRETE: 3,000 psi compressive strength minimum, Type II, Portland Cement 6 sack per cubic yard mix.
  - 2. REINFORCING STEEL: Grade 40, ASTM A 615
- F. COUPLINGS: for connecting two plain ends of equal or different material pipe, either a Romac style “LSS1” or “SS1” sewer clamp coupling or a gasketed PVC double bell repair coupling shall be used
- G. WASTEWATER MARKER POSTS: Carsonite utility marker with sewer decal 107-CS model CUM-375 CRM 3072-07 (72 inch length) by Carsonite International, Early Branch, South Carolina.
- H. STUB MARKERS: New metal posts extending down to the stub and up to within 1 foot of the designated grade.

## PART 3: EXECUTION

### 3.1 PIPE INSTALLATION

- A. GENERAL: Pipe placement shall conform to manufacturer’s recommendations. Materials shall not be dropped into the trench but shall be lowered by either hand or machine. Pipe laying shall proceed upgrade with the spigot ends of bell-and-spigot pipe pointing in the direction of flow.

The entire surface of all pipe shall be clean when laid. Interior surfaces of pipe sockets shall be cleaned when the pipe is laid and the joints completed. No debris, tools, clothing or other material shall be placed in the pipe. When pipe laying operations are not being conducted or are temporarily suspended, all pipe openings are to be plugged with an appropriate size wastewater plug. Pipes not making a good fit shall be removed from the job site

Field cut sections of pipe shall only be used for making connections to manholes, other structures or existing pipelines when make up piping is needed to make the closure.

Each pipe shall be laid true to line and grade to form a tight concentric joint with the adjoining pipe and to prevent sudden offsets to the flow line. Pipe grade shall be uniform between manholes. No

pipes are to be placed in the trench or final joints made, until unstable trench bottoms have been stabilized and fine grading of the trench bottom to accommodate the pipe invert has been completed. Immediate partial backfill may be required to prevent accidental deflection of the pipe.

State Health regulations require that wastewater mains be installed at a 10-foot minimum clear horizontal distance from potable water mains. If this separation cannot be maintained consult with the Engineer for any special precautions that may be required.

When authorized to connect new pipe to an existing plain end pipe use an approved transition coupling tightened to a watertight fit. No Fernco or Caulder couplings are allowed.

- B. PLAIN OR REINFORCED CONCRETE ENCASEMENTS: shall be constructed as shown on the Drawings or described in the Specifications.

Install temporary supports consisting of concrete blocks or bricks to support the pipe in place where long encasements are required. Not more than two supports shall be used for each pipe length, one adjacent to the shoulder of the bell and the other near the spigot end.

No encasements shall be poured until the Engineer has inspected the pipe to be encased, reinforcement and supports. The encasement shall cure a minimum of 24 hours at no less than 40 degrees Fahrenheit prior to backfilling.

- 3.2 SERVICE LINE INSTALLATION AND CONNECTIONS: Service connections to new mains shall be made with full-bodied wyes meeting the same specifications as the wastewater main. Service connections to existing mains shall be made with saddles. The main shall be cut in a workman like manner using proper tools and a template for the saddle. The manufacturer's recommendations shall be followed and recommended sealant used to assure a watertight connection. All taps to existing mains shall be performed by Mount Werner Water.

Service connections from PVC SDR35 service lines to PVC schedule 40 pipe coming out of the building is to be made with a rubber gasketed bell/spigot or bell/bell type coupler.

Provide all bends required for proper vertical or horizontal alignment.

The minimum slope for a sewer service line shall be 2% (1/4" fall per foot).

Depth of Service Lines: All services shall be installed to a minimum depth of 3-feet as measured from the top of the pipe to finished grade.

Service connections to mains shall be bedded in imported bedding material as necessary to support all fittings.

Do not backfill a service until the Engineer has visually observed the service and authorized it to be backfilled. The service shall be checked for grade, water tightness, cleanout installation and adequate cover.

All services to undeveloped property or to vacant lots shall be water tight, have the end capped and extended a minimum of 6-feet into the property.

Wastewater Marker Posts shall be installed at the end of all unconnected services. The Carsonite posts shall be buried 2-1/2 feet and extend above grade 3-1/2 feet.

Metal Stub Markers shall also be installed at the end of all unconnected services. The markers shall extend from finished grade to the stub in open areas, and shall extend from subgrade to the stub in roadways.

No live service lines shall be connected to new mains or new service lines until the latter have been tested unless otherwise approved by the Engineer. No service lines from a building to a wastewater stub shall be installed until the main line has gained preliminary acceptance from Mount Werner Water.

- 3.3 **CLEANOUT INSTALLATION:** Cleanout structures shall be located and constructed as shown in the Drawings, or as directed by the Engineer. The cleanout shall have a true and smooth interior to allow easy access for inspection lights, plugs, and cleaning equipment.

Cleanouts shall be installed at intervals not to exceed one hundred (100) feet in straight runs and for each aggregate horizontal change in direction exceeding one hundred thirty-five (135) degrees. Sizing locations and installation shall be in accordance with the Uniform Plumbing Code (UPC).

Final grade of the cleanout cover shall be as specified for manhole lids.

3.4 **FIELD QUALITY CONTROL**

- A. **GENERAL:** Test pipe line promptly after installation through completion of backfill. No more than 800-feet shall be installed without testing the completed portions.

- B. **LAMPING:** Alignment, grade and pipe condition will be checked by the Engineer. A light will be flashed between manholes by means of reflecting sunlight with a mirror. Proper alignment shall consist of a “full moon” clearly visible at the opposite end of the line from the observer’s location.

1. No more than 48 hours prior to the lamping test, the Contractor shall put water in the upper section of the line and let it flow out through the new lines and manholes. During the lamping tests, the Engineer shall check for standing water indicating sags or settled sections of pipe or manholes. The maximum amount of standing water allowed in any pipe or manhole shall be 3 percent of the pipe’s diameter or 1/2 inch whichever is smaller.
2. The Contractor shall correct any deficiencies noted such as poor alignment, displaced pipe, debris in the pipe, or any other defects. Tests will be repeated after completion of repair and backfill.

- C. **LEAKAGE:** After lamping tests are completed, testing for watertightness shall be completed by the Contractor in the presence of the Engineer.

1. **AIR TEST:** The Contractor must test wastewater mains by means of an air test. The Contractor’s testing procedure and equipment shall be approved by the Engineer prior to proceeding. All lines shall be pressurized in the Engineer’s presence and all pressurized lines shall have the pressure released in the Engineer’s presence. Gauges used to monitor the air test and fill and drain lines shall be located above grade not in the manhole.

The length of time for a 0.5 psig pressure drop from 3.5 psig to 3.0 psig shall not be less than the following table:

Length of Time (minutes : seconds)

Pipe Diameter (inches)	100'	150'	200'	250'	300'	350'	400'	450'
4	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16
24	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17
27	14:25	21:38	28:51	36:04	43:16	50:30	57:42	66:54

The Contractor shall locate and repair the defective joints or pipe in every section of line which fails the air test. The Contractor shall retest the line until the line passes the test.

- D. DEFLECTION: The maximum allowable pipe deflection is 5 percent of the pipe diameter. Deflection testing may be required if the Engineer suspects excessive pipe deflection or if the Contractor's pipe bedding procedures, in particular, tamping and compaction of the bedding, are questionable in the opinion of the Engineer.

The deflection test will be performed by the Contractor in the presence of the Engineer. The test shall be conducted by pulling a 5 percent deflection mandrel through the pipe. If the mandrel does not pass a point between manholes A and B when being pulled from A to B, the mandrel will be pulled from B to A.

The Contractor shall provide all personnel and equipment to include deflection mandrels and a water truck if necessary.

If areas of greater than 5 percent deflection are encountered, the Engineer may require that the deflection test be repeated with a 7 percent deflection mandrill or require excavation of the line in the area of excessive deflection to determine the cause. All areas of excess deflection shall be corrected by the Contractor at his expense.

#### E. VIDEO INSPECTION

1. Video inspection of all mains will be performed by a qualified contractor.
2. No more than 48 hours prior to the video inspection, the contractor shall clean and flush all new sewer mains and manholes.
3. The video inspection must be performed with a color video camera which is track driven and sits on the bottom of the pipe for proper orientation and shall have an articulating camera to allow for inspection of service taps.
4. The video must be with encoded distance totalizer, from and to manhole numbers, pipe material, size and inspection date.
5. The video log shall include:
  - i. Date of inspection
  - ii. Operator
  - iii. Project name
  - iv. Pipe material
  - v. Pipe length (edge of manhole to edge of manhole)
  - vi. Pipe diameter
  - vii. Joint spacing
  - viii. Year installed



- ix. From and to manhole numbers
- x. Manhole depth
- xi. Direction of inspection (upstream or downstream)
- xii. Location, direction (east, west, north, south) and orientation (10 o'clock, 2 o'clock) of service taps
- xiii. Observed defects
- xiv. A scalable map of the project limits bound into the video log. The map shall include the location of all manholes and sewer mains within the project limits. All manholes shall be numbered per Mount Werner Water numbering system.

## ***Cold Weather Specifications***

**(November 2006, updated March 19, 2008)**

### **Addendum #1 to Mount Werner Water Specifications for Cold Weather Water and Sewer Pipeline Construction**

Cold Weather Precautions and Specifications shall take effect when any of the following temperature conditions occur, or between November 1 and May 1, whichever occurs first:

1. When the 10:00 AM temperature is below 30-degrees Fahrenheit for 3 consecutive days, pipe installation shall not be permitted without an approved Mitigation Plan.
2. No pipe installation shall be allowed, regardless of mitigation efforts, when the temperature drops below 20-degrees Fahrenheit or when conditions are outside the manufacturer's installation specifications or recommendations, whichever is more restrictive.
3. Pipe installation operations may resume after 3 consecutive days when the 10:00 AM temperature is above 30-degrees Fahrenheit.

#### **Mitigation:**

Any requests to install water and sewer pipelines under these Cold Weather Specifications shall be subject to mitigation efforts and shall be made in writing to The Mount Werner Water and Sanitation District. The following are some guidelines for mitigation:

1. Experience has indicated that worker morale and quality of pipeline installation is related to jobsite conditions. Temporary heated facilities shall be provided to mitigate cold and wet weather working conditions.
2. PVC pipe and fittings shall be protected from the elements and installed in accordance with the Uni-Bell Plastic Pipe Association "Handbook of PVC Pipe Design and Construction". For quality control purposes, temporary enclosed facilities will be necessary to store all PVC pipe and pipe parts to ensure protection of materials from the elements in order to meet manufacturer's installation specifications.

3. All PVC pipe shall be un-banded and stored in a heated environment at a minimum temperature of 50-degrees Fahrenheit for a minimum of 24 hours prior to installation to allow all pipe materials to return to original manufactured memory.
4. All ductile iron pipe gaskets shall be stored in a heated environment not less than 50-degrees Fahrenheit. Gaskets shall be installed after the pipe has been set in place and just prior to homing the next pipe.
5. The Contractor's Cold Weather Mitigation Plan will require full time engineering observation by a professional engineer registered in the State of Colorado or a properly trained engineering technician with adequate experience under the direct supervision of a professional engineer. All pipe components and bedding shall be inspected prior to backfill.
6. Allowance for Thermal Expansion and Contraction: Per the Uni-Bell Plastic Pipe Association "Handbook of PVC Pipe Design and Construction" states, "As a general rule for every temperature change of 10-degrees Fahrenheit, PVC pipe will expand or contract 1/3" (0.023') per 100-ft. The Contractor's Mitigation Plan shall reflect a pipe stabbing plan that incorporates this variable for pipe installation and stabbing operations.
7. All excavated backfill materials shall be protected from the elements to ensure adequate materials and placement specifications are met. Frozen backfill and bedding materials are non-conforming and shall not be used.
8. Trench excavation shall be limited to only the amount of material that can be backfilled within any one day with a maximum of 60-feet of open trench at any given time. Prior to leaving the site for the day, all pipe trenches shall be fully backfilled to existing grades and compacted to specifications. No open trenches shall be allowed overnight. Backfill operations shall be coordinated with the soils engineer, in order for proper inspections to be made.
9. An additional 2 years of Warranty shall be provided over and above the standard one-year warranty period specified in other sections. Bonding shall be implemented through the City of Steamboat Springs Planning process to secure installation quality in the amount of 15% of the construction costs for the entire warranty period.
10. Prior to Preliminary Acceptance and in addition to all other warranties the Contractor installing the facilities shall provide to the District a written 3-year, materials, labor and equipment warranty on his letterhead. The warranty period shall commence upon the dated letter of Preliminary Acceptance by Mount Werner Water.

11. Trench dewatering operations shall be controlled and set up to prevent problems to downstream storm water facilities or any hazard to the motoring public or to any other properties. Under no circumstances shall groundwater be allowed to enter the pipe.

12. Standard bedding and shading specifications shall be increased from 4” below the pipe and 6” above the pipe, to 8” below the pipe and 12” above the pipe.

13. On-site air temperature readings shall be obtained and documented by the Engineer. This information shall be recorded in the engineer’s daily reporting system.

**END OF SECTION**

## **SECTION 026200**

### **WATER AND WASTEWATER LINE CROSSING**

#### **PART 1: GENERAL**

- 1.0 **RELATED DOCUMENTS:** The General Contract Conditions, Drawings and other Division-1 Specification sections apply to Work of this Section. Work shall conform to Mount Werner Water Standard Specifications, April 2009, or latest edition thereof.
- 1.1 **DESCRIPTION:** Work included: This specification shall define the precautions required to protect water systems when water and wastewater mains intersect.
- 1.2 **RELATED SECTIONS:**
  - A. Excavating, Backfilling and Compacting – Section 022210
  - B. Water Distribution Piping and Appurtenances– Section 026100
  - C. Wastewater System Piping and Appurtenances - Section 026150
- 1.3 **QUALITY ASSURANCE:** Water and wastewater main crossings shall be done in accordance with the current Colorado Department of Public Health and Environment requirements and these specifications. In the event of a conflict, the more stringent requirements, as determined by the engineer, shall govern.

#### **PART 2: PRODUCTS**

- 2.1 **MATERIALS:** Materials shall be as specified for waterline and/or wastewater line construction. See Section 026150 as appropriate.

#### **PART 3: EXECUTION**

- 3.1 **CROSSING CONDITIONS:** Six different crossing conditions have been identified for separate consideration.
- 3.2 **CROSSING REQUIREMENTS**

##### **CONDITION #1:**

When a new water main crosses less than 18-inches above a new wastewater main the following shall be done.

- 1. A joint of pipe from each main shall be centered on the other main.
- 2. Caution: The Contractor must plan the installation of the first utility installed so that the second utility installed will cross at the center of a full length of pipe of the first utility.
- 3. Backfill between the two pipes shall be heavily compacted imported or native material or lean concrete.

##### **CONDITION #2:**

When a new water main crosses below a new wastewater main the same precaution as identified for condition #1 shall be followed, except that backfill between the two pipes shall be with lean concrete.

CONDITION #3:

When a new water main crosses less than 18-inches above an existing wastewater main the following shall be done:

1. Avoid exposing existing wastewater main if possible. If joints are exposed, or the wastewater main is damaged, the section of wastewater main shall be lean concrete encased for the full width of the water main trench.
2. A full joint of the water main shall be centered over the wastewater main.
3. Backfill between the two pipes shall be heavily compacted imported or native material or lean concrete.

CONDITION #4:

When a new water main crosses below an existing wastewater main the following shall be done.

1. The wastewater mains shall be excavated to 10-feet on either side of the point at which the water line crosses and lean concrete encased. This work shall be done prior to water main installation and an adequate time in advance to permit the concrete encasement reach adequate strength (48 hours minimum) before the water main is installed below the wastewater main.
2. A full joint of the water main shall be centered under the wastewater main.
3. Backfill between the water main and the concrete encasement shall be with compacted native materials.

CONDITION #5:

When a new wastewater main crosses less than 18 inches below an existing water main the following shall be done:

1. All exposed water main joints shall be lean concrete encased for a distance of 1-foot each side of the joint.
2. A full joint of wastewater main shall be centered on the water main.
3. Backfill between the two pipes shall be heavily compacted imported or native material or lean concrete.

CONDITION #6:

When a new wastewater main crosses above an existing water main the following shall be done:

1. Avoid exposing the water main if possible. If joints are exposed or the water main is damaged, the section of main shall be lean concrete encased for the full width of the wastewater main trench.
2. A full joint of wastewater main shall be centered on the water main and the joints of the wastewater main encased in concrete for one foot each side of the joint.
3. Backfill between the two pipes shall be lean concrete.

3.3 LOCATIONS OF MAINS AND SERVICES: The Owner of the distribution or collection system will attempt to provide, upon the Contractor's request, as accurate information regarding utility locations as is available. The Contractor will ultimately be responsible for line locations and protection.

3.4 DAMAGE AND REPAIR OF EXISTING MAINS AND SERVICES: When excavating in the area of existing water and wastewater mains, the Contractor shall notify the system Owner and request accurate field locations. When excavating for crossings of existing mains, the Contractor shall use extreme caution to avoid damaging them. If the Contractor accidentally damages existing mains he shall exercise the following repair procedures in addition to the standard crossing requirements specified in Section 3.2.

- A. **DAMAGE TO EXISTING WASTEWATER MAIN OR SERVICE:** Existing wastewater mains or services shall be repaired by replacement of the damaged section of pipe with a new pipe of identical material or a new section of PVC wastewater pipe. The length of the repair pipe shall be as necessary to accomplish the repair. Joints between the repair pipe and the existing pipe shall be made with either a Romac style “LSS1” or “SS1” sewer clamp coupling or a gasketed PVC double bell repair coupling. As a minimum, all such joints shall be encased in concrete a distance of 1 foot either side of the joint. Additional concrete encasement may be required depending on the crossing condition as specified in Section 3.2.
  - B. **DAMAGE TO EXISTING WATER MAIN OR SERVICE:** Existing water mains or services shall be repaired by installing a new section of pipe in the damaged area or by use of repair couplings. New pipe for repair shall be of similar material to the existing pipe or class 52 D.I.P. for mains. Repair couplings shall be suitable for the type of pipe with which they are to be used. Both the type of pipe and the type of repair couplings shall be approved by the Engineer and the operator of the water system prior to their use.
- 3.5 **TEST HOLES:** Test holes may be required for crossing conditions 3, 4 5, and 6 for the purpose of determining the exact elevation f the existing utility. Thus requirement will be noted on the Drawings at the point of intersection of the mains.

**END OF SECTION**

## SECTION 026210

### WATER AND SEWER LINE TRENCHING, BEDDING AND BACKFILL

#### PART 1 GENERAL

##### 1.01 DESCRIPTION

Work included: Excavation, dewatering, preparation of the trench bottom; installation of foundation, bedding, and shading material; backfill, and disposal of waste material for the installation of Mt. Werner Water District water and sewer pipelines and their related appurtenances.

##### 1.02 QUALITY ASSURANCE

- A. Reference: Standard Specifications for Road and Bridge Construction, State Department of Highways, Division of Highways, State of Colorado herein called Standard Specifications. Mount Werner Water Standard Specifications for Water and Wastewater Utilities, April 2009 or latest edition.
- B. The Contractor shall conduct compacting tests as necessary to monitor the installation procedure and assure the quality of the work.
- C. Periodic compacting tests may also be performed by the Owner's Representative. The Contractor shall assist the Owner's Representative as necessary to complete the testing and shall provide a safe trench for the Owner's Representative

##### 1.03 DEFINITIONS

- A. Earth excavation: shall include all soils and loose, broken and laminated ledgerock or stones and boulders which can be reasonably ripped, broken, and removed with skillfully operated, suitably powered excavating equipment in good operating condition having a bucket capacity of 3/4 cubic yard.
- B. Rock excavation: shall include all solid rock masses which cannot be excavated as specified under "Earth Excavation" and isolated boulders exceeding 1 cubic yard in size.
- C. Unsuitable material: shall include all materials that contain roots, debris, organic, frozen, unstable or unshapable materials or stones having a maximum dimension of 12-inches or greater and that are determined by the Owner's Representative as unsuitable for providing a proper foundation or backfill.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS

- A. Foundation Materials:
  - 1. Imported:
    - a. 3/4 inch minus. Class 6 Aggregate Base Course, Section 703 of the Standard Specifications (Dry conditions only).
    - b. 3/4 inch washed. Number 67 Coarse Aggregate for Concrete, Section 703 of the Standard Specifications.

B. Bedding And Shading Materials:

1. Use of Native Bedding and Shading materials is not allowed.
2. Dams of impervious material to be approved by the Owner's Representative, are to be placed every 50' of pipe laid to a height of 2' above the top of pipe and spanning the width of the trench, to prevent the flow of ground water along the pipe. Ground water drains can only be used in sewer main trenches and are not allowed in water main trenches.
3. Imported
  - a. 3/4 inch minus: Class 6 Aggregate Base Course per Section 703 of the Standard Specifications (Dry conditions only).
  - b. 3/4 inch washed: Number 6 or Number 67 Coarse Aggregate for Concrete per Section 703 of the Standard Specifications.
  - c. 3/8 inch screened rock or Squeegee Sand, with 100% of the material passing a 3/8 inch screen and 0-3% passing a No. 200 screen.

B. Backfill Materials:

1. Native Material: Shall include all material not classified as unsuitable and material that meets the compaction and density requirements.
2. Imported Pit Run: Class 3 Aggregate Base Course per Section 703 of the Standard Specifications with the following modifications. Material to be 6 inch minus reasonably well graded pit or back run material.

PART 3: EXECUTION

3.01 TRENCH EXCAVATION

- A. General: Limit operations to as small an area as possible in order to minimize damage to adjacent property. If necessary clear and grub the area to be excavated. In areas where topsoil exists remove and salvage the topsoil for replacement. Keep topsoil segregated from other excavation materials.

The maximum amount of trench left open at one time shall be limited to 100-feet or such length as the Owner's Representative considers reasonable and necessary. No trench shall be left open over night unless specified otherwise or directed by the Owner's Representative.

A guide for desirable trench width at the top of the pipe shall be the nominal diameter of the pipe plus 12-inches on each side of the pipe.

All utility lines and water courses met shall be maintained and provided for by the Contractor without damage, or nuisance to other parties. Shoring, bracing, sheeting, other trench support methods, and trench boxes shall be used when necessary to protect the work, property and persons. The need, appropriateness and adequacy of all such devices shall be the responsibility of the Contractor.



- B. Alignment and Grade: The trench shall be excavated so that the pipe can be installed to the alignment and grade indicated on the drawings or specified. Under certain field conditions, the Owner's Representative may authorize a water main to be installed with less than or more than the specified minimum cover. Authorization must be granted prior to installation. All such authorizations will be provided in writing.

It is the Contractor's responsibility to plan far enough in advance of pipelaying operations to allow grade adjustments to be implemented to provide proper clearances when crossing existing utilities.

In subdivision work, or other work requiring changes to existing grade along the centerline of a proposed pipeline, the changes shall be made to subgrade elevation prior to installation of the line.

- C. Dewatering: The Contractor shall provide all necessary dewatering equipment and procedures necessary for excluding and removing water from trenches, and other parts of the work.

The Trench shall be maintained dry so that the work may be completed efficiently, and pipes can be laid, joined, bedded, inspected and backfilled in dewatered conditions. The pipe shall not be used to dewater the trench. No water shall be allowed to flow over or rise upon fresh concrete or mortar, and no water shall be allowed to enter the pipe.

The water shall be disposed of by the Contractor in accordance with the Contract Documents and applicable laws and regulations. The Contractor is responsible for obtaining all necessary dewatering or discharge permits and complying with their requirements.

### 3.02 FOUNDATION

- A. General: Verify that a sound stable trench bottom free from soft, loose, rocky, excessively hard or other unsuitable native material exists before proceeding
- B. Required Foundation: Install imported foundation material at all locations specifically required by the Drawings or Specification.
- C. Unsuitable Foundation: Where unsuitable foundation is encountered over excavate the trench bottom to the depth authorized by the Owner's Representative and bring the foundation to grade with the appropriate imported foundation material authorized by the Owner's Representative and compacted in lifts to 90 percent of maximum dry density.

### 3.03 BEDDING AND SHADING

- A. General: Holes for pipe bells shall be provided at each joint. Bell holes shall be no larger than necessary for joint assembly and assurance that the pipe barrel will lie flat on the trench bottom. Generally, 2-inches of clearance beneath the joint is desired. Push-on type joints require minimum depressions for bell holes. In no case shall the bell support the weight of the pipe at the time of shading and backfill. Under no circumstances shall the pipe be permanently joined in the trench until the trench bottom has been fine graded to provide uniform pipe support at the required invert elevation.
- B. Required Embedment: Imported bedding and shading materials are required for all main-line pipes and appurtenances.
- C. Procedures and Bedding and Shading: The following procedure shall be used for all types of pipe. Special care is required in the embedment Zone to assure proper filling and compaction of materials beneath pipe haunches and to avoid displacing or damaging the pipe. Bedding and shading materials shall be placed in a minimum of two lifts. The thickness of the first lift shall not exceed the pipe spring line. Following placement of the first lift a "tee bar" shall be used to

compact loose material under the pipe haunches. The use of the end of a shovel handle to compact under pipe haunches is not considered an acceptable alternative to a “tee bar”. Mechanical compaction may be required at the first lift as well as succeeding lifts for pipe diameters larger than 12-inches or where dictated by trench width.

Depending on the diameter of the pipe being installed, installation of shading materials may require a single lift or multiple lifts. Lift thickness from the spring line or top of bedding to the top of shading shall not exceed 18-inches.

Shading Zone materials shall be placed by hand shoveling, or by careful placement with a Backhoe. Dumping or shoving excavated materials over the trench sidewall, and “chipping” of soil from the top of the trench are not considered acceptable means of shading the pipe. Embedment Zone materials shall be compacted to 92 percent of maximum dry density. The method of compaction used by the Contractor to obtain the required density is subject to the Owner’s Representative’s review. If the specified compaction is not being obtained, the Contractor will be required to modify his compaction procedures to meet specified requirements. This may require the use of other types of compaction equipment or a reduction in size of lifts being compacted.

Any damages to the pipe that occurs from improper compaction procedures or the use of mechanical compaction too close to the pipe shall immediately be repaired by the Contractor. If compaction equipment which is narrower than full trench width is used, the equipment shall be operated first on each side of the pipe between the edge of the pipe and the trench walls and then centered over the pipe.

Horizontal placement of bedding and shading shall extend the full trench width to undisturbed trench width to undisturbed trench wall material.

### 3.04 TRENCH BACKFILL

- A. General: Backfill materials shall be placed in lifts and compacted to 95 percent. Road crossings shall in general, be backfilled with imported material.

Salvaged topsoil shall be replaced to its approximate original depth in all open areas and areas to be re-vegetated.

- B. For Manholes Located in Gravel or Paved Areas: Backfill materials shall be compacted to 95 percent in lifts recommended not to exceed 6-inches.

- C. Deviations of material moisture content:

1. Excessive moisture content: The Contractor shall attempt to dry wet backfill material to a moisture content suitable for backfilling. If wet native backfill cannot be compacted to the specified requirements after reasonable drying effort by the Contractor, the Engineer may waive the compaction requirement, or may authorize the Contractor to use imported backfill material. Where only the upper portion of the trench section is backfilled with imported material the Contractor shall install geotextiles as authorized by the Engineer to separate the imported and native materials.

2. Insufficient moisture content: Where compaction requirements cannot be met because of insufficient moisture content, the Contractor will be required to add moisture to the material as required for proper compaction.

- D. Flooding and Jetting of Trenches: Flooding or jetting of trenches shall not be permitted.

### 3.05 FIELD QUALITY CONTROL

- A. Compaction: The degree of bedding or backfill compaction specified shall be 95 percent of maximum dry density as determined by ASTM D 1557, Modified Proctor. The moisture content of bedding or backfill materials shall be within  $\pm 2.0$  percent of optimum moisture as determined by ASTM D 1557.

Compaction testing shall include moisture density relations, and density in place. If compaction testing, or other visual observations, indicate the possibility of inadequate compaction at a lower depth, the Owner's Representative may require the Contractor or re-excavate a lower depth to conduct additional testing.

When requested by the Owner's Representative, the Contractor shall proof roll the trench with a loaded front end loader or truck of sufficient size to determine if soft spots exist.

If the tests indicate inadequate compaction, the Contractor shall re-compact the material. In cases where there is repeated failure to achieve the required state of compaction, the Owner's Representative may require that the backfill be removed and re-compacted in 6-inch lifts or replaced with imported material at the Contractor's expense.

Testing frequency shall be as required to assure the completed work meets specifications but shall be no less than the following:

1. In the City of Steamboat Springs Right-of-Way – use the City of Steamboat Springs testing frequency specifications.
2. Out of the City of Steamboat Springs Right-of-Way - An average of one test for every other lift per type of material placed per 250 linear foot of trench. Additional testing is recommended near manholes, valve boxes and key fill areas.

- B. Testing Quality of Materials: All material proposed to be imported from off site shall be sampled and tested by the Contractor. Sampling procedures shall result in samples that are representative of the actual materials delivered to the project site.

1. Class 6 Aggregate Base Course shall be tested for conformance with section 703.03 of the Standard Specifications.
2. Washed rock shall be tested for gradation.
3. Imported Pit Run shall be tested for AASHTO soil classification plasticity index, liquid limit and gradation.

- C. Trench Settlement:

1. General: Variations in soil type and moisture conditions along with inconsistencies in compactive effort may cause settlement to occur in portions of the backfill. The specified compaction requirements shall be considered a minimum. Spot testing for in place density by the Owner's Representative during construction shall not relieve the contractor of the responsibility to assure that the trench backfill does not settle beyond the limits established below. The Contractor shall be responsible for repair of areas of excessive settlement.
2. Measurement: Measurement of settlement shall generally take place in July or August, one winter season following completion of trench backfill.

3. Limits: The following limits to trench backfill settlement shall apply.
  - a. Asphaltic Concrete Paved Areas: Settlement greater than 1/2 inch but less than 1-1/2 inches shall be repaired by removing the asphalt to a minimum of 2 feet on either side of the settled area and replacing it with a new, thicker section of asphalt to produce a final level surface. Settlement greater than 1-1/2 inches shall be repaired by removing the asphalt and recompact or replacing the trench backfill and gravels then applying a new asphalt surface.
  - b. Gravel Surfaces: The Contractor shall add additional compacted gravel to trenches where settlements are less than 1-1/2 inches. In cases where the settlement is greater than 1-1/2 inches the Contractor shall be required to replace and recompact backfill material as necessary.
4. Warranty: When settlement of trenches necessitates repair, the warranty period for the trench repairs shall be extended one year beyond the time of the repairs.

**END OF SECTION**

## SECTION 026220

### PLASTIC PIPE

#### PART 1 - GENERAL

##### 1.01 WORK INCLUDED

- A. Furnishing and installation of polyvinyl chloride (PVC) and fittings in association with storm sewers, roof drain laterals, fountain drain laterals, planter box drain laterals, and landscape underdrains.

##### 1.02 WORK EXCLUDED

- A. Pipe associated with the sanitary sewer system and water distribution and snowmelt systems are not included in this Specification. Materials associated with water and sanitary sewer systems shall be governed by the latest version of the Mt. Werner Water and Sanitation District's Standard Specifications.

##### 1.03 RELATED WORK

- A. Section 02221; Excavating, Backfilling, And Compacting
- B. Section 02601; Manholes
- C. Section 02720; Catch Basin Inlets

#### PART 2 - PRODUCTS

##### 2.01 PVC PIPE

- A. Roof, Fountain, and Planter Box Drainage Pipe and Fittings
  - 1. PVC drainage pipe and fittings shall conform to the requirements of ASTM D3034 and shall have a minimum pipe stiffness of 46 psi and be SDR = 35. Pipe shall be of push-on-joint assembly manufactured with bell and spigot joints integral with the pipe wall and shall be furnished with a factory-assembled, solid cross-section rubber ring gasket firmly secured in place. The pipe shall be produced by a continuous extrusion process employing a prime grade of white unplasticized PVC, and shall be as uniform as commercially practical in color, opacity, density and other physical properties. The pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects.
  - 2. Fittings shall be manufactured with integral bell and spigot ends in the same manner as the pipe, and shall be furnished with factory-assembled gaskets that eliminate the need for ring insertions in the field and solvent-welded connections.
- B. Storm Sewer Pipe and Fittings
  - 1. PVC storm sewer pipe and fittings in sizes 4-inch through 15-inch shall conform to the requirements of ASTM D3034 and shall have a minimum pipe stiffness of 46 psi and be SDR = 35. PVC storm sewer pipe in 18-inch and 24-inch sizes shall conform to the requirements of ASTM F679 and have a minimum pipe stiffness of

46 psi. Storm sewer pipe and fittings shall otherwise conform to the Specifications set forth above for Roof, Fountain, and Planter Box Drainage Pipe and Fittings.

2. Connections of drainage laterals into storm sewer mains shall be made using rubber gasketed wye saddles or fittings oriented to allow the lateral to introduce flows into the main from above the crown of the main line in the generally downstream direction.

C.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Preparation of Pipe Prior to Installation: Inspect all pipe and fittings before lowering into the prepared trench to ensure that no cracked, broken, or defective pipe or fittings are being used in the work. Remove foreign matter and soil from the inside of the pipe.
- B. Handling: Provide and use proper methods, tools, and facilities for the safe and proper protection of the work. Protect pipe from sunlight during storage. Lower all pipe into the trench in such a manner as to avoid any physical damage to the pipe. Stretch in excess of 2 feet per 100 feet of the preinstalled length will not be permitted. Reject all damaged pipe and remove from the jobsite.
- C. Lines and Grades: Pipe shall be laid to the lines, grades, and elevations shown on the Plans. Storm sewer and lateral drain line pipe shall be sloped uniformly in accordance with the Plans to allow for continuous gravity drainage.
- D. Installation of Pipe and Fittings: Pipe and fittings shall be installed in accordance with the manufacturer's instructions. Owner's Representative's approval of the pipe installation shall be required prior to backfilling the pipe zone.

**END OF SECTION**

## **SECTION 033000**

### **CAST-IN-PLACE CONCRETE**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### **1.2 SUMMARY**

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
- B. Related Requirements:
  - 1. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.

##### **1.3 DEFINITIONS**

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

##### **1.4 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, forms and form removal limitations, anchor rod and anchorage device installation tolerances, steel reinforcement installation, concrete repair procedures, and concrete protection.

##### **1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
  1. Location of construction joints is subject to approval of the Architect.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Material Certificates: For each of the following, signed by manufacturers:
  1. Cementitious materials.
  2. Admixtures.
  3. Form materials and form-release agents.
  4. Steel reinforcement and accessories.
  5. Fiber reinforcement.
  6. Curing compounds.
  7. Floor and slab treatments.
  8. Bonding agents.
  9. Adhesives.
  10. Joint-filler strips.
  11. Repair materials.
- C. Material Test Reports: For the following, from a qualified testing agency:
  1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- D. Field quality-control reports.
- E. Minutes of preinstallation conference.

#### 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M.



1.8 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

1.9 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  - 1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
  - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and as follows:
  - 1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
  - 1. ACI 301.
  - 2. ACI 117.

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
  - 1. Plywood, metal, or other approved panel materials.
  - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
    - a. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- E. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- F. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
  - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- G. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  - 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.

## 2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed bars, ASTM A 775/A 775M, epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.

## 2.4 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 775M.
- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
  - 1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

## 2.5 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cementitious Materials:
  1. Portland Cement: ASTM C 150/C 150M, Type I/II, gray.
  2. Fly Ash: ASTM C 618, Class F.
  3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
- C. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
  1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
  2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C 260/C 260M.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- F. Water: ASTM C 94/C 94M.

## 2.6 FIBER REINFORCEMENT

- A. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1 to 2-1/4 inches long.

## 2.7 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

## 2.8 CONCRETE COLOR

- A. Integrally Colored Concrete: Integral color of all exposed concrete bands shall be 'Adobe', as manufactured by Davis Colors, 800.800.6856 or approved equal.

## 2.9 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
  - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- D. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

## 2.10 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
  - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
  - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
  - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

2.11 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
  - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
  - 1. Fly Ash: 25 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
  - 1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
  - 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.
- E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions.

2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Normal-weight concrete:
  - 1. Minimum Compressive Strength: 5000 psi at 28 days.
  - 2. Maximum W/C Ratio: 0.40.
  - 3. Minimum Cementitious Materials Content: 540 lb./cu. yd.
  - 4. Slump Limit: 4 inches, plus or minus 1 inch.
  - 5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
  - 6. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 7.5 lb./cu. yd.

2.13 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.14 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
  - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
  - 1. Class A, 1/8 for smooth-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
  - 1. Install keyways, reglets, recesses, and the like, for easy removal.
  - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### 3.2 EMBEDDED ITEM INSTALLATION

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
  - 2. Install dovetail anchor slots in concrete structures as indicated.

### 3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete must be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
  - 1. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

### 3.4 SHORING AND RESHORING INSTALLATION

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
  - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

### 3.5 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
  - 1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

### 3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
  - 2. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  - 3. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
  - 4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  - 5. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
  - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.



- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

### 3.7 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
  - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
  - 1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
  - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
  - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
  - 1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  - 2. Maintain reinforcement in position on chairs during concrete placement.
  - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
  - 4. Slope surfaces uniformly to drains where required.
  - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

### 3.8 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  - 1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

### 3.9 MISCELLANEOUS CONCRETE ITEM INSTALLATION

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
  - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
  - 2. Construct concrete bases 4 inches high unless otherwise indicated, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
  - 3. Minimum Compressive Strength: 5000 psi at 28 days.
  - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
  - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
  - 6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

### 3.10 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
  - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
    - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.
  - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

### 3.11 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
  - 1. Steel reinforcement placement.
  - 2. Steel reinforcement welding.
  - 3. Headed bolts and studs.
  - 4. Verification of use of required design mixture.
  - 5. Concrete placement, including conveying and depositing.
  - 6. Curing procedures and maintenance of curing temperature.
  - 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:
  - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
  - 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
  - 3. Air Content: ASTM C 231/C 231M, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  - 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
  - 5. Compression Test Specimens: ASTM C 31/C 31M.
    - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
  - 6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
  - 7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
  - 8. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
10. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

**END OF SECTION**

## **SECTION 044100**

### **SITE STONE**

#### **PART 1 GENERAL**

##### **1.01 RELATED DOCUMENTS**

- A. The General Contract Conditions, Drawings, and Division - 1 Specification sections, apply to Work of this section.

##### **1.02 DESCRIPTION**

- A. The work in this section consists of furnishing and installation of stone slab retaining walls.

##### **1.03 RELATED SECTIONS**

- A. Section 312000 – Earthwork
- B. Section 321123 – Aggregate Base Course

##### **1.04 QUALITY ASSURANCE**

- A. Source: Specified stone shall come from a single source and shall be tagged at the quarry by the landscape architect.
- B. Stone Slab Retaining Walls: Steamboat Promenade and Burgess Creek stone features shall be the standard of comparison for all stone work.
- C. Stone Slab Retaining Walls: Prior to placement of stone material contractor shall meet on site with the Owner's Representative to review placement and aesthetic approaches for the stone placement of each stone feature in the creek. The Contractor shall install a mockup of material, which may remain part of the work if approved by Owner's Representative. The mockup shall constitute an area of stone slab walls as shown on the drawings. The Contractor should anticipate rehandling of stone to achieve desired design intent.
- D. Construct a sample mock up of approved materials, 12 -feet long by 2-feet high. Show color, range of stone sizes and projection, proportion, and craftwork. Owner's representative must approve sample location prior to construction. Do not begin any other stone work until the mock-up is approved. Approved panel shall become the standard of comparison for all stone work. Do not alter, move or destroy panel until the contract is complete. Contractor shall be responsible for removal and disposal of sample wall panel. Mock up shall not remain part of work.
- E. The firm that is employed to construct the stonework shall be customarily employed in the landscape stone masonry industry. Prior to beginning construction of the walls, the Contractor must demonstrate to the Owner's Representative that the firm has at least three years of previous experience constructing stone walls and has completed at least five generally similar projects. The firm shall employ skilled labor with a working knowledge of stone masonry techniques. Journeyman or lead mason must have a minimum experience of 3 years.
- F. The Owner's Representative reserves the right to reject the Contractor's masonry personnel or stonework subcontractor based on these experiences and skill requirements. If rejected, the Contractor shall obtain personnel and/or a subcontractor having qualifications acceptable to the Owner's Representative.
- G. No adjustments in prices or completion time will be allowed due to changes in personnel or delays in obtaining satisfactory personnel or subcontractor.

- H. Contractor shall guarantee their respective work against defective materials or faulty workmanship as specified in the General Conditions and Division One Specifications.
  - I. Contractor shall obtain mortar ingredients of uniform quality, from one manufacturer for each cementitious component and from one source and producer for each aggregate for the entire project.
  - J. Contractor shall comply with the following standards, except where more stringent requirements are stated on the drawings or herein:
    - 1. American National Standards Institute, ANSI/NSB 211 (A41.1), "Building Code Requirements for Masonry"
    - 2. American Society for Testing Materials, ASTM.
    - 3. National Concrete Masonry Association, NCMA, "A Manual of Facts on Concrete Masonry."
    - 4. Uniform Building Code, UBC, Chapter 24 – Masonry.
- 1.05 SUBMITTALS: Submittals shall be made in accordance with the Special Conditions of the Contract. The following shall be submitted for the Work in this Section:
- A. Product Data:
    - 1. Stone Slab Retaining wall: Provide quarry contact information and available stone slab dimensions.
- 1.06 DELIVERY, STORAGE AND HANDLING
- A. Store masonry materials on platforms or pallets. Store mortar materials under cover in a dry location. Protect steel materials from moisture and keep free of loose scale and rust. Handle masonry materials carefully to avoid chipping, breakage, contact with soil or other contaminating material. Deliver cementitious materials in the manufacturer's unbroken, labeled containers. Care shall be taken in transportation and handling of stone, so as not to scratch or damage the stone, particularly the naturally weathered surfaces.
- 1.07 PROJECT CONDITIONS
- A. Hot Weather Conditions

Protect all masonry construction from direct exposure to wind and sun for 48 hours after installation when erected in an ambient air temperature of 99°F (37°C) in the shade with relative humidity less than 50%.
  - B. Cold Weather Conditions

Before erecting masonry during temperatures below 40°F, submit a written statement and receive approval on methods proposed to heat masonry materials and protect masonry from freezing as required hereafter. Keep masonry completely covered and free of frost, ice and snow at all times, maintain a minimum temperature of 40°F (4°C) when laid. Maintain temperature of mortar and grout between 70°F (21°C) and 100°F (43°C). Do not exceed 160°F (71°C) temperature of mixing water or of water and sand introduced to cement. Maintain air temperature on both side of masonry above 40°F (4°C) for at least 72 hours, 48 hours if high-early strength cement is used in

the mortar in lieu of Portland cement or masonry cement. Do not build upon frozen work. Do not place concrete footings on muddy or frozen surfaces.

## PART 2 PRODUCTS

### 2.01 GENERAL

- A. Prior to the delivery of stone to the work site, an inspection of the quarry shall be arranged by the Owner Representative and Landscape Architect, and shall include the Landscape Architect and Quarry Representative. The quarry shall identify the rock source and procedures that will be used to stockpile and grade the sizes of stone specified. The Owner's Representative and Architect will tag primary stone to be selected for the project. Tags and reference names shall remain on stone for placement on site.
- B. Upon delivering the stone to the site, Owner's Representative will examine the stone and may reject any determined to be damaged or scratched on the desired exposed faces or unnaturally shaped. These stone shall be removed from the site at the Contractor's expense.
- C. Stone/boulder features shall incorporate a mix of shapes and sizes with bedding planes and proportions of stone in different sizes resembling the elevations shown in the drawings. Natural bedding planes of stone slab walls are to be laid horizontally; horizontal and vertical joints to be frequently interrupted. Stone shall appear naturally weathered; cut faces shall not be visible; and sharp edges shall not be exposed.
- D. The nominal sizes of boulders and stone slabs listed shall serve as the minimum acceptable dimension on any axis through the approximate center of mass of the stone. Stone with any dimension smaller than the nominal dimension stated shall be used as the next nominal size less.
- E. Contractor shall notify the Owner's Representative at a minimum 48 hours in advance of stone placement.

### 2.02 STONE SLAB RETAINING WALLS

- A. Stone slabs shall be 'Sienna Buff' sandstone as supplied by Siloam Stone Inc., 315 North 7<sup>th</sup>, Canon City, Colorado 81212, 719-275-4275 or approved equal. Reference plans and details for specific stone sizes and types.
  - 1. Primary Stone: Primary Stone shall be tagged at the quarry by the landscape architect. Contractor shall arrange with quarry to have stone stockpiled. Stones can vary in height across the length of the slab. Approximate sizes and quantity shall be as shown on the drawings. Stone Tags shall remain on the stones during delivery to the site.

### 2.03 FIRE FEATURE STONE

- A. Stones are to match existing stone fire pit source. Contact Torian Plum representative to determine original source of stone veneer at fire pit.

### 2.04 MORTAR AND GROUT

- A. As specified in Section 044313.13. Color to be selected from Davis Colors by Owner Representative.

### 2.05 GEOTEXTILE FABRIC

- A. Mirafi 140 N as supplied by TC Mirafi, 706-693-2226, or approved equal.



## PART 3 EXECUTION

### 3.01 GENERAL

- A. Stone shall be placed individually in a manner to avoid displacing underlying materials or placing undue impact force on the underlying materials. Stone shall not be dropped from a height of more than 2 inches.
- B. Stone shall be placed in position by the use of a multi-prong grapple device or suitable equipment for handling material. Dayline buckets and skips shall not be used for placement of stone.
- C. Stone shall be placed with weathered and most natural, rounded surface up, or as directed.
- D. Stone shall be placed in the presence of the Owner's Representative, and Owner's Representative shall approve the placement before stone are backfilled and/or mortared. The contractor should anticipate that rehandling of individual stone after initial placement will be required to achieve required elevations and placements.
- E. Backfill excavation around site boulder / stone as indicated on construction plans and in accordance with Section 312000 and 321123.
- F. Provide chases, reveals, reglets, openings and other spaces as shown or required for contiguous work. Close up openings in stonework after other work is in place. Use materials and set to match surrounding stonework.
- G. During all seasons, protect partially completed stonework against weather when work is not in progress. Cover top of wall with strong, waterproof, non-staining membrane extending at least 2-feet down the stone face and anchor securely in place.
- H. Do not build on frozen work; remove and replace stonework damaged by frost or freezing.
- I. Do not use stone units with chips, cracks, voids, stains or other defects which might be visible in the finished work unless otherwise acceptable to the Owner's Representative.
- J. Set stone in accordance with drawings. Provide anchors, supports, fasteners and other attachments as shown or necessary to secure stonework in place. Adjust accessories for proper setting of stone. Completely fill slots for anchors, dowels, fasteners and supports with mortar during setting of stone. Minimize appearance of all mortar.
- K. Execute stonework by skilled mechanics and employ skilled stone fitters at the site to do necessary field cutting as stone is set.

### 3.02 STONE SLAB RETAINING WALL PLACEMENT

- A. Excavate for placement of stone, such that top of stone slab will meet grade specified on grading plan and detail. Provide a firm, smooth, uniform surface. Contractor shall prepare and subgrade according to Sections 31200 and 31123 and as indicated in the construction plans and specifications.
- B. Place geotextile fabric as indicated in construction details in accordance with manufacturer's recommendations and instructions.
- C. Contractor shall cut stone slabs as required to meet desired lines, layout, and grades. Contractor shall place filler stones and grout to meet desired grades.

- D. Contractor shall place aggregate base course and stone slab in accordance with specifications and construction plans. Contractor shall minimize the appearance of cut stone faces. Contractor shall mortar stones in place as indicated in construction plans and as directed by Owner's Representative.

3.03 FIRE FEATURE STONE

- A. Contractor shall decommission the existing fire feature as necessary with existing electrical and gas utilities.
- B. Contractor shall excavate and demolish concrete around the existing fire pit for temporary storage on-site. The existing fire pit is to be handled with care to limit the amount of damage and reinstallation of stone veneer.
- C. Excavate for placement of fire pit to meet grade specified on grading plan and detail. Provide a firm, smooth, uniform surface. Contractor shall prepare and subgrade according to Sections 31200 and 321123 and as indicated in the construction plans and specifications.
- D. Contractor shall coordinate with gas piping, gas feature, electrical to match existing conditions.
- E. Contractor to touch up stone veneer as necessary to match existing conditions.

3.04 ADJUSTMENT, PROTECTION, AND CLEAN-UP

- A. Upon completion of work, remove from the premises all surplus materials, tools, equipment, rubbish, debris, and rejected stone resulting from the work.
- B. Remove and replace stone units that are broken, chipped, stained or otherwise damaged. Where directed, remove and replace units that do not match adjoining stonework. Provide new matching units; install as specified and point-up to eliminate evidence of replacement. Repoint defective and unsatisfactory joints as required to provide a neat, uniform appearance.
- C. Clean stonework not less than six days after completion. Thoroughly clean and scrub completed wall with fiber brushes, using a mild alkaline abrasive cleaner that contains no caustic or harsh fillers. Do not use wire brushes or acid type cleaning agents. Begin at top and work down. Clean stone thoroughly, leaving no mortar stains or traces of cleaning compound.
- D. Protect the stonework from collapse, deterioration, discoloration or damage during subsequent construction and until acceptance of the work.

**END OF SECTION**

## SECTION 044313.13 - ANCHORED STONE MASONRY VENEER

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Stone masonry anchored to concrete backup.
  - 2. Ties and anchors.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each variety of stone, stone accessory, and manufactured product.
- B. Samples for Initial Selection: For colored mortar and other items involving color selection.
- C. Samples for Verification:
  - 1. For each stone type indicated. Include at least five samples in each set and show the full range of color and other visual characteristics in completed Work.
  - 2. Submit color samples of mortar showing manufacturer's full range of standard and optional colors. Submit a cured mortar sample using approved color.
  - 3. Submit a sample of each type of veneer anchor.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, supply sources, and other information as required to identify materials used. Include mix proportions for mortar and source of aggregates.
  - 1. Neither receipt of list nor approval of mockups constitutes approval of deviations from the Contract Documents contained in mockups unless Architect approves such deviations in writing.
- C. Material Test Reports:
  - 1. Stone Test Reports: For each stone variety proposed for use on Project, by a qualified testing agency, indicating compliance with required physical properties, other than

abrasion resistance, according to referenced ASTM standards. Base reports on testing done within previous five years.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs experienced stonemasons and stone fitters.
- B. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
  - 1. Build mockup of typical wall area as shown on Drawings.
  - 2. Build mockups for each type of stone masonry in sizes approximately 72 inches long by 30 inches high or as directed by Owner's representative. Show color, range of stone sizes, different proportion of stone sizes, and projection, texture, bond, reinforcement, color and tooling of mortar joints, capstone and craftwork. Owner's representative must approve sample location prior to construction. Do not begin any other stone work until the sample panel is approved. Approved panel shall become the standard of comparison for all stone work. Do not alter, move or destroy panel until the contract is complete. Contractor shall be responsible for removal and disposal of sample wall panel. Mockup shall not remain part of work.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- C. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

#### 1.7 FIELD CONDITIONS

- A. Protection of Stone Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed stone masonry when construction is not in progress.
  - 1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
- B. Stain Prevention: Immediately remove mortar and soil to prevent them from staining stone masonry face.
  - 1. Protect base of walls from rain-splashed mud and mortar splatter using coverings spread on the ground and over the wall surface.
  - 2. Protect sills, ledges, and projections from mortar droppings.

- C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace stone masonry damaged by frost or freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
  - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 degrees F and above and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

## 1.8 COORDINATION

- A. Advise installers of adjacent Work about specific requirements for placement of reinforcement, veneer anchors, flashing, and related items to be built into stone masonry.
- B. Coordinate locations of dovetail slots installed in concrete that are to receive stone anchors.

## PART 2 - PRODUCTS

### 2.1 STONE VENEER

- A. Site walls shall incorporate a mix of shapes and sizes with larger stone predominantly at lower levels. Refer to construction plans for representative wall elevation. Natural bedding planes are to be laid horizontally; horizontal and vertical joints to be frequently interrupted. Cap stones shall be placed on the top of the wall as indicated in the construction plans. Face stone shall be furnished according to the percentages described below and shall correlate with the square footage of the stone wall face, not the overall quantity of stone.
- B. Provide stone sound and free of defects that will impair its strength, durability or appearance. Natural variations in color and markings that are characteristic of the quarry from which the stone is obtained will be acceptable, provided they do not impair the strength or durability of the stone, mar its appearance or exceed the range of variations represented by the approved panel.
- C. Stone shall be “Sienna Buff” sandstone as supplied by Siloam Stone Inc., 315 North 7<sup>th</sup>, Canon City, Colorado 81212, 719-275-4275 or approved equal. Reference construction plans for example elevation of stone veneer wall.
  - 1. Furnish face stones with the following dimensions:
    - a. Rise: 8 to 24 inches
    - b. Length: 12 to 30 inches
    - c. Depth: 4 to 6 inches, unless otherwise indicated or shown on drawings.
  - 2. Quantities of face stone shall be furnished with the following dimensions:
    - a. Rise:
      - 1) 8 to 12 inches: 40% of wall face
      - 2) 13 to 18 inches: 40% of wall face

- 3) 19 to 24 inches: 20% of wall face
- b. Length:
  - 1) 12 to 18 inches: 30% of wall face
  - 2) 19 to 24 inches: 40% of wall face
  - 3) 25 to 30 inches: 30 % of wall face

## 2.2 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150/C 150M, Type I or Type II, except Type III may be used for cold-weather construction; natural color or white cement may be used as required to produce mortar color indicated.
  - 1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Mortar Cement: ASTM C 1329/C 1329M.
- E. Masonry Cement: ASTM C 91/C 91M.
- F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979/C 979M. Use only pigments with a record of satisfactory performance in stone masonry mortar.
- G. Colored Portland Cement-Lime Mix: Packaged blend of portland cement, hydrated lime, and mortar pigments. Mix shall produce color indicated or, if not indicated, as selected from manufacturer's standard colors. Pigments shall not exceed 10 percent of portland cement by weight.
- H. Aggregate: ASTM C 144.
- I. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
- J. Water: Potable.

## 2.3 VENEER ANCHORS

- A. Wire Veneer Anchors: Hot dip galvanized dovetail veneer ties, 3/16" diameter minimum, inserted into slots built into concrete backup and extending at least 2" into the veneer bed joint. Dovetail slots shall be constructed vertically. Space ties 16" on center vertically and horizontally.
- B. Cap Stone Anchors: Not less than 1/2" diameter stainless steel all-thread dowels, 2 minimum per stone, set with epoxy 2" minimum into backing and into cap stone.

## 2.4 MISCELLANEOUS MASONRY ACCESSORIES

- A. Weep/Vent Products: Use the following unless otherwise indicated:
  - 1. Round Plastic Tubing: Medium-density polyethylene, 3/4-inch OD by thickness of stone masonry.

## 2.5 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar and grout stains, efflorescence, and other new construction stains from stone masonry surfaces without discoloring or damaging masonry surfaces; expressly approved for intended use by cleaner manufacturer and stone producer.

## 2.6 FABRICATION

- A. General: Fabricate stone units in sizes and shapes required to comply with requirements indicated.
- B. Select stone to produce pieces of thickness, size, and shape indicated, including details on Drawings and pattern specified in " Stone Veneer" Article.
- C. Cut and drill sinkages and holes in stone for anchors and supports.
- D. Carefully inspect stone at quarry or fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units before shipment.
  - 1. Clean sawed backs of stone to remove rust stains and iron particles.
- E. Thickness of Stone: Provide thickness indicated.

## 2.7 MORTAR MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
  - 1. Do not use calcium chloride.
  - 2. Use portland cement-lime masonry cement or mortar cement mortar unless otherwise indicated.
  - 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in the form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Stone Masonry: Comply with ASTM C 270, Property Specification.
  - 1. Mortar for Setting Stone: Type S.

- D. Pigmented Mortar: Use colored cement product.
  - 1. Pigments shall not exceed 10 percent of portland cement by weight.
  - 2. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine surfaces indicated to receive stone masonry, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stone masonry.
- B. Examine substrate to verify that dovetail slots, inserts, reinforcement, veneer anchors, flashing, and other items installed in substrates and required for or extending into stone masonry are correctly installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Coat concrete and unit masonry backup with asphalt dampproofing.
- B. Clean dirty or stained stone surfaces by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

#### 3.3 SETTING STONE MASONRY

- A. Perform necessary field cutting and trimming as stone is set.
  - 1. Use hammer and chisel to split stone that is fabricated with split surfaces. Make edges straight and true, matching similar surfaces that were shop or quarry fabricated.
  - 2. Pitch face at field-split edges as needed to match stones that are not field split.
- B. Sort stone before it is placed in wall to remove stone that does not comply with requirements relating to aesthetic effects, physical properties, or fabrication, or that is otherwise unsuitable for intended use.
- C. Arrange stones in random-range ashlar pattern with random course heights, random lengths (interrupted coursed), and uniform joint widths.
- D. Arrange stones with color and size variations uniformly dispersed for an evenly blended appearance.
- E. Install supports, fasteners, and other attachments indicated or necessary to secure stone masonry in place.



- F. Set stone accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
- G. Maintain uniform joint widths except for variations due to different stone sizes and where minor variations are required to maintain bond alignment if any. Lay walls with joints not less than 1/4 inch at narrowest points or more than 1/2 inch at widest points.
- H. Install embedded flashing and weep holes at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- I. Place weep holes and vents in joints where moisture may accumulate, including at base of cavity walls, above shelf angles, and at flashing.
  - 1. Use round plastic tubing to form weep holes.
  - 2. Space weep holes 24 inches o.c.
  - 3. Place pea gravel in cavities as soon as practical to a height of not less than 2 inches to maintain drainage.

### 3.4 CONSTRUCTION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/4 inch in 10 feet. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/4 inch in 20 feet.
- B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4 inch in 20 feet.
- C. Measure variation from level, plumb, and position shown in plan as a variation of the average plane of each stone face from level, plumb, or dimensioned plane.
- D. Variation in Mortar-Joint Thickness: Do not vary from joint size range indicated.

### 3.5 INSTALLATION OF ANCHORED STONE MASONRY

- A. Anchor stone masonry to concrete with corrugated-metal veneer anchors unless otherwise indicated. Secure anchors by inserting dovetailed ends into dovetail slots in concrete.
- B. Embed veneer anchors in mortar joints of stone masonry at least halfway, but not less than 2 inches through stone masonry and with at least a 5/8-inch cover on exterior face.
- C. Space anchors to provide not less than one anchor per 2 sq. ft of wall area. Install additional anchors within 12 inches of openings, sealant joints, and perimeter at intervals not exceeding 12 inches.
- D. Set stone in full bed of mortar with full head joints unless otherwise indicated. Build anchors into mortar joints as stone is set.
- E. Provide 1-inch cavity between stone masonry and backup construction unless otherwise indicated. Keep cavity free of mortar droppings and debris.
  - 1. Do not attempt to trowel or remove mortar fins protruding into cavity.

- F. Rake joints to uniform depths with square bottoms and clean sides.

### 3.6 ADJUSTING AND CLEANING

- A. Remove and replace stone masonry of the following description:
  - 1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Architect.
  - 2. Defective joints.
  - 3. Stone masonry not matching approved samples and mockups.
  - 4. Stone masonry not complying with other requirements indicated.
- B. Replace in a manner that results in stone masonry matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean stone masonry as work progresses. Remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean stone masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on mockup; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before cleaning stone masonry.
  - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
  - 4. Wet wall surfaces with water before applying cleaner; remove cleaner promptly by rinsing thoroughly with clear water.
  - 5. Clean stone masonry by bucket and brush hand-cleaning method described in BIA Technical Note No. 20, Revised II, using job-mixed detergent solution.
  - 6. Clean stone masonry with proprietary acidic cleaner applied according to manufacturer's written instructions.

### 3.7 EXCESS MATERIALS AND WASTE

- A. Excess Stone: Stack excess stone where directed by Owner for Owner's use.
- B. Disposal as Fill Material: Dispose of clean masonry waste, including mortar and excess or soil-contaminated sand, by crushing and mixing with fill material as fill is placed.
  - 1. Crush masonry waste to less than 4 inches in greatest dimension.
  - 2. Mix masonry waste with at least 2 parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
  - 3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other waste, and legally dispose of off Owner's property.

END OF SECTION 044313.13

## SECTION 051200 - STRUCTURAL STEEL FRAMING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Structural steel.
2. Grout.

#### 1.3 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

#### 1.4 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication of structural-steel components.
  1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
  2. Include embedment Drawings.
  3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
  4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, fabricator, and testing agency.
- B. Welding certificates.
- C. Field quality-control and special inspection reports.

1.7 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
  - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
  - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
  - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
  - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992/A 992M.
- B. Channels, Angles: ASTM A 36/A 36M.
- C. Plate and Bar: ASTM A 36/A 36M.
- D. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B, structural tubing.
- E. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.
  - 1. Finish: Black except where indicated to be galvanized.
- F. Welding Electrodes: Comply with AWS requirements.

## 2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.
- B. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- C. Unheaded Anchor Rods: ASTM F 1554, Grade 36, weldable.
  - 1. Nuts: ASTM A 563 (ASTM A 563M) hex carbon steel.
  - 2. Plate Washers: ASTM A 36/A 36M carbon steel.
  - 3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
  - 4. Finish: Plain.
- D. Threaded Rods: ASTM A 36/A 36M.
  - 1. Nuts: ASTM A 563 (ASTM A 563M) hex carbon steel.
  - 2. Washers: ASTM A 36/A 36M carbon steel.
  - 3. Finish: Plain.
- E. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.
- F. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.
- G. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

## 2.3 PRIMER

- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- B. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

## 2.4 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## 2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning."
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
  1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
  2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
  3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

## 2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
  1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

## 2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
  1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
  2. Surfaces to be field welded.
  3. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
  4. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
  1. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness

of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

- D. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.

## 2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
  - 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.

## 2.9 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
  - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
  - 1. Liquid Penetrant Inspection: ASTM E 165.
  - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
  - 3. Ultrasonic Inspection: ASTM E 164.
  - 4. Radiographic Inspection: ASTM E 94.
- D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
  - 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
  - 2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.
- E. Prepare test and inspection reports.



## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
  - 1. Prepare a survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

### 3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
  - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
  - 2. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
  - 3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
  - 1. Level and plumb individual members of structure.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection.

- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

### 3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
  - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

### 3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
  - 1. Verify structural-steel materials and inspect steel frame joint details.
  - 2. Verify weld materials and inspect welds.
  - 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.
  - 1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
    - a. Liquid Penetrant Inspection: ASTM E 165.
    - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
    - c. Ultrasonic Inspection: ASTM E 164.
    - d. Radiographic Inspection: ASTM E 94.

3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION 051200

## SECTION 071413

### HOT FLUID-APPLIED RUBBERIZED ASPHALT WATERPROOFING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 2.01 SUMMARY

###### A. Section Includes:

1. Rubberized-asphalt waterproofing membrane reinforced.
2. Molded-sheet drainage panels.
3. Insulation.

###### B. Related Sections:

1. Section 075556 "Fluid-Applied Protected Membrane Roofing" for hot fluid-applied, rubberized-asphalt roofing.
2. Section 079200 "Joint Sealants" for joint-sealant materials and installation.

##### 3.01 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.
- B. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins to adjoining waterproofing, and other termination conditions.
  1. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.
- C. Samples: For the following products in manufacturer's standard sizes unless otherwise indicated:
  1. Flashing sheet.
  2. Membrane-reinforcing fabric.
  3. Insulation.
  4. Drainage panel.

##### 4.01 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

- B. Product Test Reports: For waterproofing, based on evaluation of comprehensive tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Warranties: Sample of special warranties.

#### 5.01 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that is approved or licensed by manufacturer for installation of waterproofing required for this Project and is eligible to receive special warranties specified.
- B. Source Limitations: Obtain waterproofing materials sheet flashings, protection course, molded-sheet drainage panels, insulation from single source from single manufacturer.
- C. Mockups: Install waterproofing to 100 sq. ft. of deck to demonstrate surface preparation, crack and joint treatment, corner treatment, thickness, texture, and execution quality.
  - 1. If Architect determines mockups do not comply with requirements, reapply waterproofing and reinstall overlaying construction until mockups are approved.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

#### 6.01 DELIVERY, STORAGE, AND HANDLING

- A. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.
- B. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- C. Protect stored materials from direct sunlight.

#### 7.01 PROJECT CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, or when temperature is below 0 deg F.
  - 1. Do not apply waterproofing in snow, rain, fog, or mist.
- B. Maintain adequate ventilation during application and curing of waterproofing materials.

8.01 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace waterproofing and sheet flashings that do not comply with requirements or that fail to remain watertight within specified warranty period.
  - 1. Warranty insulation will retain 80 percent of original published thermal value.
  - 2. Warranty pavers will not dish or warp and will not crack, split, or disintegrate in freeze-thaw conditions.
  - 3. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pedestal-mounted pavers on plaza decks.
  - 4. Warranty Period: 10 years from date of Substantial Completion.
- B. Special Installer's Warranty: Specified form signed by Installer, covering Work of this Section, for warranty period of two years.
  - 1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pedestal-mounted pavers on plaza decks.

PART 2 - PRODUCTS

1.01 WATERPROOFING MEMBRANE

- A. Hot Fluid-Applied, Rubberized-Asphalt Waterproofing Membrane: Single component; 100 percent solids; hot fluid-applied, rubberized asphalt.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Tremco Incorporated; Tremproof 6100.
    - b. Or approved equal.

2.01 FLASHING SHEET MATERIALS

- A. Elastomeric Flashing Sheet: 50-mil minimum, uncured sheet neoprene as follows:
  - 1. Tensile Strength: 1400 psi minimum; ASTM D 412, Die C.
  - 2. Elongation: 300 percent minimum; ASTM D 412.
  - 3. Tear Resistance: 125 psi minimum; ASTM D 624, Die C.
  - 4. Brittleness: Does not break at minus 30 deg F; ASTM D 2137.

3.01 AUXILIARY MATERIALS

- A. Primer: ASTM D 41, asphaltic primer.
- B. Elastomeric Sheet: 50-mil minimum, uncured sheet neoprene as follows:
  - 1. Tensile Strength: 1400 psi minimum; ASTM D 412, Die C.
  - 2. Elongation: 300 percent minimum; ASTM D 412.
  - 3. Tear Resistance: 125 psi minimum; ASTM D 624, Die C.
  - 4. Brittleness: Does not break at minus 30 deg F; ASTM D 2137.

- C. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum termination bars; approximately 1 by 1/8 inch thick; with anchors.
- D. Sealants and Accessories: Manufacturer's recommended sealants and accessories.
- E. Reinforcing Fabric: Manufacturer's recommended, spun-bonded polyester fabric.
- F. Protection Course: ASTM D 6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:
  - 1. Thickness: 1/4 inch, nominal.
  - 2. Thickness: 1/8 inch, nominal, for vertical applications; 1/4 inch, nominal, elsewhere.
- G. Protection Course: Manufacturer's standard, 80- to 90-mil- thick, fiberglass-reinforced rubberized asphalt or modified bituminous sheet.

#### 4.01 MOLDED-SHEET DRAINAGE PANELS

- A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 sieve, laminated to one side with a polymeric film bonded to the other side of a studded, nonbiodegradable, molded-plastic-sheet drainage core, with a vertical flow rate of 9 to 15 gpm/ft. Compressive strength 30,000 psf or greater.

#### 5.01 INSULATION

- A. Board Insulation: Extruded-polystyrene board insulation complying with ASTM C 578, square edged.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. DiversiFoam Products.
    - b. Dow Chemical Company (The).
    - c. Owens Corning.
    - d. Pactiv Corporation.
    - e. T. Clear Corporation.
  - 2. Type IV, 25-psi minimum compressive strength.
  - 3. Type VI, 40-psi minimum compressive strength.
  - 4. Type VII, 60-psi minimum compressive strength.
  - 5. Type V, 100-psi minimum compressive strength.
- B. Unfaced Wall Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, Type VI, 40-psi minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. DiversiFoam Products; CertiFoam40 Drainage Board.
    - b. Dow Chemical Company (The); Perimate.

#### PART 3 - EXECUTION

1.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
  - 2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

2.01 PREPARATION

- A. Clean and prepare substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.
- D. Remove grease, oil, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
  - 1. Abrasive blast clean concrete surfaces uniformly to expose top surface of fine aggregate according to ASTM D 4259 with a self-contained, recirculating, blast-cleaning apparatus. Remove material to provide a sound surface free of laitance, glaze, efflorescence, curing compounds, concrete hardeners, or form-release agents. Remove remaining loose material and clean surfaces according to ASTM D 4258.
- E. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.

3.01 JOINTS, CRACKS, AND TERMINATIONS

- A. Prepare and treat substrates to receive waterproofing membrane, including joints and cracks, deck drains, corners, and penetrations according to manufacturer's written instructions.
  - 1. Rout and fill joints and cracks in substrate. Before filling, remove dust and dirt according to ASTM D 4258.
  - 2. Adhere strip of elastomeric sheet to substrate in a layer of hot rubberized asphalt. Extend elastomeric sheet a minimum of 6 inches on each side of moving joints and cracks or joints and cracks exceeding 1/8 inch thick, and beyond deck drains and penetrations. Apply second layer of hot fluid-applied, rubberized asphalt over elastomeric sheet.
  - 3. Embed strip of reinforcing fabric into a layer of hot rubberized asphalt. Extend reinforcing fabric a minimum of 6 inches on each side of nonmoving joints and cracks not exceeding 1/8 inch thick, and beyond roof drains and penetrations.
    - a. Apply second layer of hot fluid-applied, rubberized asphalt over reinforcing fabric.



- B. At expansion joints and discontinuous deck-to-wall or deck-to-deck joints, bridge joints with elastomeric sheet extended a minimum of 6 inches on each side of joints and adhere to substrates in a layer of hot rubberized asphalt. Apply second layer of hot fluid-applied, rubberized asphalt over elastomeric sheet.

#### 4.01 FLASHING INSTALLATION

- A. Install elastomeric flashing sheets at terminations of waterproofing membrane according to manufacturer's written instructions.
- B. Prime substrate with asphalt primer.
- C. Install elastomeric flashing sheet and adhere to deck and wall substrates in a layer of hot rubberized asphalt.
- D. Extend elastomeric flashing sheet up walls or parapets a minimum of 8 inches above plaza deck pavers and 6 inches onto deck to be waterproofed.
- E. Install termination bars and mechanically fasten to top of elastomeric flashing sheet at terminations and perimeter of roofing.

#### 5.01 MEMBRANE APPLICATION

- A. Apply primer, at manufacturer's recommended rate, over prepared substrate and allow to dry.
- B. Heat and apply rubberized asphalt according to manufacturer's written instructions.
  - 1. Heat rubberized asphalt in an oil- or air-jacketed melter with mechanical agitator specifically designed for heating rubberized asphalt.
- C. Start application with manufacturer's authorized representative present.
- D. Reinforced Membrane: Apply hot rubberized asphalt to substrates and adjoining surfaces indicated. Spread to a thickness of 90 mils; embed reinforcing fabric, overlapping sheets 2 inches; spread another 125-mil- thick layer to provide a uniform, reinforced, seamless membrane 215 mils thick.
- E. Apply waterproofing over prepared joints and up wall terminations and vertical surfaces to heights indicated or required by manufacturer.
- F. Cover waterproofing with protection course with overlapped joints before membrane is subject to backfilling or construction or vehicular traffic.

#### 6.01 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate according to manufacturer's written instructions. Use methods that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.
  - 1. For vertical applications, install protection course before installing drainage panels.

7.01 INSULATION INSTALLATION

- A. Install one or more layers of board insulation to achieve required thickness over waterproofed surfaces. Cut and fit to within 3/4 inch of projections and penetrations.
- B. On vertical surfaces, set insulation units into rubberized asphalt according to manufacturer's written instructions.
- C. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

8.01 FIELD QUALITY CONTROL

- A. Engage a full-time site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions; surface preparation; and application of the membrane, flashings, protection, and drainage components; furnish daily reports to Architect.
- B. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, waterproofing application, protection, and drainage components, and to furnish reports to Architect.
  - 1. Flood Testing: Flood test each deck area for leaks, according to recommendations in ASTM D 5957, after completing and protecting waterproofing but before overlaying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water. Testing agency shall observe flood testing.
    - a. Flood to an average depth of 2-1/2 inches with a minimum depth of 1 inch and not exceeding a depth of 4 inches. Maintain 2 inches of clearance from top of sheet flashings.
    - b. Flood each area for 24 hours.
    - c. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.
  - 2. Electric Field Vector Mapping (EFVM): Testing agency shall survey entire waterproofing area for potential leaks using EFVM.

9.01 CLEANING AND PROTECTION

- A. Protect waterproofing from damage and wear during remainder of construction period.
- B. Protect installed board insulation from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

**SECTION 073363**

**INTENSIVE GARDEN ROOF® ASSEMBLY**

**PART I – GENERAL**

**1.01 SUMMARY**

- A. The General Contract Conditions, Drawings, and Division - 1 Specification sections, apply to Work of this section.

**1.02 RELATED SECTIONS**

- A. DIVISION 03 – Miscellaneous Cast-In-Place Concrete – Section 033000
- B. DIVISION 07 – Hot Fluid-Applied Rubberized Asphalt Waterproofing – Section 071413
- C. DIVISION 32 – Planting – Section 329300

**1.03 REFERENCES**

- A. American Society for Testing and Materials (ASTM).
- B. Canadian General Standards Board, CGSB-37.50-M89, Standard for Asphalt, Rubberized, Hot Applied, for Roofing and Waterproofing.
- C. Underwriters Laboratories (UL) Class A.
- D. ANSI/SPRI VR-1 2011 “Procedure for Investigating Resistance to Root Penetration on Vegetative Roofs”.

**1.04 DEFINITIONS**

- A. Green Roof -- An area of planting/landscaping, built up on a waterproofed substrate at any level that is separated from the natural ground by a man-made structure.
- C. Intensive Green Roof -- Landscaping requiring regular maintenance, consisting of deeper growing media depths (> 6 inches (152mm)) with a wider variety of plant species possible including shrubs and small trees.
- D. Lawn Green Roof – Lawn oriented landscaping requiring at-grade lawn oriented maintenance. Can include sodded or seeded turfgrasses or naturalized grasses with growing media depths > 8 inches (203mm).
- E. Garden Roof® -- Patented system of drainage, water retention and root barrier components utilized in the construction of green roofs over Hydrotech's MM 6125EV® roofing membrane..

**1.05 SYSTEM DESCRIPTION**

- A. Furnish and install a completed Intensive Garden Roof® Assembly including, protection course, root barrier protection, water retention mat, drainage/water retention component, filter fabric, lightweight engineered growing medium and vegetation.

**1.06 SUBMITTALS**

- A. Certification from an approved independent testing laboratory experienced in testing rubberized asphalt material, that the material meets the CGSB-37.50-M89 standard for rubberized asphalt membranes, including applicable ASTM procedures.

- B. Certification showing full time quality control of production facilities responsible for the manufacture of the rubberized asphalt and that each batch of material is tested to insure conformance with the manufacturers published physical properties.
- C. Certification showing that all components of the green roof assembly are being supplied and warranted by a single-source manufacturer.
- D. Evidence that the roof membrane assembly is currently Class A listed with Underwriters Laboratories.
- E. Provide product data on all components of the green roof assembly.
- F. Evidence indicating that water is available at the roof level to ensure that the vegetation can receive sufficient moisture through proper maintenance of the green roof.

#### 1.07 QUALITY ASSURANCE

- A. The Roofing/Waterproofing Contractor shall demonstrate qualifications to perform the work of this Section by submitting the following documentation:
  - 1. Certification or license by the membrane manufacturer as a locally based, authorized applicator of the product the installer intends to use, for a minimum of five (5) years.
  - 2. List of at least three (3) projects, satisfactorily completed within the past five (5) years, of similar scope and complexity to this project. Previous experience submittal shall correspond to specific membrane system proposed for use by applicator.
- B. The Green Roof Installing Contractor shall demonstrate qualifications to perform the work of this Section by submitting the following documentation:
  - 1. Certification or license by the green roof assembly supplier as a locally based, authorized applicator of the products the installer intends to use, for a minimum of five (5) years.
  - 2. List of at least three (3) projects, satisfactorily completed within the past five (5) years, of similar scope and complexity to this project. Previous experience submittal shall correspond to specific membrane system proposed for use by applicator.
- C. Refer to Section 1.05 SYSTEM DESCRIPTION. Include single-source for all components from the manufacturer.
- D. Green Roof Supplier shall show evidence that the specified green roof assembly has been developed, marketed, supported and installed for a minimum of fifteen (15) years on projects of similar complexity.
- E. Pre-Construction Conferences. The manufacturer will meet with the necessary parties at the jobsite to review and discuss project conditions as it relates to the integrity of the roofing assembly.

#### 1.08 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original unopened containers of packaging clearly labeled with manufacturer's name, brand name, instruction for use, all identifying numbers, and U.L. labels.
- B. Materials shall be stored in a neat, safe manner, not to exceed the allowable structural capacity of the storage area.
- C. Store materials in a clean, dry area protected from water and direct sunlight.
- D. Store all adhesives at temperatures between 60°F (15.5°C) and 80°F (26.6°C). If exposed to lower temperatures, restore materials to 60°F (15.5°C) minimum temperature before using.
- E. Vegetation shall be handled and stored in accordance with the Hydrotech Extensive Garden Roof Plant Installation and Maintenance Guideline.

#### 1.09 PROJECT CONDITIONS

- A. Adhesives contain petroleum distillates and are extremely flammable. Do not breathe vapors or use near an open fire. Do not use in confined areas without adequate ventilation. Consult container or packaging labels and Material Safety Data Sheets (MSDS) for specific safety information.
- B. Do not allow waste products (petroleum, grease, oil, solvents, vegetable or mineral oil, animal fat, etc.) to come in contact with the roof membrane. Any exposure to foreign materials or chemical discharges shall be presented to membrane manufacturer for evaluation to determine any impact on the roof membrane assembly performance.
- C. Deck Preparation; refer to Section 3.02 Preparation.
- D. Deck slopes greater than 3 inches in 12 inches (approx. 15 degrees or 25%) shall be limited to extensive and shallow-intensive applications and require special installation considerations.
- E. Humidity and temperature conditions, building location, building use and occupancy conditions may require the installation of a vapor retarder underneath roof substrate boards to prevent moisture condensation within the roofing assembly. The decision to use a vapor retarding membrane is the responsibility of the design professional.
- F. General Contractor shall assure that adequate protection is provided after installation of the membrane and plantings to prevent damage from subsequent trade traffic.

#### 1.10 WARRANTY

- A. Upon completion of the work, the contractor shall supply the owner with a single-source warranty of U.S. origin direct from the manufacturer.
- B. Each warranty varies in scope and terms. **CONTACT Hydrotech for exact warranty terms and conditions to meet the specific project requirements.**
- C. Warranties available from the manufacturer:
  - 1. **Material Warranty;** excludes labor.  
Duration: 2-, 5-, 10-, 20-year
  - 2. **Watertightness Warranty;** includes labor and material to maintain watertight condition and replacement of Hydrotech supplied roof substrate board.  
Duration: 5-, 10-, 15-, 20-year
  - 2. **Thermal Warranties;** includes 80% retention of the original thermal value and remain on the deck to a maximum 70 mph gust wind speed.  
Duration 5-, 10-, 15-, 20-year
  - 4. **Total System Warranties;** covers components of the green roof assembly, including membrane, flashing, insulation, Garden Roof® components, pavers and Checker Block® ballast units. Includes removal and replacement of the insulation, Garden Roof® components, pavers, Checker Block® ballast units and growing media (≤24 inches deep) when supplied by, installed, and maintained per Hydrotech's requirements and replacement of the Hydrotech supplied roof substrate board.
    - a. Duration of Membrane/Flashing and replacement of Hydrotech supplied roof substrate board from date of installation: 5-, 10-, 15-, 20-year (watertight condition)
    - b. Duration of Insulation from date of purchase: 5-, 10-, 15-, 20-year (80% of original thermal value; remain on the deck withstanding wind speeds not to exceed 70 mph gust wind speed)
    - c. Material Integrity of Garden Roof® Components from date of purchase: 5-, 10-, 15-, 20-year

- d. Duration of Pavers and Checker Block® ballast units from date of purchase: 5-, 10-year (will not crack, split or disintegrate due to freeze-thaw)

**\*\*CONTACT HYDROTECH FOR EXACT WARRANTY TERMS AND CONDITIONS\*\***

## PART 2 - PRODUCTS

### 2.01 GENERAL

- A. Refer to Section 1.05 SYSTEM DESCRIPTION. All components shall be obtained as a single-source from the membrane / green roof manufacturer to ensure total system compatibility and integrity.

Manufacturer: American Hydrotech, Inc.  
303 East Ohio Street  
Chicago, Illinois 60611-3318  
800-877-6125 or 312-337-4998  
FAX: 312-661-0731  
Web Site: [www.hydrotechusa.com](http://www.hydrotechusa.com)

**or Approved Equal**

### 2.02 MATERIALS

#### A. Membrane

1. Membrane shall be a hot, fluid applied, rubberized asphalt membrane meeting the CGSB-37.50-M89 standard and other pertinent physical properties:  
- American Hydrotech, Inc., Monolithic Membrane 6125EV® (up to 25% post-consumer recycled-content)

<u>PROPERTY</u>	<u>TEST METHOD</u>	<u>TYPICAL RESULT</u>
Flash point	ASTM D-92 CGSB-37.50-M89	<500°F* (260°C)
Penetration	ASTM D-5329 CGSB-37.50-M89	98 mm @77°F (25°C) 187 mm @122°F (50°C)
Flow	ASTM D-5329 CGSB-37.50-M89	1.0 mm @ 140°F (60°C)
Toughness	CGSB-37.50-M89	16.0 Joules
Ratio of Toughness to Peak Load	CGSB-37.50-M89	0.069
Water Vapor Permeability	ASTM E-96, PROCEDURE E CGSB-37.50-M89	0.3 ng/Pa(s)M <sup>2</sup>
Water Absorption	CGSB-37.50-M89	.11 gram weight gain
Low Temperature Flexibility (-25°C)	CGSB-37.50-M89	No delamination, adhesion loss, or cracking

Low Temperature Crack Bridging Capability	CGSB-37.50-M89	No cracking, adhesion loss, or splitting
Heat Stability	CGSB-37.50-M89	No change in viscosity, penetration, flow or low temperature flexibility
Viscosity	CGSB-37.50-M89	11.0 seconds
Water Resistance (5 days/50°C)	CGSB-37.50-M89	No delamination, blistering, emulsification, or deterioration
Softening Point	ASTM -36	180°F (82°C)
Elongation	ASTM D-5329	1000% minimum
Resiliency	ASTM D-5329	40% minimum
Bond to Concrete	ASTM D-5329	Pass 0°F (-18°C)
Acid Resistance	ASTM D-896 Procedure 7.1 (N-8)	Pass-50% Nitric Acid -50% Sulfuric Acid
Resistance to Hydrostatic Pressure	ASTM D-08.22 Draft 2 (developed: D5385)	100 psi (equals 231 foot of head water)
Resistance to Salt Water	ASTM D-896 similar 20% sodium chloride sodium carbonate calcium chloride	No delamination, blistering, emulsification or deterioration
Resistance to Fertilizer	ASTM D-896 similar undiluted, 15/5/5, nitrogen/phosphorus potash	No delamination, blistering, emulsification or deterioration
Resistance to Animal Waste	3-year exposure	No deterioration
Solids Content		100%-no solvents
Shelf Life		10 years (sealed)
Specific Gravity		1.15 + .02

C. Separation/Root Barrier Protection Course

1. Combination of a fiberglass reinforced rubberized asphalt protection sheet and polyethylene root barrier.  
- American Hydrotech, Inc., Hydroflex® 30 and Root Stop HD
2. Pressure-sensitive polyethylene tape for Rootstop and Rootstop HD  
- American Hydrotech, Inc. Root Stop Tape

D. Drainage/Water Retention Component

1. Three-dimensional, molded panels of recycled polyethylene with drainage channels top and bottom sides and water retention reservoirs top side shall meet the following physical properties.
  - American Hydrotech, Inc., Gardendrain®
    - a. Gardendrain GR50

E. Filter Fabric

1. Non-woven, polymeric, geotextile fabric.
  - American Hydrotech, Inc., Systemfilter

F. Growing Media

1. Custom growing media mix capable of supporting vigorous growth of the specified vegetation, complying with the following specification.
  - American Hydrotech, Inc., Intensive LiteTop® Growing Media

Property	Intensive LiteTop Growing Media*
<b>Grain Size Distribution (ASTM F1632 Method B)</b>	
clay fraction (<0.002mm)	< 3%
silt fraction (0.075-0.002mm)	< 12%
passing #200 sieve (0.075mm)	< 15%
passing #60 sieve (0.25mm)	5 - 25 %
passing #18 sieve (1.0mm)	20 - 50 %
passing #10 sieve (2.0mm)	30 - 60%
passing 1/8-inch sieve	35 - 70 %
passing 1/4-inch sieve	60 - 95%
passing 3/8-inch sieve	95 - 100 %
<b>Density (ASTM E2399)</b>	
Initial Media Density	55 lbs – 75 lbs/cf
Maximum Media Density	76 lbs – 93 lbs/cf
<b>Water/Air Management (ASTM E2399)</b>	
saturated water capacity	> 40%
saturated air content	> 10%
total pore space	> 45%
<b>Water Permeability</b>	
Hydraulic Conductivity	> 10 in/hr
<b>pH, Lime, and Salt Content</b>	
pH (saturated paste)	6.0 – 8.0
EC salts content (water extract)	<3.0 mmhos/cm
<b>Organics (LOI 550°C) (ASTM F1647)</b>	
Organic Matter content	6 – 12 %
<b>Compost Fraction</b>	
1) Meet or exceed USEPA Class A standard, 40 CFR 503.13, Tables 1 & 3 (chemical contaminants) and 40 CFR 503.32(a) (pathogens) and/or be permitted in the state of origin to produce Class A material.	
2) Meet US Compost Council STA/TMECC criteria or equal for Class I or II stable, mature product.	
*Values shall be adjusted due to availability of local materials or special project conditions related to plant selection and/or environmental conditions.	

2. Expanded lightweight aggregate for use as fill material for drainage/water retention component as required.



- American Hydrotech, Inc., LiteTop® Lightweight Aggregate
  - a. 5/16" - 3/8" expanded, lightweight aggregate

G. Filter Fabric

- 1. Water permeable polymeric fabric.
  - American Hydrotech, Inc., Stone Filter Fabric

H. Miscellaneous

- 1. Metal Edging
  - Extruded aluminum edging perforated to allow water flow as shown on plans and details.
  - American Hydrotech, Inc. GardenEdge® Metal Edge Restraint; size as noted on plans and details.
  - American Hydrotech, Inc. GardenEdge® Aluminum Leveling Strips: available to accommodate sloped/level roof surfaces.

**Size and Finish: T.B.D.**

- 2. Inspection Chambers
  - Aluminum and stainless steel over drain chambers perforated to allow water flow as shown on plans and details.
  - American Hydrotech, Inc. GardenHatch® Inspection Chambers; size as noted on plans and details.

**Location and Size: T.B.D.**

2.03 RELATED MATERIALS

- A. Intensive plant materials (specified elsewhere) shall be as shown on plans.
- B. Metal counterflashing shall be required to provide protection to vulnerable flashing materials from damage due to gardening activities.

PART 3 - EXECUTION

3.01 INSPECTION

- A. The roofing contractor shall examine all surfaces to receive the roofing assembly to verify it is acceptable and proper for the application of the membrane. **Refer to American Hydrotech's Pre-Installation & Application Guidelines.**
- B. The roofing contractor shall not proceed with the installation of the roof membrane assembly until all roof defects have been corrected.

3.02 PREPARATION

- A. All surfaces must be dry, smooth, free of depressions, voids, protrusions, clean and free of unapproved curing compounds, form release agents and other surface contaminant.
  - 1. Re-Roof/Tear-Off Application
    - a. Asphalt, coal tar pitch or other existing membrane must be removed. **CONTACT Hydrotech.**
    - b. Deck type acceptable to Hydrotech.

### 3.03 INSTALLATION

#### A. Detailing/Flashing

1. All detailing and flashing shall be done in accordance with the manufacturer's standard guideline details.
2. All detailing and flashing shall be completed before installing the membrane over the field of the substrate.
3. Roof substrate board joints shall be pre-detailed with membrane and fabric reinforcing prior to full fabric reinforced membrane application.
4. All liquid-applied, resin flashings shall be applied over properly completed membrane flashing details in accordance with the manufacturer's standard guideline details.

#### B. Membrane Application

1. Apply the rubberized asphalt membrane at a rate to provide a continuous, monolithic coat of 90 mil minimum (approximately 2.3 mm), into which shall be fully embedded a layer of the spunbonded polyester fabric reinforcing sheet, followed by another continuous monolithic coat of membrane at an average thickness of 125 mil (approx. 3.2 mm). Total membrane thickness shall be 215 mils average (approx. 5.5 mm), 180 mils minimum.
2. Overlap fabric reinforcing sheet 1-2 inches (25.4 mm - 50.8 mm) with membrane between sheets.
3. Pre-detailing of joints between plywood and roof substrate board decks shall be required for warranties greater than 10 years.

### 3.04 SEPARATION/PROTECTION COURSE INSTALLATION

#### A. Separation/Protection course shall be installed as follows:

1. Hydroflex® 30 separation/protection course shall be embedded into the membrane while it is still hot to insure a good bond. Installation of a separation course shall be necessary in order to carry out the water test.
  - a. Overlap adjoining sheet edges (dry) a minimum of 2"-3" (50.8 mm – 76.2 mm) to insure complete coverage

### 3.05 MEMBRANE INTEGRITY TEST

#### A. The roof area or portions thereof shall be leak tested by means of electronic testing or by ponding water at a minimum depth of 2" (50.8 mm) for a period of 48 hours to check the integrity of the membrane installation.

1. VERIFY that the structure can support the deadload weight of a watertest before testing.
2. If leaks should occur the water shall be drained completely and the membrane installation repaired.

#### B. In the event of excessive damage to the membrane assembly, electronic beach detection testing shall be required prior to the placement of subsequent overburden.

### 3.06 GARDEN ROOF® COMPONENTS INSTALLATION

#### A. Root Barrier Protection.

1. Root Stop HD shall be laid over the Hydroflex 30, lapping adjacent sheets 5 feet (1.5 m). A 1 foot (300 mm) overlap is acceptable when Seam Tape is used to continuously seal the lap edges. Root Stop shall be turned up all vertical roofed/flashed surfaces, installing additional material as required, to completely protect waterproofing and flashings.

#### B. Drainage/Water Retention Component

1. Gardendrain GR50 shall be installed with holes up, over the root barrier protection, water retention mat. Adjacent panels shall be butt together. Gardendrain shall be cut to fit around penetrations, etc. with a heavy-duty utility knife or small toothed saw.
  2. The cups of the Gardendrain shall be filled with lightweight aggregate level with the top surface of the panels where required due to loading conditions.
- C. Filter Fabric
1. A layer of Systemfilter shall be laid over the Gardendrain, lapping adjacent rolls a minimum of 12 inches (300 mm). Enough material shall be left to be drawn up above the anticipated growing media level. Any excess shall be trimmed down to the level of the growing media.
- 3.07 HARDSCAPE/ACCESSORY INSTALLATION
- A. Metal edge restraints, precast curbing and all specified edging materials shall be installed as shown on plans and details.
  - B. Drains shall be fitted with inspection/maintenance chambers and grills, built up to ensure access at growing media level as shown on plans and details.
- 3.08 GROWING MEDIA INSTALLATION
- A. LiteTop growing media shall be placed carefully to avoid damage or displacement of other materials such as walls, paving, drainage components, filter fabric, and roofing membrane.
  - B. LiteTop growing media shall be placed to within 1 inch greater than final grade or to a depth of no greater than 8 inches and compacted as described in 3.08.C. below. For final grades less than 8 inches only one round of compaction shall be performed and remaining growing media loosely placed such that top of growing media exceeds final grade by 1 inch (see 3.08.D. below). For final grades greater than 8 inches, place growing media at no greater than 6 inches and repeat procedure until growing media has been compacted within 1 inch of final grade.
  - C. Compaction shall be performed with a 300 – 400 lb. landscape roller to achieve a 50 – 60 % compaction. Mechanical compactors including plate compactors are not recommended.
  - D. After compaction remaining growing media shall be placed at 1 inch greater than final grade and thoroughly watered or jetted over entire area. Low settled areas shall be filled with additional growing media and re-wet to achieve uniform prescribed final grade.
- 3.09 VEGETATION INSTALLATION
- A. Intensive plant materials (specified elsewhere) shall be installed in accordance with the plans and specifications.

**END OF SECTION**

**SECTION 22 0719**

**PLUMBING PIPING INSULATION**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.02 SUMMARY**

- A. Section includes insulating the following plumbing piping services:
  - 1. Domestic cold-water piping.
  - 2. Domestic hot-water piping.
  - 3. Domestic recirculating hot-water piping.
  - 4. Sanitary waste piping exposed to freezing conditions.
  - 5. Roof drains and rainwater leaders.
  - 6. Supplies and drains for handicap-accessible lavatories and sinks.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

**1.04 QUALITY ASSURANCE**

- A. Comply with the following applicable standards and other requirements specified for miscellaneous components:
  - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.06 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.07 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Mineral-Fiber, Preformed Pipe Insulation:

1. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- I. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials.

2.02 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.03 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- D. PVC Jacket Adhesive: Compatible with PVC jacket.

2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
  1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
  1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  2. Service Temperature Range: Minus 20 to plus 180 deg F .
  3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

4. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F .
3. Solids Content: 60 percent by volume and 66 percent by weight.
4. Color: White.

## 2.05 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
3. Service Temperature Range: 0 to plus 180 deg F .
4. Color: White.

## 2.06 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F .
4. Color: White or gray.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.

3. Service Temperature Range: Minus 40 to plus 250 deg F .
4. Color: White.

## 2.07 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
  1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

## 2.08 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. , in a Leno weave, for pipe.

## 2.09 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. .

## 2.10 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  1. Width: 3 inches .
  2. Thickness: 11.5 mils .
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.



## 2.11 SECUREMENTS

### A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing seal.
2. Aluminum: ASTM B 209 , Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.

### B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

### C. Wire: 0.062-inch soft-annealed, stainless steel.

## 2.12 PROTECTIVE SHIELDING GUARDS

### A. Protective Shielding Piping Enclosures, All ADA required locations.:

1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

#### A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### 3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- O. For above-ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
  - 4. Cleanouts.

### 3.04 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
  - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe

diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

### 3.05 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
  1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.06 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch , and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.07 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.08 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.09 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

- C. Do not field paint aluminum or stainless-steel jackets.

### 3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Drainage piping located in crawl spaces.
  - 2. Underground piping.
  - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 3.11 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
  - 1. NPS 1 and Smaller: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 1/2 inch thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
    - c. Polyolefin: 1/2 inch thick.
  - 2. NPS 1-1/4 and Larger: Insulation shall be one of the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
    - b. Polyolefin: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
  - 1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 1 inch thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
    - c. Polyolefin: 1 inch thick.



C. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be one of the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  - b. Polyolefin: 1 inch thick.

D. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be one of the following:
  - a. Flexible Elastomeric: 1/2 inch thick.
  - b. Polyolefin: 1/2 inch thick.

E. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation shall be one of the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  - b. Phenolic: 1 inch thick.

**END OF SECTION**

**SECTION 221005**  
**PLUMBING PIPING**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Pipe, pipe fittings, valves, and connections for piping systems.
  - 1. Sanitary sewer.
  - 2. Domestic water.
  - 3. Storm water.
  - 4. Flanges, unions, and couplings.
  - 5. Pipe hangers and supports.
  - 6. Valves.
  - 7. Flow controls.
  - 8. Check.
  - 9. Water pressure reducing valves.
  - 10. Relief valves.
  - 11. Strainers.

**1.02 RELATED REQUIREMENTS**

- A. Section 08 3100 - Access Doors and Panels.
- B. Section 09 9113 - Exterior Painting.
- C. Section 09 9123 - Interior Painting.
- D. Section 22 0516 - Expansion Fittings and Loops for Plumbing Piping.
- E. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- F. Section 33 1300 - Disinfecting of Water Utility Distribution.

**1.03 REFERENCE STANDARDS**

- A. ANSI Z21.22 - American National Standard for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems; 1999, and addenda A&B (R2004).
- B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2012 (ANSI B16.18).
- C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; The American Society of Mechanical Engineers; 2013.
- D. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV; The American Society of Mechanical Engineers; 2011.
- E. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; The American Society of Mechanical Engineers; 2013.

- F. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV; The American Society of Mechanical Engineers; 2012.
- G. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 2014 (ANSI/ASME B31.9).
- H. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; The American Society of Mechanical Engineers; 2015.
- I. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications; The American Society of Mechanical Engineers; 2015.
- J. ASSE 1003 - Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems; The American Society of Sanitary Engineering; 2009.
- K. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2016.
- L. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- M. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).
- N. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2015a.
- O. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes; 2014.
- P. ASTM B68/B68M - Standard Specification for Seamless Copper Tube, Bright Annealed; 2011.
- Q. ASTM B75/B75M - Standard Specification for Seamless Copper Tube; 2011.
- R. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2014.
- S. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2013.
- T. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV); 2013.
- U. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2010.
- V. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2002 (Reapproved 2010).
- W. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2014.
- X. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015.
- Y. ASTM D2239 - Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Inside Diameter; 2012.
- Z. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2015.
- AA. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2013.
- AB. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2012.

- AC. ASTM D2609 - Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe; 2015.
- AD. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2014.
- AE. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings; 1996 (Reapproved 2010).
- AF. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2015.
- AG. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992 (Reapproved 2014).
- AH. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing; 2013a.
- AI. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems; 2011; R 2011a.
- AJ. **11**
- AK. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; American Welding Society; 2011-AMD 1.
- AL. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; American Water Works Association; 2012 (ANSI/AWWA C110).
- AM. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; American Water Works Association; 2012 (ANSI/AWWA C111/A21.11).
- AN. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; American Water Works Association; 2009 (ANSI/AWWA C151/A21.51).
- AO. AWWA C550 - Protective Interior Coatings for Valves and Hydrants; American Water Works Association; 2013.
- AP. AWWA C606 - Grooved and Shouldered Joints; 2015 (ANSI/AWWA C606).
- AQ. AWWA C651 - Disinfecting Water Mains; American Water Works Association; 2005 (ANSI/AWWA C651).
- AR. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications; Cast Iron Soil Pipe Institute; 2009.
- AS. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; Cast Iron Soil Pipe Institute; 2011
- AT. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2015.
- AU. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2012.
- AV. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2015.
- AW. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2013.
- AX. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2009.

- AY. MSS SP-67 - Butterfly Valves; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2011.
- AZ. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2013.
- BA. MSS SP-85 - Cast Iron Globe & Angle Valves, Flanged and Threaded Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2011.
- BB. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2010.
- BC. NSF 61 - Drinking Water System Components - Health Effects; 2014 (Errata 2015).
- BD. NSF 372 - Drinking Water System Components - Lead Content; 2011.
- BE. PPI TR-4 - PPI Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB), and Minimum Required Strength (MRS) Ratings For Thermoplastic Piping Materials or Pipe; Plastics Pipe Institute; 2013.

#### 1.04 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

### PART 2 PRODUCTS

#### 2.01 GENERAL REQUIREMENTS

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

#### 2.02 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

- A. SOLID CORE PVC Pipe: ASTM D2665 or ASTM D3034.
  - 1. Fittings: Solid Core PVC.
  - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

#### 2.03 SANITARY SEWER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
  - 1. Fittings: Cast iron.

2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
  - B. Copper Tube: ASTM B306, DWV.
    1. Fittings: ASME B16.29, wrought copper, or ASME B16.23, solvent.
    2. Joints: ASTM B32, alloy Sn50 solder.
  - C. SOLID CORE PVC Pipe: ASTM D1785 Schedule 40, or ASTM D2241 SDR 26 with not less than 150 psi (1 034 kPa) pressure rating.
    1. Fittings: ASTM D2466, SOLID CORE PVC.
    2. Joints: Solvent welded, with ASTM D2564 Solvent cement.
- 2.04 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING
- A. Copper Pipe: ASTM B42, hard drawn.
    1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
  - B. Ductile Iron Pipe: AWWA C151/A21.51.
    1. Fittings: Ductile or gray iron, standard thickness.
    2. Joints: AWWA C111/A21.11, rubber gasket with 3/4 inch (19 mm) diameter rods.
  - C. Cross-Linked Polyethylene (PEX) Pipe: ASTM F876 or ASTM F877.
    1. PPI TR-4 Pressure Design Basis:
      - a. 160 psig (1102 kPa) at maximum 73 degrees F (23 degrees C).
      - b. 100 psig (689 kPa) at maximum 180 degrees F (82 degrees C).
    2. Fittings: Brass and engineered polymer (EP) ASTM F1960.
- 2.05 DOMESTIC WATER PIPING, ABOVE GRADE
- A. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), Drawn (H).
    1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
    2. Joints: ASTM B32, alloy Sn95 solder.
  - B. Cross-Linked Polyethylene (PEX) Pipe: ASTM F876 or ASTM F877.
    1. PPI TR-4 Pressure Design Basis:
      - a. 160 psig (1102 kPa) at maximum 73 degrees F (23 degrees C).
      - b. 100 psig (689 kPa) at maximum 180 degrees F (82 degrees C).
    2. Fittings: Brass and copper.
    3. Fittings: Brass and engineered polymer (EP) ASTM F1960.
    4. Joints: Mechanical compression fittings.
    5. Joints: ASTM F1960 cold-expansion fittings.

2.06 STORM WATER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

- A. SOLID CORE PVC Pipe: ASTM D2665 or ASTM D3034.
  - 1. Fittings: SOLID CORE PVC.
  - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.07 STORM WATER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A74 extra heavy weight.
  - 1. Fittings: Cast iron.
  - 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- B. SOLID CORE PVC Pipe: ASTM D2665 or ASTM D3034.
  - 1. Fittings: SOLID CORE PVC.
  - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.08 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.
  - 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
  - 2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
  - 3. Trapeze Hangers: Welded steel channel frames attached to structure.
  - 4. Vertical Pipe Support: Steel riser clamp.
  - 5. Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.
  - 6. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
    - a. Bases: High density polypropylene.
    - b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
    - c. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
    - d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
    - e. Height: Provide minimum clearance of 6 inches (150 mm) under pipe to top of roofing.
- B. Plumbing Piping - Drain, Waste, and Vent:
  - 1. Hangers for Pipe Sizes 1/2 Inch (15 mm) to 1-1/2 Inches (40 mm): Malleable iron, adjustable swivel, split ring.
  - 2. Hangers for Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
  - 3. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

- C. Plumbing Piping - Water:
  - 1. Hangers for Pipe Sizes 1/2 Inch (15 mm) to 1-1/2 Inches (40 mm): Malleable iron, adjustable swivel, split ring.
  - 2. Hangers for Cold Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
- D. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
  - 1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
  - 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
  - 3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
  - 4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
  - 5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
  - 6. Other Types: As required.

#### 2.09 GLOBE VALVES

- A. Manufacturers:
- B. 2 Inches (50 mm) and Larger:
  - 1. MSS SP-85, Class 125, iron body, bronze trim, handwheel, outside screw and yoke, renewable bronze plug-type disc, renewable seat, flanged ends. Provide chain-wheel operators for valves 6 inches (150 mm) and larger mounted over 8 feet (2400 mm) above floor.

#### 2.10 BALL VALVES

- A. Construction, 4 Inches (100 mm) and Smaller: MSS SP-110, Class 150, 400 psi (2760 kPa) CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, full port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, threaded or grooved ends with union.

#### 2.11 BUTTERFLY VALVES

- A. Construction 1-1/2 Inches (40 mm) and Larger: MSS SP-67, 200 psi (1380 kPa) CWP, cast or ductile iron body, nickel-plated ductile iron disc, resilient replaceable EPDM seat, wafer ends, extended neck, 10 position lever handle.
- B. Provide gear operators for valves 8 inches (150 mm) and larger, and chain-wheel operators for valves mounted over 8 feet (2400 mm) above floor.

#### 2.12 SWING CHECK VALVES

- A. Up to 2 Inches (50 mm):
  - 1. MSS SP-80, Class 125, bronze body and cap, bronze swing disc with rubber seat, solder ends.

#### 2.13 SPRING LOADED CHECK VALVES

- A. Class 125, iron body, bronze trim, stainless steel springs, bronze disc, Buna N seals, wafer style ends.



2.14 WATER PRESSURE REDUCING VALVES

- A. Up to 2 Inches (50 mm):
  - 1. ASSE 1003, bronze body, stainless steel, and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded single union ends.

2.15 RELIEF VALVES

- A. Temperature and Pressure Relief:
  - 1. ANSI Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F (98.9 degrees C), capacity ASME BSOLID CORE PVC-IV certified and labelled.

2.16 STRAINERS

- A. Size 2 inch (50 mm) and Under:
  - 1. Threaded brass body for 175 psi (1200 kPa) CWP, Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.
  - 2. Class 150, threaded bronze body 300 psi (2070 kPa) CWP, Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.
- B. Size 1-1/2 inch (40 mm) to 4 inch (100 mm):
  - 1. Class 125, flanged iron body, Y pattern with 1/16 inch (1.6 mm) stainless steel perforated screen.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- C. Group piping whenever practical at common elevations.
- D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 0516.
- E. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- F. Provide access where valves and fittings are not exposed.
  - 1. Coordinate size and location of access doors with Section 08 3100.
- G. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

- H. Provide support for utility meters in accordance with requirements of utility companies.
- I. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
  - 1. Painting of interior plumbing systems and components is specified in Section 09 9123.
  - 2. Painting of exterior plumbing systems and components is specified in Section 09 9113.
- J. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.
- K. Install water piping to ASME B31.9.
- L. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
- M. SOLID CORE PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- N. Sleeve pipes passing through partitions, walls and floors.
- O. Inserts:
  - 1. Provide inserts for placement in concrete formwork.
  - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
  - 3. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- P. Pipe Hangers and Supports:
  - 1. Install in accordance with ASME B31.9.
  - 2. Install hangers to provide minimum 1/2 inch (15 mm) space between finished covering and adjacent work.
  - 3. Place hangers within 12 inches (300 mm) of each horizontal elbow.
  - 4. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
  - 5. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
    - a. Painting of interior plumbing systems and components is specified in Section 09 9123.
  - 6. Provide hangers adjacent to motor driven equipment with vibration isolation; refer to Section 22 0548.

### 3.04 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- C. Install globe valves for throttling, bypass, or manual flow control services.
- D. Provide spring loaded check valves on discharge of water pumps.
- E. Provide flow controls in water recirculating systems where indicated.

3.05 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Disinfect water distribution system in accordance with Section 33 1300.
- B. Prior to starting work, verify system is complete, flushed and clean.
- C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- E. Maintain disinfectant in system for 24 hours.
- F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.06 SERVICE CONNECTIONS

- A. Provide new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve, and sand strainer.
- 1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.

**END OF SECTION**

**SECTION 221006**

**PLUMBING PIPING SPECIALTIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Drains.
- B. Cleanouts.
- C. Hose bibbs.
- D. Hydrants.
- E. Backflow preventers.

**1.02 RELATED REQUIREMENTS**

- A. Section 22 1005 - Plumbing Piping.

**1.03 REFERENCE STANDARDS**

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASME A112.6.3 - Floor and Trench Drains; 2001 (R2007).
- C. ASME A112.6.4 - Roof, Deck, and Balcony Drains; 2008 (Reaffirmed 2012).
- D. ASSE 1011 - Hose Connection Vacuum Breakers; 2004.
- E. ASSE 1012 - Backflow Preventer with Intermediate Atmospheric Vent; 2009.
- F. ASSE 1013 - Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers; 2011.
- G. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2011.
- H. ASTM C478 - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections; 2015.
- I. ASTM C478M - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections (Metric); 2015.
- J. NSF 61 - Drinking Water System Components - Health Effects; 2014 (Errata 2015).
- K. NSF 372 - Drinking Water System Components - Lead Content; 2011.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- C. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Install floor cleanouts at elevation to accommodate finished floor.
- E. Install approved portable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.
- F. Pipe relief from backflow preventer to nearest drain.
- G. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to washing machine outlets or flush valves.

**END OF SECTION**

## SECTION 230513

### BASIC MECHANICAL REQUIREMENTS

#### PART 1 GENERAL

##### 1.01 GENERAL CONDITIONS

- A. The General Contract Conditions, Drawings, Division-1 Specifications and Supplementary Conditions of the General Contract apply to work under this Division.

##### 1.02 QUALITY ASSURANCE

- A. If manufacturer's material or equipment is listed in Schedules, Specifications or on Drawings, they are types to be provided for establishment of size, capacity, grade, and quality. If other acceptable manufacturers are used, cost of any change in construction required by their use shall be borne by Contractor.
- B. Equipment shall conform to State and/or local Energy Conservation Standards.
- C. Execute and test all work per Underwriters, state and local codes, rules, and regulations applicable to trade affected. Included are recommendations of NFPA, SMACNA, OSHA, and ASHRAE. References to standards are latest revision of standard specified.
- D. Comply with rules and regulations of local utility companies. Include cost of valves, valve boxes, meter boxes, meters, and accessory equipment required for project for a complete and functioning installation.

##### 1.03 INTENT AND INTERPRETATIONS

- A. It is the intent of these Drawings and Specifications to result in a complete mechanical installation in complete accordance with all applicable codes and ordinances.
- B. Drawings are diagrammatic in character and do not necessarily indicate every required pipe, offset, transition, water bypass etc. Items not specifically mentioned in the Specification or noted on the Drawings, but which are obviously necessary to make a complete working installation, shall be included.
- C. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both. If, during the performance of the Work, Contractor finds a conflict, error or discrepancy in the Contract Documents, it shall be reported to the Owner's Representative in writing at once and before proceeding with the Work affected thereby. Work done by the contractor after this discovery of such discrepancies, inconsistencies, or ambiguities shall be done at the Contractor's risk.
- D. Mechanical Drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for these purposes or have to be made from field measurements, the Contractor shall take the necessary measurements and prepare the drawings.
- E. Symbols used on the Drawings are defined in the Legend on the Drawings. All symbols indicated on the Legend may not necessarily be required for the project.
- F. "Provide" shall mean "furnish and install." "Accepted" or "acceptable" denotes that the work or equipment item is in conformance with the design concept of the project and, in general, complies with the pertinent information given in the Contract Documents.
- G. Before any work is installed, determine that equipment will properly fit the space, that required

clearances can be maintained and that equipment can be located without interferences between systems, with structural elements, or with the work of other trades.

- H. If conflicts are discovered in Contract Documents as work progresses, submit a set of drawings marked with red pencil showing recommended modifications to the Owner's Representative for approval prior to installation.
- I. The Drawings indicate the general arrangement of mechanical systems. However, rearrangement will not be permitted without specific approval prior to installation. The Contractor shall submit shop drawings to the Owner's Representative indicating the rearrangement with original drawings indicating why rearrangement is required.
- J. Provide incidental equipment such as tools, scaffolding, consumable items, testing equipment, appliances and the like whether listed or not. Provide labor, fees, licenses, start-up and checkout services also.
- K. In the event that any discrepancies of any kind exist or required items or details have been omitted, notify the Owner's Representative in writing of such discrepancy or omission at least five days prior to bid date. Failure to do so shall be construed as willingness to supply all necessary materials and labor required for the proper completion of this work. Refer to Division-1 specifications for further requirements and information.

#### 1.04 DESIGN RESPONSIBILITY

- A. The snowmelt contractors selected for the Torian Plum, project shall be the only snowmelt contractors bidding on the design build snowmelt system for the Torian Plum property. The Promenade snowmelt contractors are:
  - 1. TBD
  - 2. TBD
- B. The design guidelines for each snowmelt system are presented in this specification. These specifications are intended for use with all mechanical trades work associated with this project.
- C. The installing contractor shall design the snowmelt system to be fully functioning and connected to the Torian Plum Snowmelt System for the Promenade.
- D. Individual snowmelt zones shall be designed by the system installer and shall be located on required shop drawings for review by the Owner's Representative. All shop drawings shall utilize a drawing scale of 1":10' unless clarity requires an enlarged scale.
- E. The contractor shall provide a service agreement to Torian Plum for the area of work. This shall be a separate line item in the work proposal. The service agreement shall indicate the service required for the work area.
- F. Insulation under the snowmelt system shall not be used at any location without prior consent of the architect of record and the project owner and owner's representative. Insulation at the edge of the snowmelt zones (vertical insulation) shall be used wherever the snowmelt system abuts or is directly adjacent to a landscaped area or planter bed. Coordinate the areas and locations where vertical insulation shall be used with the owner's representative. Refer to the insulation and snowmelt specifications for more information.

1.05 JOB CONDITIONS

- A. Location, size, and type of equipment and material shown as existing are taken from existing drawings. Verify exact conditions in field prior to start of construction.
- B. Before submitting bid, examine premises and become familiar with all existing conditions which may affect cost. No allowance will subsequently be made for not following this procedure.
- C. There is existing equipment being used in the project which is not limited to but includes snowmelt piping, snowmelt manifolds, control conduit, snow melt piping mains/branches, gas meters/services, water services and sewer systems. Become familiar with existing locations and rough-in requirements prior to installation. Report any difficulties or discrepancies to Owner's Representative prior to start of work.
- D. Not all piping, offsets, transitions, water bypasses and multiple connections required to install the new work into the available space are shown on the drawings. Field measure for exact requirements and install accordingly.
- E. Confer, cooperate, and coordinate work with other trades. Coordinate space requirements carefully with all trades. In event of conflict, install mechanical and electrical systems within space in the following order of priority.
  - 1. Plumbing waste and vent piping.
  - 2. Ductwork.
  - 3. Electrical conduit and lighting.
  - 4. Hydronic water piping.
- F. Where locations of devices and equipment are not specifically mentioned in the Specifications or indicated on the Drawings, verify locations with Owner's Representative prior to rough-in.
- G. Submit large scale coordinated composite layouts in both plan and elevation, showing, piping, ducts, and conduits in areas that appear congested. Check routing of work prior to fabrication. Report conflicts to Owner's Representative.
- H. Provide carpentry, masonry, concrete and metal work required for work of this Division where not specifically called for under other Sections.
- I. Complete all work necessary to meet requirements without additional expense to the Owner.

1.06 PERMITS AND FEES

- A. Arrange and pay for all inspections, permits, licenses, certificates, and fees required in connection with work.

1.07 SUBMITTALS AND SHOP DRAWINGS

- A. Refer to Division-1 specification for submittal and shop drawing requirements. It is the responsibility of the snow melt system contractor and fire feature mechanical contractor to provide a schedule of submittals that that allows for 28 days between providing the submittal and when work is to be performed or equipment ordered.
- B. Submittals shall include catalog cut-sheets, manufacturer's data sheets, written descriptions, and specification sheets detailing the associated product, item, assembly, quantity, and tag symbol used on



- plans. All submittals shall be provided with a disk of pdf's for each submitted item or group of items.
- C. Shop drawings shall include details, installation drawings, assembly drawings, fabrication drawings, diagrams, and other information which show adaptation or installation of Contractor-furnished products or materials for overall project.
  - D. The purpose of submittals and shop drawings is to ensure that Contractor understands design requirements and demonstrates understanding by indicating and detailing intended materials, methods, and installation practices. Submittals and shop drawings are not a method of requesting substitutions or deviation from Specifications. If discrepancies between submittals, shop drawings, and Contract Documents are discovered either prior to or after submittals and shop drawings are reviewed, requirements of Contract Documents shall take precedence. Submittals and shop drawings which are submitted, but which are not required by Contract Documents, will be returned Not Reviewed.
  - E. Submittals and shop drawings shall identify specific equipment with numbers or letters identical to those listed or scheduled on the Drawings or Specifications.
  - F. After review, Mechanical submittals and shop drawings will be returned together with a Submittal Review Sheet which indicates comments on submittals and shop drawings and with specific actions such as: No Exception Taken; Make Corrections Noted, Re-submittal Not Required; Make Corrections Noted, Re-submittal Required; Rejected; Not Reviewed. Continue to re-submit submittals and shop drawings until No Exception Taken or Make Corrections Noted, Re-submittal Not Required action is indicated.
- 1.08 RECORD DOCUMENTS
- A. Record Documents must be kept current throughout the Project. Requirements for Record Documents are found in Section 01770.
- 1.09 DELIVERY, STORAGE, HANDLING
- A. Provide delivery and safe storage of materials and equipment. Make provisions for introduction into building of equipment too large to pass through finished openings. Provide for hoisting of equipment.
- 1.10 PROTECTION OF EQUIPMENT
- A. Protect materials and equipment from physical damage, construction dirt, and the elements from time of shipment to time installation is accepted by Owner.
  - B. Protect mechanical work against theft, injury, or damage from all causes.
- 1.11 GUARANTEE
- A. Guarantee materials, workmanship, and operation of equipment installed for period of two years from date of completion or from the date of the owner's representative's acceptance of entire Work. Repair or replace any part of work which shows defect during that time.
  - B. The Guarantee (warranty) shall be separate for each snowmelt system and scope of work and shall start upon completion of the system and acceptance of system by owner's representative.
  - C. Be responsible for damage to property of Owner or to work of other contractors during construction and guarantee period.
  - D. Furnish equipment warranties to Owner.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 HANDLING OF EQUIPMENT USING REFRIGERANTS

- A. Technicians handling equipment with refrigerants, for removal or installation, shall be EPA (Environmental Protection Agency) certified in accordance with Regulation No. 15 of Colorado Air Quality Control Commission, Section 608 of the Clean Air Act, 1990, as amended.
- B. Type of technician certification shall be compatible with the handled equipment: high, very high, or low pressure appliances.
- C. Equipment to be removed shall be evacuated of refrigerant to the pressures established in the Prohibition of Venting Table of Section 608 for the type of refrigerant handled. Evacuation equipment shall be certified in accordance with ARI 740.
- D. Evacuated refrigerant shall be recovered and recycled in accordance with EPA's requirements at the Contractor's expense.
- E. Prior to handling of equipment with refrigerants, submit proof of technical and refrigerant handling equipment certification. After handling of refrigerants, submit detailed documentation, including type of refrigerant and quantities, indicating the steps taken to comply with EPA regulations.

3.02 MECHANICAL EQUIPMENT WIRING AND CONNECTIONS

- A. Voltage characteristics shall be as in Electrical Division of Specifications and on Electrical Drawings.

3.03 DEMOLITION

- A. During demolition, carefully remove existing equipment, piping, ductwork, and related items as required for Work. Tag items, protect from damage, and store as directed by Owner. Deliver list of items stored to Owner. At completion of work or when directed by Owner's Representative, remove from job site stored items not reused or wanted by Owner.
- B. Hazardous material may exist at job site. If hazardous material is discovered, stop work in that area, notify Owner's Representative immediately. Owner will remove hazardous material. Do not resume work in that area until notified to do so by Owner.
- C. Dispose of or recycle refrigerant and refrigeration equipment in accordance with State and Federal regulations.

3.04 EXCAVATING AND BACKFILLING

- A. Have all underground utilities located and marked before excavating. Instruct employees on markings and color codes and train employees on excavation and safety procedures for natural gas lines. When excavation approaches gas lines, expose lines by carefully probing and hand digging.
- B. Do excavating, backfilling, and compacting per Division 2.
- C. Walls of trenches shall be minimum 6" from side of nearest mechanical work. Install pipes with minimum 6" clearance between when located in same trench.

- D. Pipe Trenching: Dig trenches to depth, width, configuration, and grade appropriate to piping being installed. Dig trenches to 6" below level of bottom of pipe to be installed. Install 6" bed of pea gravel or fine granular material, mechanically tamp to firm bed for piping, true to line and grade. Provide depressions only at hubs, couplings, flanges, or other normal pipe protrusions.
- E. Do not backfill until work has been inspected, tested, approved. Backfill material shall be approved by Owner's Representative. Do not bury lumber, metal, or other debris with backfill.
- F. Trench Backfill: Backfill to 12" above top of piping with pea gravel or fine granular material (as space allows). Compact properly. Continue backfill to finish grade in 6" layers, each properly moistened and mechanically compacted. Do not compact by hydraulic jetting. Settling shall be refilled, tamped, and refinished.
- G. Use suitable excavated material to complete backfill.
- H. Repair any damage to finished surfaces.

3.05 CUTTING AND PATCHING

- A. Locate all holes and chases required for work during progress of construction; provide properly sized metal sleeves or wood boxes for sleeving. Before beginning sleeving or installation work, study Contract Drawings and check piping, ductwork, equipment locations for interference with other trades. If conflicts are discovered, submit recommended solution for approval prior to installation. Do all cutting, repairing, structural reinforcing for installation of work per Owner's Representative's directions. Do not cut for any reason without Owner's Representative's approval.
- B. Sleeves and chases are prohibited in any structural member except where approved by Owner's Representative.
- C. Cut and patch all openings in existing walls, floors, and roof as required for ductwork and piping. Patching consists of completing work to match and blend in with adjoining existing work. Patches which are not properly blended shall be redone. Do patching work with craftsmen qualified and skilled in type of patching work required.

3.06 TEMPORARY FACILITIES

- A. Light, Heat, Power, Etc.: Provide temporary power supply or other facilities required for Work. Arrange with proper parties to bring facilities from services to required location on premises.

3.07 INSPECTIONS

- A. Do not cover up or enclose work until inspected, tested, and approved. Any work enclosed or covered up before such approval shall be uncovered, tested, and approved.

3.08 ACCESS DOORS

- A. Furnish hinged steel access doors with concealed latch, whether shown or not, in walls and in architectural features or for access to concealed valves, air vents, balancing valves, or other operating devices requiring adjustment, servicing, maintenance, or replacement.
- B. Access door shall be size of equipment to be removed or 24" by 24" if used for service only.
- C. Furnish doors to trades performing work in which they are to be installed. Group valves, devices, and other equipment, to permit use of minimum number of access doors.

- D. Doors shall be type compatible with finish in which they are to be installed.

3.09 SUPERVISION

- A. Supervise work to proceed in proper sequence without delay to other contractors. Keep supervisor on premises at all times to ensure that intent of Drawings and Specifications is being followed.

3.10 INSTALLATION

- A. Workmanship shall be first quality. Appearance of work shall be of equal importance to its mechanical operation. Lack of quality workmanship shall be reason for rejection of system in part or in whole.
- B. Install so that all valves and equipment can be easily accessed and serviced by adequate clearance, installation of access doors, unions in piping, or other methods.
- C. Complete installation shall function smoothly.
- D. Install equipment and materials per manufacturers' recommendations and local codes or regulations.
- E. Place or replace all equipment nameplates where they can be seen and read without difficulty.
- F. Flush pipes free of foreign substances before installing valves or making final connections. Clean all piping and equipment.

3.11 LUBRICATION OF EQUIPMENT

- A. Lubricate equipment before operating and before turning over to Owner.

3.12 TESTING

- A. All tests specified herein and/or called for by authorities having jurisdiction shall be witnessed by Owner's Representative.
- B. Upon completion of the work, deliver certificates of inspection and final approval to Owner's Representative.

3.13 SYSTEM START-UP AND TESTING

- A. Start up and test all equipment per manufacturer's instructions. Operate system to establish proper operation and performance. Make necessary adjustments and corrections.
- B. Certify to Owner in writing that system has been operated and tested and is operating to design performance requirements.

3.14 COMPLETION

- A. Clean insulation covering, pipes, equipment, and accessories to receive prime coat of paint. Clean equipment received with prime coat to receive final coat.
- B. Instruct Owner in operation and maintenance of mechanical systems. Minimum participants shall include mechanical contractor and controls contractor representatives. Refer to design responsibility this specification for more information.

- C. After tests and adjustments have been made and systems pronounced satisfactory for permanent operation, refinish damaged finish and leave everything in proper working order and appearance.
- D. On completion of work, remove tools, scaffolding, debris, etc., from grounds and leave premises clean.

3.15 PROJECT CLOSE-OUT

- A. Upon written notice from the Contractor certifying that the work is complete and ready for inspection, Engineer will prepare a punch list of items determined to be incomplete or otherwise not in compliance with intent of Contract Documents.
- B. When required, subsequent visit to review completion of punch list work will be made after receipt of written statement from Contractor indicating punch list work is complete. Include copies of intermediate observation reports and final punch list with individual items initialed by Contractor to attest that individual work items are completed.

3.16 OPERATION AND MAINTENANCE

- I. Prior to completion of project, submit three (3) sets of maintenance manuals covering operation and maintenance of mechanical equipment with moving or movable parts, including plumbing systems. Instructions shall be in pamphlet or typewritten form in three ring binders. Instructions for each unit shall be indicated by separate tab.
- J. Include test and balance report.
- K. Include valve tag list.
- L. Include name, address, and telephone number of party to be contacted for 24-hour service for each item of equipment. This shall be a single point of contact by the installing contractor.
- M. Include starting, stopping, lubrication, preventative maintenance schedule, and adjustment information for each piece of equipment.
- N. Include guarantees and warranties of all equipment.
- O. The contractor shall provide a service agreement with their bid. The service agreement shall be a length of 2 years following substantial completion or starting on a date as determined by the Owner's Representative. The Torian Plum system shall be provided with a separate service agreement with the starting date of the agreement being defined for each system with a service agreement. The service contract shall include maintenance of the systems as required for the 2-year contract. Physical operation of the snow melt system for this period by the installing contractor shall be excluded in the service agreement.

**END OF SECTION**

**SECTION 230529**

**HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**

**PART 1 GENERAL**

**1.01 WORK INCLUDED**

- A. Pipe hangers and supports.
- B. Flashing for mechanical equipment.
- C. Sleeving for mechanical equipment.

**1.02 REFERENCE STANDARDS**

- A. Pipe Supports: ANSI B31.1, Power Piping.
- B. Duct Hangers and Reinforcement: SMACNA Duct Manuals.
- C. Fire Barrier Products: ASTM E119-00e, ASTM E814-02, ASTM 84-04, and UL 1479.

**1.03 SUBMITTALS**

- A. Furnish manufacturer's submittal data for prefabricated equipment supports.

**1.04 DESIGN RESPONSIBILITY**

- A. The designing and installing contractor shall provide supports, anchors, and seals as appropriate for the project.
- B. Piping within buildings shall be hung from structure either by method of inserts into concrete or attachment to joists where required or supported from the floor slab where required.
- C. Torian Plum Parking Garage pipe hanging requirements: The anchors for the pipe hangers shall be drilled into the flanges of the double-tees. No drilling shall occur into the tendons in the double-tee legs.
- D. Torian Plum Parking Garage sleeving requirements for penetration through the parking garage roof: The penetrations will be sleeved through the roof of the garage. The sleeves should extend 4" (minimum) to 6" (preferred) above the slab. The waterproofing will extend up a minimum of 4" on the sleeves.

**PART 2 PRODUCTS**

**2.01 INSERTS**

- A. Malleable iron case, galvanized steel shell, expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms.

**2.02 PIPE HANGERS AND SUPPORTS**

- A. Hangers, pipe sizes to 1-1/2": Adjustable steel ring (insulated pipe) or band (uninsulated pipe).
- B. Hangers, hot pipe sizes 2" to 4" and all cold pipe sizes: Adjustable steel clevis.

- C. Hangers, hot pipe sizes 5" and over: Adjustable steel yoke and cast iron roll.
  - D. Multiple or Trapeze Hangers:
    - 1. Trapeze hangers shall be constructed from 12 gauge roll formed ASTM A570 Gr. 33 structural steel channel 1-5/8" x 1-5/8" minimum.
    - 2. Mount pipes to trapeze with two piece pipe straps sized for outside diameter of pipe or insulation (if pipes are required to be insulated). For pipe required to be insulated, provide a 360 degree 12" long galvanized metal shield surrounding a 360 degree insert of high density calcium silicate insulation of the same thickness as the adjoining pipe insulation.
    - 3. For pipes subjected to axial movement:
      - a. Strut mounted roller support for pipes 5" and over. Use pipe protection shield or saddles on insulated lines.
      - b. Strut mounted pipe guide.
  - E. Wall Support, pipe sizes to 3": Carbon steel hook.
  - F. Wall Support, pipe sizes 4" and over: Welded steel bracket and pipe strap. Adjustable steel yoke pipe roll or roller chair for hot pipe sizes 5" and over.
  - G. Vertical Support: Steel riser clamp.
  - H. Floor Support, hot pipe sizes to 4" and all cold pipe sizes: Carbon steel, adjustable pipe saddle, locknut nipple, floor flange, concrete pier or steel support sized for pipe elevation.
  - I. Floor Support, hot pipe sizes 5" and over: Adjustable roller stand and base plate, steel screws, concrete pier or steel support sized for pipe elevation.
  - J. Support steam and condensate return pipe on adjustable roller hangers.
  - K. For pipe sizes 1-1/2" and smaller, protect insulated horizontal pipe at point of support by 180 degree, 12" long sheet metal shield. No hanger shall penetrate or crush insulating material.
  - L. For pipe sizes 2" and larger, protect insulated horizontal pipe at point of support by 180 degree, 12" long galvanized sheet metal shield surrounding 180 degree insert of high density calcium silicate insulation of same thickness as adjoining pipe insulation. On cold piping, extend insulation insert 1" beyond sheet metal shield at each end. Oversize hangers to accommodate shielded inserts. No hanger shall penetrate or crush insulating material. At contractor's option, pre-manufactured thermal hanger shields with integral vapor barrier, equivalent to Value Engineered Products Pro-Shield or Pro-Shield N/T, may be utilized. For exterior installations use Weather Shield with aluminum jacket.
  - M. Provide copper plated hangers and supports for copper piping where piping and hanger are in direct contact with one another.
- 2.03 PIPE HANGER RODS
- A. Threaded steel.
- 2.04 UPPER ATTACHMENTS

- A. Steel structure: Beam clamp or C-clamp with retaining strap.
- B. Concrete structure: Drop-in anchor, zinc plated carbon steel body with flanged top, four way expansion slots.
- C. Wood structure: Angle clip - minimum 1-1/2" by 1-1/2" by 3/16" thick with two lag or wood screws into wood member, penetrated a minimum of 2" into wood. For nominal 2" lumber (1-1/2" thick) through-bolt with minimum 1/4" diameter machine screw and minimum 1" OD flat washer each side. Double-nut threaded rod through angle clip.

### PART 3 EXECUTION

#### 3.01 INSERTS

- A. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- B. Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 4" or ducts over 60" wide.
- C. Where concrete slabs form finished ceiling, finish inserts flush with slab surface.
- D. Where inserts are omitted, drill through concrete slab from below and provide rod with recessed square steel plate and nut above slab. Obtain written permission of location and procedure from Structural Engineer prior to commencing work.

#### 3.02 ANCHORS

- A. Use anchors for suspending hangers from reinforced concrete slabs, and sides of reinforced concrete beams.
- B. Review anchor locations, depths with Architect and Structural Engineer before installation.
- C. Install per manufacturer's design criteria, installation instructions.

#### 3.03 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as follows:

Nominal Pipe Size	Maximum Hanger Spacing			Hanger Rod Diameter
	<u>Steel</u>	<u>Copper</u>	<u>Schedule 40 PVC</u>	
1-1/2" and Smaller	6'-0"	6'-0"	4'-0"	3/8"
2" to 4"	10'-0"	10'-0"	4'-0"	3/8"
5" to 8"	10'-0"	10'-0"	4'-0"	1/2"
10" to 12"	10'-0"	10'-0"	4'-0"	5/8"

- B. Install hangers to provide minimum 1/2" clear space between finished covering and adjacent work, except where UL listing for fire rated ceiling requires 4" minimum separation.
- C. Place hanger within 1'-6" of each elbow or tee.



- D. Use hangers which are vertically adjustable 1-1/2" minimum after piping is erected.
- E. Support horizontal cast iron hub and spigot pipe within 1'-0" of each hub and with 5'-0" maximum spacing between hangers, except that pipe exceeding 5'-0" in length shall be supported at intervals no greater than 10'-0". Support horizontal no-hub cast iron pipe runs at each fitting and at each length of pipe less than 4'-0" with at least one hanger. Support horizontal no-hub pipes longer than 4'-0" on both sides of each joint. When "MG" cast iron or "Clamp-All" stainless steel couplings are used, with approval of local authorities, piping may be supported as specified for hub and spigot pipe.
- F. Support vertical piping at every floor. Support vertical soil pipe at each floor at hub. Support no-hub pipe so weight is carried from pipe to support and not from joint to support.
- G. Support each branch pipe to equipment at take-off and within 12" of termination.
- H. Provide galvanized steel insulation protection saddles at all support points for insulated pipes on trapeze hangers.
- I. Anchor all supporting lugs or guides to building structure.
- J. Anchor and support water connections to plumbing fixtures, in pipe chases or walls, to fixture carriers or waste and vent piping. Supports shall be similar to Adjusto-Spacer System as manufactured by Thomas Industries. Place Adjusto-Spacers every 10'-0" on vertical pipe and every 5'-0" on horizontal pipe. Insulate pipe area in contact with Adjusto-Spacers with duct tape, felt liner, or plastic liner material.
- K. Provide multiple or trapeze hangers where several pipes can be installed in parallel and at same elevation. Space trapeze hangers based upon smallest pipe size.
- L. Support riser piping independently of connected horizontal piping.
- M. Repair any fire rated coating to structure damaged during installation of attachments.

#### 3.04 EQUIPMENT BASES AND SUPPORTS

- A. Concrete bases for equipment will be provided by others only if shown on architectural or structural drawings. All other bases shall be provided by this contractor.
- B. Bases shall be 4" thick minimum, extended 6" beyond machinery bedplates. Thicken concrete at anchor bolts if imbedment exceeds 2".
- C. Size and locate all bases. Furnish all required anchor bolts and sleeves.
- D. Secure equipment or vibration isolation devices for equipment to bases with anchor bolts. Anchor bolts shall be provided by equipment manufacturer or specified by equipment manufacturer and supplied by contractor. Bolts shall be securely imbedded in the concrete base. Grout machinery under entire bearing surface unless isolated for vibration. After grout has set, remove all wedges, shims, jack bolts. Fill space with non-shrinking grout. Provide lead washers at equipment anchor bolts.
- E. Fabricate equipment supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.

#### 3.05 FLASHING AND SAFING

- A. Where exposed piping and ductwork passes through walls, floors, roofs, provide chrome plated or stainless steel escutcheon for piping and a minimum 26 gauge galvanized angle frame for ductwork. Roll frame to match the diameter of round duct.
- B. Provide sound rated flashing around ducts and pipes passing from equipment rooms, installed per manufacturer's data for sound control to meet the attenuation specified on architectural drawings for the designated wall.
- C. Flash and counterflash where mechanical equipment passes through weather- or water-proofed walls, floors, roofs.

3.06 SLEEVES

- A. Provide pipe sleeves to applicable trades with precise rough-in locations for pipes passing through concrete or masonry construction. Provide framed 18 gauge galvanized sheet metal sleeves for ductwork. Unless otherwise indicated, sleeves shall be of size to provide from 1/4" to 1" clearance between bare pipe or duct and sleeve or between insulation jacket and sleeve. Where pipe or duct passes through concrete floor, extend sleeve minimum 1" above finished floor.
- B. Sleeves in bearing walls, waterproof membrane floors, wet areas shall be steel pipe or cast iron pipe for small round ducts and pipes, 16 gauge galvanized sheet metal for ducts. Sleeves in non-bearing walls, floors, ceilings shall be steel pipe, cast iron pipe, or galvanized sheet metal with lock-type longitudinal seam.
- C. Where uninsulated pipes or ducts penetrate bearing walls (excluding foundations), fire rated walls, partitions, floors, pack and seal entire space between pipe and sleeve with Dow Corning 3-6548 Silicone RTV Foam, or 1" minimum thickness of 3M Fire Barrier, CP-25 Caulk, or 303 putty on each side of opening.
- D. Encase all insulated pipes penetrating fire walls and floors in 360 degree metal-shielded insulation inserts as manufactured by Value Engineered Products. Pack and seal space between shield and sleeve per preceding paragraph. Extend insulation insert on all refrigerant, chilled water, domestic cold water lines 1" beyond sheet metal shield.
- E. Where pipe or duct penetrations occur in non-fire rated floors or walls, pack space between pipe or duct and sleeve or insulation insert and sleeve on each end with mineral wool or other non-combustible material.
- F. Pipe to sleeve closure for pipes penetrating foundations, waterproofing membrane floors, wet areas shall be "Link-Seal."
- G. After painting is completed, install chrome plated escutcheons on all pipes passing through finished walls and floors.

**END OF SECTION**

**SECTION 230553**

**IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT**

**PART 1 GENERAL**

**1.01 WORK INCLUDED**

**A. Identification for the following:**

1. Piping.
2. Valves.

**PART 2 PRODUCTS**

**2.01 ACCEPTABLE MANUFACTURERS**

- A. Brimar's
- B. Emblem Tape and Label Co.
- C. Line Guard, Inc.
- D. Seton Name Plate Corp.
- E. T & B Westline
- F. Utility Marking Tape
- G. W.H. Brady Co.

**2.02 MATERIALS**

- A. Pipe markers.
- B. Pipe banding.
- C. Underground tape system.
- D. Decals, stencils, pressure sensitive labels.
- E. Valve Tags.
- F. Charts and diagrams.

**PART 3 EXECUTION**

**3.01 PIPE IDENTIFICATION**

- A. Identify each piping system and indicate direction of flow with band-secured or snap-on printed labels in mechanical room and other exposed areas and pressure sensitive, self-adhesive labels in concealed areas. Apply markings after painting and cleaning of piping and insulation is completed.
- B. Apply legend and flow arrows at valve locations, at points where piping enters or leaves valve or meter box, at not less than every 30'-0" of run or at least once in every exposed location. Locate markings for maximum visibility.
- C. Wherever two or more pipes run parallel, apply markings in same relative location on each.
- D. Wording/color combinations shall meet ANSI specifications unless colors are specified otherwise.

- E. Sizes of lettering and flow arrows shall be as follows:

<u>Outside Diameter of Pipe or Covering (inclusive)</u>	<u>Letter</u>	<u>Size of</u>	<u>Minimum Length of Flow Arrow</u>
5/8" to 2"	1/2"		2-1/2"
2-1/2" and larger	1"		4"

### 3.02 VALVE IDENTIFICATION

- A. Identify each automatic temperature control valve and each manually operated valve by means of a brass or aluminum tag, 1-1/2" round, with stamped numbers or letters 1/2" high, filled with black paint. Number tags consecutively. Fasten with chain and brass "S" hooks.

### 3.03 CHARTS AND DIAGRAMS

- A. Provide 8-1/2" x 11" charts in each equipment room designating number, area served, service or function, location of each tagged item. Frame charts and diagrams in metal frames with clear glass and hang in locations as directed.

### 3.04 UNDERGROUND UTILITIES IDENTIFICATION

- A. Install underground tape system containing metallic element to allow location by magnetic detector.
- B. Tape: 4" wide minimum, installed in trench above utility line at depth of 12" to 18" below finished grade or pavement subgrade level. Extend continuously along entire length of buried utility lines. Conform to following:

<u>Tape Color</u>	<u>Legend</u>
Yellow	Caution - Gas Utility Below
Blue	Caution - Water Utility Below
Green	Caution - Sewer Utility Below

- C. Provide 8" diameter x 18" deep pre-cast concrete box with concrete lid, located directly over stub for future connection. Fill box with gravel, set top 1" above grade. Provide engraved brass marker indicating size, utility, invert elevation. Attach permanently to cover with bolt or special adhesive. (For example: 4" CW, 6222.5 ft.). Do not terminate any stub under concrete paving, equipment, or other inaccessible location.

**END OF SECTION**

**SECTION 230719**

**HVAC PIPING INSULATION**

**PART 1 GENERAL**

**1.01 WORK INCLUDED**

- A. Piping insulation.

**1.02 SUBMITTALS**

- A. Furnish manufacturer's submittal data for insulation.
- B. Submittals shall indicate complete material data proposed and thickness of material for individual services.

**1.03 QUALITY ASSURANCE**

- A. Insulating materials and finishes shall comply with applicable codes.
- B. Determine that code authorities will approve any product installed.

**1.04 JOB CONDITIONS**

- A. Perform work at ambient and equipment temperatures as recommended by manufacturer.

**PART 2 PRODUCTS**

**2.01 ACCEPTABLE MANUFACTURERS**

- A. CertainTeed
- B. Imcoa
- C. Knauf
- D. Owens-Corning
- E. Johns Manville
- F. Nomaco
- G. Dow

**2.02 GENERAL**

- A. Adhesives and Insulation Materials: Composite fire and smoke hazard ratings maximum 25 for Flame Spread and 50 for Smoke Developed. Adhesives shall be waterproof.

**2.03 MATERIALS AND COMPONENTS**

- A. Pipe Insulation
  - 1. Type A: Heavy density one-piece fiberglass, factory applied vapor barrier jacket, double surface adhesive self-sealing lap, "K" factor 0.23 at 75 F mean temperature.
  - 2. Type B: Flexible polyolefin or polyethylene closed cell, "K" factor 0.24 at 75 F mean temperature pre-slit glued or un-slit sections.

3. Insulation Exposed to Weather: Protect insulation with weatherproof metal jacket. Jacket shall be factory applied aluminum, 0.016" thick, with laminated vapor barrier and "Z" groove watertight seal. Seal each joint with snap straps containing permanent plastic sealing compound. Secure with 1/2" wide stainless steel bands. Insulate fittings with mitered sections of same material. Seal joints with sealing compound and preformed aluminum bands.

B. Hot Equipment Insulation

1. Type A (80 F - 350 F): Rigid 6 lb. density fiberglass board, "K" factor 0.23 at 75 F mean operating temperature. Secure insulation with weld pins or stick clips on flat surfaces. Point all joints, finish with wire mesh and insulating cement. Cover with glass cloth.
2. Insulation Exposed to Weather: Finish with an additional two 1/8" coats of asphalt base weather-resistant mastic with glass fabric reinforcement between coats.

- C. Snowmelt System Rigid Insulation: The snowmelt system shall have vertical rigid insulation where the promenade abuts or is directly adjacent to landscaping and planter beds. Rigid insulation shall be a minimum of R-10, 2" thick, closed cell expanded polystyrene and be compliant with ASTM D1621 and ASTM C203. Water absorption shall be by ASTM C272 and not exceed 0.1 (% by volume). Water vapor permeance shall be by ASTM E96, 0.8 perms maximum. Insulation shall meet or exceed the requirements of ASTM-C5788, Type V. and shall have a long term stable R-value up to 15 years.

PART 3 EXECUTION

3.01 PREPARATION

- A. Surface shall be clean and dry prior to installation. Insulation shall be dry before and during application. Finish with systems at operating temperatures.

3.02 INSTALLATION

- A. Insulation shall be continuous through inside walls. Pack around pipes with fireproof self-supporting insulation material, fully sealed.
- B. Finish insulation neatly at hangers, supports, other protrusions, and where the insulation breaks for service or access requirements.
- C. Do not insulate the following unless specified:
1. Drain piping downstream of system drain valve.
  2. Unions and flanged valves on hot lines (65 F to 250 F).
  3. Bonnet on screwed valve bodies.
  4. Expansion joints, flexible connections.
  5. Removable plates on check valves.
- D. Do not cover piping until tested.
- E. Remove and reapply insulation if, in opinion of Architect, it has not been installed in first class workmanlike manner.
- F. Locate insulation seams in least visible locations.

- E. Clean insulation finishes after installation, leaving clean surface for painting. Replace surfaces if damaged during construction. Reapply tape found peeling during construction or guarantee period.
- F. Where removed for new connection or remodeling, replace existing insulation to match existing thickness, density, finish.
- G. Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship.

3.03 INSTALLATION OF PIPE INSULATION

- A. Seal longitudinal laps with vapor barrier adhesive or with factory applied double surface pressure sensitive adhesive system. Seal end joints with 3" wide butt strips secured with vapor barrier adhesive. Seal all seams on cold water piping with Benjamin Foster 30-35 Seal Fast mastic.

3.04 INSTALLATION OF INSULATION ON FITTINGS AND VALVES

- A. Insulate fittings and valves with firmly compressed foil-faced fiberglass blanket and 25/50 UL rated PVC fitting covers (Zeston or equal).
- B. Where installation of PVC fitting covers is prohibited by local authorities, insulate fittings and valves with molded fiberglass fittings or firmly compressed foil-faced fiberglass blanket. Secure in place with 20 gauge corrosion resistant wire and apply smoothing coat of insulating cement. Finish with layer of glass cloth embedded between two coats of vapor barrier mastic. Lap glass fabric 2" onto adjacent insulation.
- C. Insulation on fittings and valves shall be same thickness as on pipe.
- D. Trowel insulation cement to neat bevel at unions, flanges, and whenever insulation terminates. Allow room to remove flange bolts, disconnect unions, etc.

3.05 INSTALLATION OF HOT EQUIPMENT INSULATION

- A. Cut, contour, and miter insulation board and apply with edges tightly butted, joints staggered where two or more layers are necessary, secured with 1/2" x 0.015" galvanized steel bands on 12" centers or with weld pins or stick clips with washers on 18" centers.
- B. Equipment and Boiler Breeching: Finish with 1" galvanized wire mesh, tightly stretched in place with edges tied together between two coats of insulating cement trowelled to hard finish.

3.06 INSULATION SCHEDULES

- A. Pipe Insulation:

		Thickness	
		Type	Type
<u>Service</u>	<u>Pipe Size</u>	<u>A</u>	<u>B</u>
Low Temperature 120 F - 200 F	All	1-1/2"	---

END OF SECTION

**SECTION 230923**

**CONTROLS AND INSTRUMENTATION**

**PART 1 GENERAL**

**1.01 WORK INCLUDED**

- A. Electric/electronic controls including sensors, switches, relays, thermostats, control panels for instruments.
- B. Low voltage, line voltage control wiring and conduit.

**1.02 QUALITY ASSURANCE**

- A. Temperature control contractor shall be an independent contractor who specializes in the design and field installation of electric temperature control systems. System shall be installed by competent mechanics, regularly employed by the temperature control contractor.
- B. Wiring: Per requirements of NEC and Division 16.

**1.03 SUBMITTALS AND SHOP DRAWINGS**

- A. Furnish manufacturer's submittal data for all control components.
- B. Shop drawings shall include schematic diagrams, piping and wiring diagrams, valve schedule, written description of control sequence. Written description shall refer to control components, identify them by name and symbol number. Written description of control sequences shall include equipment furnished with factory-furnished controls.

**1.04 DESIGN RESPONSIBILITY**

- A. It is the installing contractor's responsibility to design and install fully functioning controls and instrumentation as required for the project at each boiler room and for each boiler system.
- B. All controls and instrumentation shall be of high quality and shall be able to communicate and compatible with each equipment controller/panel used throughout the project.
- C. It is the designing and installing contractor's responsibility to provide controls equipment that is compatible with the Steamboat Base Area Redevelopment (Promenade) project. Coordinate with the controls provider for any additional components required to incorporate the area shown on these drawings into the overall controls of the snowmelt system.

**PART 2 PRODUCTS**

**2.01 ACCEPTABLE MANUFACTURERS**

- A. The controls and instrumentation for the project shall be compatible with all controls used throughout the project.

**2.02 SYSTEM REQUIREMENTS**

- A. Provide control systems consisting of snowmelt sensors, control valves, indicating devices, interface equipment and other apparatus required to operate mechanical system and to perform functions specified.



- B. Unless specified otherwise, provide fully proportional components.
- C. Unless otherwise specified, all devices shall have adjustable setpoint.
- D. Provide necessary relays and signal boosters to make system complete and operable as required by sequence of operation.

2.03 AUTOMATIC CONTROL VALVE

- A. Select valve to fail safe in normally open or closed position as dictated by freeze, humidity, fire, or temperature protection.
- B. Select water valve for maximum pressure drop of 5 psi.
- C. Control Valves, 1/2" through 2": Cast brass body, screwed ends, removable bonnet, stainless steel stem, Teflon or rubber packing. Body rating: 175 psig SWP at 150 F.
- D. Control Valves 2-1/2" and Larger: Cast iron body, flanged connections, removable bonnet, stainless steel stem, Teflon or rubber packing. Body rating: 175 psig SWP at 150 F.
- E. Fully proportioning, modulating plug with equal percentage flow characteristic for hot water duty.
- F. Refer to specification section 15511 Snow Melt System for more information.

2.04 VALVE OPERATOR

- A. Synthetic rubber, spring return, diaphragm or piston type.
- B. Close against system differential pressure.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Coordinate location of exposed control sensors with plans and site details before installation. Locate sensors in areas with low pedestrian traffic.
- B. Unless otherwise shown on electrical drawings, provide line voltage wiring for all new sensors.

3.02 SEQUENCE OF OPERATION

- A. Coordination: Where control devices are specified to be part of a manufactured piece of equipment, provide any additional devices, piping, and wiring required to achieve the specified sequence of operation.
- B. Refer to specification section 15971 and equipment schedules for sequence of operations.

**END OF SECTION**

## SECTION 230993

### SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

#### PART 1 GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. This Section includes control sequences for HVAC systems, snowmelt systems, subsystems, and equipment.

##### 1.3 DEFINITIONS

- A. DDC: Direct-digital controls.

##### 1.4 DESIGN RESPONSIBILITY

- A. It shall be the responsibility of the installing contractor to design and install a fully functioning DDC controls system for each snow melt system on the project. All sensors and controls used on the Torian Property area shall be compatible with those used on the Steamboat Base Area Redevelopment Torian Parking Garage system.
- B. Each manifold in the snowmelt system shall be provided with a snowmelt sensor and control valve as specified in section 15511.
- C. All components of the snow melt controls system shall be by a single manufacturer.

##### 1.5 SNOW MELT CONTROLS SYSTEM SCOPE

- A. Refer to the plans and specifications of the Steamboat Base Area Redevelopment Project for all information regarding the snowmelt DDC system that is to be designed and installed.

##### 1.6 SEQUENCE OF OPERATION.

- A. Snowmelt System Control: The area shown on the plans and specifications shall be incorporated into the following controls strategies and requirements.
  - 1. General: The system shall be set up for basic operation to run both an on/off mode and an idling mode. While the system is in basic off mode, the system operator shall be able to select specific user-identified zones to operate in idling mode. The system operator shall be able to easily switch between idling and melting modes. The system shall monitor status of all system equipment and temperatures at all zone temperature sensors and all thermometer locations within the boiler room as well as outdoor air temperature. The system shall monitor and record overall energy consumption (in Btu's) based on a main snow melt system supply/return water temperature differential and main pump operation. The system shall monitor and log the run time of each separate boiler.
  - 2. Basic on/off operation (Primary Mode):
    - a. Upon a signal from a central temperature moisture sensor indicating precipitation and an outside air temperature below 40 degrees F (adjustable through software by

- operator), the system shall initiate melting mode and the master controller shall signal all remote panels.
  - b. The boiler controls shall stage the boilers to the best operating efficiency to maintain the leaving water temperature setpoint for the system.
  - c. The snow melt pumps shall run continuously during melting mode to maintain the system defined pressure differential at each of the three measured pressure differential points in the snow melt system.
  - d. When the outdoor temperature rises above the melting setpoint and moisture is no longer present, the system shall idle for a minimum of 3 hours (adjustable from 1 to 8 hours).
3. Basic idling mode (Secondary Mode):
- a. When the outdoor air temparture is below 38 degrees F (adjustable through software by operator) but no moisture is present, the system shall operate in idling mode and the master controller shall signal to all remote panels.
  - b. The boiler controls shall stage the boilers to the best operating efficiency to maintain a reduced leaving water temperature setpoint for the system (adjustable through software by operator).
  - c. The snow melt pumps shall run continuously during melting mode to maintain the system defined pressure differential at each of the three measured pressure differential points in the snow melt system.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

**END OF SECTION**

## SECTION 231123

### FACILITY NATURAL-GAS PIPING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. Section Includes:
  - 1. Pipes, tubes, and fittings.
  - 2. Piping specialties.
  - 3. Piping and tubing joining materials.
  - 4. Valves.
  - 5. Pressure regulators.
  - 6. Concrete bases.

##### 1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

##### 1.04 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
  - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
- B. Natural-Gas System Pressure within Buildings: 0.5 psig or less.
- C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

##### 1.05 ACTION SUBMITTALS

- A. Product Data: For each type of the following:

1. Piping specialties.
2. Corrugated, stainless-steel tubing with associated components.
3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.
5. Service meters. Indicate pressure ratings and capacities. Include supports.

- B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1.06 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.

1.07 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- D. Protect stored PE pipes and valves from direct sunlight.

1.09 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
- B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Construction Manager's written permission.

#### 1.10 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Section 083113 "Access Doors and Frames."

### PART 2 - PRODUCTS

#### 2.01 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
  1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
  2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
  3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
  4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
    - a. Material Group: 1.1.
    - b. End Connections: Threaded or butt welding to match pipe.
    - c. Lapped Face: Not permitted underground.
    - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
  5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
    - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
- B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.
  1. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
  2. Coating: PE with flame retardant.
    - a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      - 1) Flame-Spread Index: 25 or less.
  3. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.

4. Striker Plates: Steel, designed to protect tubing from penetrations.
5. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
6. Operating-Pressure Rating: 5 psig .

## 2.02 PIPING SPECIALTIES

### A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig .
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches

### B. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig .

## 2.03 JOINING MATERIALS

### A. Joint Compound and Tape: Suitable for natural gas.

### B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

## 2.04 MANUAL GAS SHUTOFF VALVES

### A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

### B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig .
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

- C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
  - 1. CWP Rating: 125 psig .
  - 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
  - 3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  - 4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
  
- D. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
  - 1. Body: Bronze, complying with ASTM B 584.
  - 2. Ball: Chrome-plated brass.
  - 3. Stem: Bronze; blowout proof.
  - 4. Seats: Reinforced TFE; blowout proof.
  - 5. Packing: Separate packnut with adjustable-stem packing threaded ends.
  - 6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  - 7. CWP Rating: 600 psig .
  - 8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  - 9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
  
- E. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
  - 1. Body: Bronze, complying with ASTM B 584.
  - 2. Ball: Chrome-plated bronze.
  - 3. Stem: Bronze; blowout proof.
  - 4. Seats: Reinforced TFE; blowout proof.
  - 5. Packing: Threaded-body packnut design with adjustable-stem packing.
  - 6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  - 7. CWP Rating: 600 psig .
  - 8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  - 9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
  
- F. Bronze Plug Valves: MSS SP-78.
  - 1. Body: Bronze, complying with ASTM B 584.
  - 2. Plug: Bronze.
  - 3. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  - 4. Operator: Square head or lug type with tamperproof feature where indicated.
  - 5. Pressure Class: 125 psig .
  - 6. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  - 7. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
  
- G. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.
  - 1. Body: Cast iron, complying with ASTM A 126, Class B.
  - 2. Plug: Bronze or nickel-plated cast iron.
  - 3. Seat: Coated with thermoplastic.
  - 4. Stem Seal: Compatible with natural gas.
  - 5. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.



6. Operator: Square head or lug type with tamperproof feature where indicated.
7. Pressure Class: 125 psig .
8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

H. Valve Boxes:

1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

## 2.05 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Body and Diaphragm Case: Die-cast aluminum.
2. Springs: Zinc-plated steel; interchangeable.
3. Diaphragm Plate: Zinc-plated steel.
4. Seat Disc: Nitrile rubber.
5. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
6. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
7. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.

## 2.06 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 requirements for prevention of accidental ignition.

### 3.03 OUTDOOR PIPING INSTALLATION

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Steel Piping with Protective Coating:
  - 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
  - 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
  - 3. Replace pipe having damaged PE coating with new pipe.
- C. Copper Tubing with Protective Coating:
  - 1. Apply joint cover kits over tubing to cover, seal, and protect joints.
  - 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
- D. Install fittings for changes in direction and branch connections.
- E. Install pressure gage downstream from each service regulator. Pressure gages are specified in Section 230519 "Meters and Gages for HVAC Piping."

### 3.04 INDOOR PIPING INSTALLATION

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.

- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
  - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- N. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- O. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- P. Connect branch piping from top or side of horizontal piping.
- Q. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- R. Do not use natural-gas piping as grounding electrode.
- S. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- T. Install pressure gage downstream from each line regulator. Pressure gages are specified in Section 230519 "Meters and Gages for HVAC Piping."
- U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

### 3.05 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
- B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

- C. Install anode for metallic valves in underground PE piping.

### 3.06 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
  - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
  - 2. Cut threads full and clean using sharp dies.
  - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
  - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
  - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
  - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
  - 2. Bevel plain ends of steel pipe.
  - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
- G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.
- H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
  - 1. Plain-End Pipe and Fittings: Use butt fusion.
  - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

### 3.07 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
  - 1. NPS 1 and Smaller: Maximum span, 96 inches ; minimum rod size, 3/8 inch .
  - 2. NPS 1-1/4 : Maximum span, 108 inches ; minimum rod size, 3/8 inch .
  - 3. NPS 1-1/2 and NPS 2 : Maximum span, 108 inches ; minimum rod size, 3/8 inch .
  - 4. NPS 2-1/2 to NPS 3-1/2 : Maximum span, 10 feet ; minimum rod size, 1/2 inch .
  - 5. NPS 4 and Larger: Maximum span, 10 feet ; minimum rod size, 5/8 inch .

- C. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
  - 1. NPS 3/8 : Maximum span, 48 inches ; minimum rod size, 3/8 inch .
  - 2. NPS 1/2 : Maximum span, 72 inches ; minimum rod size, 3/8 inch .
  - 3. NPS 3/4 and Larger: Maximum span, 96 inches ; minimum rod size, 3/8 inch .

### 3.08 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

### 3.09 LABELING AND IDENTIFYING

- A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

### 3.10 PAINTING

- A. Comply with requirements in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for painting interior and exterior natural-gas piping.
- B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
- C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

### 3.11 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base.
  - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
  - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.

3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Use 3000-psig , 28-day, compressive-strength concrete and reinforcement as specified in Section 033000 "Cast-in-Place Concrete."

### 3.12 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  1. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.
- C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.13 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

### 3.14 OUTDOOR PIPING SCHEDULE

- B. Aboveground natural-gas piping shall be one of the following:
  1. Steel pipe with malleable-iron fittings and threaded joints.
  2. Steel pipe with wrought-steel fittings and welded joints.

### 3.15 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

- A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:
  1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
  2. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping shall be one of the following:
  1. Steel pipe with malleable-iron fittings and threaded joints.
  2. Steel pipe with wrought-steel fittings and welded joints.

### 3.16 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:
  1. Bronze plug valve.
  2. Cast-iron, nonlubricated plug valve.

- B. Distribution piping valves for pipe sizes NPS 2 and smaller shall be the following:
  - 1. Two-piece, full-port, bronze ball valves with bronze trim.
- C. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be the following:
  - 1. Two-piece, full-port, bronze ball valves with bronze trim.
- D. Valves in branch piping for single appliance shall be one of the following:
  - 1. One-piece, bronze ball valve with bronze trim.
  - 2. Two-piece, full-port, bronze ball valves with bronze trim.

**END OF SECTION**

**SECTION 232113**

**HYDRONIC PIPING**

**PART 1 GENERAL**

**1.01 WORK INCLUDED**

- A. Hot water piping.
- B. Domestic water piping.
- C. Sanitary drainage and vent piping.
- D. Natural gas piping.
- E. Equipment drains, overflows, and condensate piping.
- F. Snowmelt piping

**1.02 SUBMITTALS**

- A. Furnish manufacturer's submittal data for pipes.
- B. Submittals shall indicate each pipe size used and include inside pipe dimensions, outside pipe dimensions and pressure loss tables for each pipe size used.
- C. Submittals shall be clearly labeled for the application the submitted piping is intended to be used for.

**1.03 DESIGN RESPONSIBILITY**

- A. It is the responsibility of the designing and installing snowmelt contractor to use the specified type of pipe and fitting as applicable for the service of the pipe and/or fitting.
- B. It is the responsibility of the contractor performing installation of the mechanical work to submit piping as required by this section and as noted on the drawings.
- C. Substitution of piping materials shall not be allowed without the written consent of the Owner's Representative.

**1.04 QUALITY ASSURANCE**

- A. Welding materials and labor shall conform to ASME code for pressure piping and applicable State Labor Regulations.
- B. Use welders fully qualified and licensed by State authorities. Furnish certification from approved testing agency or National Certified Pipe Welding Bureau that welders performing work are certified.
- C. All piping materials shall comply with local codes.

**1.05 REFERENCE STANDARDS**



- A. ANSI/ASTM A126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- B. ANSI/AWS D.1.1 - Structural Welding Code.
- C. FS WW-P-521 - Pipe Fittings, Flange Fittings, and Flanges: Steel and Malleable Iron (Threaded and Butt Welding) Class 150.

## PART 2 PRODUCTS

### 2.01 PIPE AND TUBE

- A. Steel Pipe: ANSI/ASTM A53, black.
- B. Hubless Cast Iron Soil Pipe and Fittings: ANSI/ASTM A888, coated service weight.
- C. Cast Iron Soil Pipe: ANSI/ASTM A74, coated, service weight.
- D. Hubless Cast Iron Soil Pipe and Fittings: CISPI 301.
- E. Copper Water Tube: ASTM B280-03, seamless.
- F. Brass Pipe: ANSI/ASTM B43, IPS 85 red brass.
- G. Rigid (C)PVC Plastic Pipe: ANSI/ASTM D1784.
- H. PVC Plastic Sewer Pipe: ANSI/ASTM D2729.
- I. Copper Drainage Tube (DWV): ASTM B306-88.
- J. Crosslinked Polyethylene Pipe (PEX): ASTM F876, ASTM F2165, DIN 4726
- K. Polyethylene Pipe (MDPE): ASTM D2513, DOT CFR Title 49 Part 192

### 2.02 PIPE AND TUBE JOINTS AND FITTINGS

- A. Threaded Pipe Fittings: Malleable Iron, ANSI/ASME B16.3; Cast Iron Pipe Fittings, ASTM A126; Class 250.
- B. Cast Iron Pipe Fittings: ANSI/ASTM A74, ASTM C564, rubber gasket joints.
- C. Copper and Brass Pipe Fittings: ASME B16.23, pressure fittings; ASME B16.29, drainage fittings.
- D. PVC Sewer Pipe Fittings: ANSI/ASTM D2729.
- E. CPVC Threaded Pipe Fittings: ANSI/ASTM F437.
- F. CPVC Socket-type Pipe Fittings: ANSI/ASTM F439.
- G. Crosslinked Polyethylene Pipe Fittings: ASTM F877, ASTM F2080, CSAB 137.5
- H. Polypropylene Pipe Fittings: Drainage pattern mechanical joint for above grade and butt fusion joint for below grade. Mechanical joints shall not expose metal to inside of pipe. All joints shall be per manufacturer's written installation instructions.

- I. Solvent for PVC Jointing: ANSI/ASTM D2564.
- J. Solvent for CPVC Jointing: ANSI/ASTM D2846/F493.
- K. Flexible Joints for Plastic Drain and Sewer Pipe Using Elastomeric Seals: ASTM D3212.

## 2.03 UNIONS AND COUPLINGS

- A. 2" and smaller: 125 psi cast iron for threaded ferrous piping; bronze for copper or brass pipe, soldered joints.
- B. 2 1/2" and larger: 150 psi forged steel flanges, raised face with welding neck, for ferrous piping; bronze flanges for copper or brass piping. Gaskets for water piping to 140 F equal to Garlock premium grade style 22 red rubber, 1/16" thick. Gaskets for fuel oil, natural gas equal to Garlock Blue-Gard style 3000 synthetic fiber with nitrile binder, 1/16" thick. Gaskets for steam, condensate, and water above 140 F as manufactured by Flexitallic.
- C. Grooved and Shouldered Pipe Ends: Malleable iron housing clamps to engage and lock, designed to permit some angular deflection, contraction, expansion; C-shape composition sealing gasket, steel bolts, nuts, washers; galvanized couplings for galvanized pipe.
- D. Dielectric Unions and Flanges: Epco or equal having proper gasket material for connection of dissimilar metals. Unions, 2" and smaller; dielectrically gasketed flanges, 2-1/2" and larger. Use dielectric connections wherever joining dissimilar metals in open domestic water and condenser water systems.

## 2.04 STRAINERS

- A. 2" and smaller: Threaded brass or iron body, Y pattern with 1/32" stainless steel perforated screen. Hose end connection.
- B. 2-1/2" and larger: Flanged iron body, basket pattern with 1/8" stainless steel perforated screen. Hose end connection.
- C. Screen free area: Minimum three times area of inlet pipe.

## PART 3 EXECUTION

### 3.01 GENERAL

- A. Verify location(s) of all return air plenums. All piping and support materials installed in air plenums shall be plenum-rated. Do not install specified non-plenum-rated materials in air plenums; use plenum-rated options.
- B. Route piping in orderly manner and maintain proper slope. Install to conserve headroom and interfere as little as possible with use of space. Run exposed piping parallel to walls. Group piping whenever practical at common elevations. Install concealed pipes close to building structure to keep furring to a minimum.
- C. Piping shall be buried at a minimum depth as recommended by the manufacturer for the application, unless otherwise noted on the plans. Snowmelt piping on top of the Torian Parking Garage Structure shall be routed as indicated in the construction drawings and depth as indicated on the construction drawings.
- D. Maintain following pipe slopes unless otherwise noted on drawings:

1. Hydronic piping: 1" up per 40'-0" in direction of flow.
  2. Condensate drain piping: 1/8" down per linear foot in the direction of flow.
  3. Sanitary waste 3" and smaller: 1/4" down per 1'-0" in direction of flow.
  4. Sanitary waste 4" and larger: 1/8" down per 1'-0" in direction of flow.
  5. Sanitary vent piping, all sizes: Graded and connected as to drip back by gravity to the drainage pipe it serves.
- E. Make reductions in horizontal hydronic water pipe with flat top eccentric reducing fittings.
- F. Install piping to allow for expansion and contraction without stressing pipe or connected equipment.
- G. Provide clearance for installation of insulation and for access to valves, air vents, drains, unions.
- H. Install same type piping material specified for inside building to 5'-0" outside building.
- I. Provide hose end drain valve on all strainers 1-1/2" and larger.
- J. Make connections to equipment with unions or flanges.
- K. Condensate drain piping shall be equal to or larger than the exit diameter of the drain pan drain connection.
- L. Pipe Reducers: Use reducers, not bushings, for changes in pipe sizes.
- M. On closed systems, equip low points with 3/4" drain valves, high points with air vents.
- N. Install vertical dirt leg in gas piping ahead of all gas-fired equipment and appliances.
- 3.02 PREPARATION
- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, inside and outside, before assembly.
- C. Remove welding slag or foreign material from pipe and fitting materials.
- D. Close ends of pipe immediately after installation. Leave closure in place until removal is necessary for completion of installation.
- E. Flush each piping system and prove clean.
- F. Piping shall be prepared as indicated in the manufacturer's written installation instructions.
- 3.03 STEEL PIPE CONNECTIONS
- A. 2" and smaller - threaded; 2-1/2" and larger - welded.
- B. All joints for gas piping installed in plenums and concealed spaces shall be welded.
- C. Do not use mitered and welded elbows in lieu of fittings.

- D. Die cut threaded joints with full cut standard taper pipe threads with 1/2" wide white Teflon pipe joint sealant tape applied to male threads only.
- E. Use only malleable iron threaded pipe fittings for gas piping above grade.
- F. Use butt weld fittings for welded steel pipes. Use oxyacetylene or electric arc process.
- G. Flanged Piping - Use American National Standard regular galvanized hex head bolts and galvanized heavy cold pressed hex nuts. Coat gaskets with lubricant before installing.
- H. Grooved Piping - Ductile iron conforming to ASTM-395. Victaulic Style 07, with EPDM synthetic elastomer gasket, oval neck track bolts and nuts for grooved end pipe. Use pipe grooving tool specifically designed for system. Use grooved mechanical couplings and fasteners only for chilled water and condenser water piping and only in accessible locations.
- I. Use long radius elbows for water piping.

#### 3.04 CAST IRON PIPE CONNECTIONS

- A. Joints for Bell and Spigot Pipes: Neoprene gasketing system with "Ty-Seal" water soluble lubricant.
- B. Joints for Plain End Pipe Above Grade: Stainless steel band type gasket and clamp mechanical fastener.
- C. Use hubless piping above grade only.

#### 3.05 COPPER PIPE CONNECTIONS

- A. 2-1/2" and smaller: Use 15% silver brazing alloy and silver brazing flux on below-grade joints. Use 95% tin, 5% antimony lead-free solder and ASTM B813-91 non-corrosive STM 1.0 flux on other joints. Apply flux on cleaned end of pipe and inside fittings with smooth even coats.
- B. 3" and larger: Use 15% silver brazing alloy and silver brazing flux. Apply flux on cleaned end of pipe and inside fittings with smooth even coats.
- C. Continuously purge piping with dry nitrogen during silver brazing process.

#### 3.06 APPLICATION OF PIPING SYSTEMS

##### SERVICE

Snowmelt System

Natural Gas, Equipment Vents

Condensate Drain, Pumped Condensate.

Equipment Drains and Overflows.

Sanitary Drain and Vent above slab-on-grade.

##### MATERIAL

Steel, Schedule 40; copper, type L hard drawn, crosslinked polyethylene with oxygen diffusion layer

Steel, Schedule 40 above grade  
Polyethylene (MDPE) below grade

Steel, Schedule 80, copper Type L hard drawn, CPVC Plastic

Copper, type M or DWV, hard drawn. CPVC Plastic

Copper, type DWV, hard drawn; Cast iron. PVC

<u>SERVICE</u>	<u>MATERIAL</u>
Sanitary Drain and Vent below slab-on-grade inside building.	Cast iron, PVC
Sanitary Sewer outside building.	PVC; Cast iron.
Domestic Water, unburied.	Copper, type L, hard drawn.
Domestic Water, buried	Copper, type K continuous, soft drawn.
Exposed Piping for Corrosive Materials	Polypropylene; High Silicon Iron (Duriron).
Buried Piping for Corrosive Materials	Polypropylene; High Silicon Iron (Duriron).

### 3.07 PIPE TESTING

#### A. General

1. The existing snowmelt piping, locations as indicated in the construction drawings, shall be tested for leaks or breaks prior to operation of the snow melt system. The hydrostatic test as described in these specifications shall be performed to determine if repairs are needed to the existing piping systems. If repairs to the piping are required, coordinate use of the allowance for this work with the Owner's representative.
2. Test all piping systems. Correct leaks by remaking joints. Remove equipment not able to withstand test pressure from system during test. Consult governing codes for special system requirements.
3. Give ample notice of dates when acceptance test will be conducted. Conduct pressure, performance, operating tests in presence of representative of agencies having jurisdiction. Submit three copies of successful test reports to Owner.
4. Test piping before being permanently enclosed.
5. Obtain certificates of approval, acceptance, compliance with regulations of agencies having jurisdiction. Submit to Owner.

#### B. System Tests

1. Hydrostatic test - water piping and existing snowmelt piping: Hand pump system to greater of 100 psig or 150% of operating pressure. Maintain pressure until system has been inspected for leaks but not less than four hours.
2. After testing the hydronic system for proper operation of automatic devices and controls, operate system for one week, then drain and wash out with pre-start-up cleaning chemicals. Clean strainer baskets, refill system, leave in proper working order. After system has been in operation for one month, thoroughly check system and devices for water leakage.
3. Compressed air or nitrogen test: Subject piping system to required gas pressure with oil free air or nitrogen. System shall maintain pressure for duration of soapy water test of each joint.
  - a. Natural gas piping: Test pressure of 100 psig for 4 hours or test pressure of 60 psig or above for 24 hours showing no pressure drop except that caused by temperature changes.

Do not use flame or other liquid for testing. Do not repair defects in gas piping or fittings; remove and replace with sound material.

4. Waste, drain, vent piping: Fill system with water to point of overflow but not less than 10'-0" head. Maintain water level for 4 hours.

### 3.08 UNDERGROUND PIPE INSTALLATION

- A. Protect steel pipe installed below grade and to minimum 6" above grade with factory applied covering, Pro-Co felt and pipe line enamel No. 4 Double Wrap or X-Tru-Coat plastic coating.
- B. Protect field joints on steel pipe as follows:
  1. Clean fittings, nipples, other field joints thoroughly.
  2. Apply Tapecoat Company prime coat and one layer of Tapecoat #20 heat applied, 62 mil tape per manufacturer's recommendations.
- C. Provide thrust block at all direction changes on pressure pipe.
- D. Bury all outside water piping minimum 7'-0" below grade to top of pipe.
- E. Bury all outside gas piping minimum 1'-6" below grade to top of pipe.
- F. Gas piping outside, below grade shall have a #12 or heavier, insulated (THW or RHW), solid copper wire installed with the gas piping and shall be taped to the pipe at 6 foot intervals. The wire shall not wrap around the pipe and must be one continuous, unbroken length. Coil tracer wire at each end of run with enough wire to extend a minimum of two feet above grade.
- G. Snowmelt piping mains shall be installed at the recommended depth of the manufacturer for the ground surface temperature expected during operation of the snowmelt system, unless otherwise noted on the construction drawings. Should the installing contractor not be able to achieve the recommended depth throughout the project, provide calculations indicating expected heat loss of piping for review by the Owner's Representative. Adjustment of the boiler output temperature and/or additional boilers may be required due to heat loss of shallowly buried snowmelt mains.
- H. Snowmelt zone piping shall be continuous from the supply connection to the return connection at the snowmelt manifold. No joints are allowed in the snowmelt zone piping except where accessible at the snowmelt manifold vault or at a piping junction vault.
- I. Snowmelt zone piping below concrete pavers located in a layer of sand, shall be held in place with a welded 6x6 wire mesh.
- J. Snowmelt piping in concrete shall be held in place with the piping manufacturer's pipe stands to the correct elevation as recommended by the manufacturer for the application and concrete thickness.
- K. Snowmelt zone piping shall not cross through or into and adjacent area where the Landscape Architects cross section elevation detail is different or where the design traffic loading differs. Where expansion joints, construction joints, control joints, or abrupt changes in elevation occur, piping installation shall conform to the manufacturer's written installation instructions and recommendations.

**END OF SECTION**

**SECTION 232116**

**HYDRONIC SPECIALTIES**

**PART 1 GENERAL**

**1.01 WORK INCLUDED**

- A. Air vent.
- B. Expansion tank.
- C. Air separator.
- D. Relief valve.
- E. Pump inlet flow straightening fitting.
- F. Pressure reducing valve.
- G. Flow switch.

**1.02 SUBMITTALS**

- A. Furnish manufacturer's submittal data for:

- 1. Air vent.
- 2. Expansion tank.
- 3. Air separator.
- 4. Relief valve.
- 5. Pressure reducing valve.
- 6. Flow switch.

**1.03 DESIGN RESPONSIBILITY**

- A. It is the responsibility of the installing snowmelt contractor to size the equipment as required and associated with this specification section for use in a system with 2 boilers. All equipment shall be located such as not to interfere with the future installation.

**PART 2 PRODUCTS**

**2.01 ACCEPTABLE MANUFACTURERS**

- A. Air Vent
  - 1. Armstrong
  - 2. Amtrol
  - 3. Bell & Gossett
  - 4. Taco

B. Expansion Tank

1. Armstrong
2. Amtrol
3. Bell & Gossett
4. Taco

C. Air Separator

1. Armstrong
2. Amtrol
3. Bell & Gossett
4. Taco ACT

D. Relief Valve

1. A.W. Cash Co.
2. Bell & Gossett
3. Armstrong
4. Watts Regulator Co.

E. Pump Inlet Flow Straightening Fitting

1. Amtrol
2. Armstrong
3. Bell & Gossett
4. Taco

F. Pressure Reducing Valve

1. Armstrong
2. Bell & Gossett
3. Fisher
4. Taco
5. Watts Regulator Co.

G. Flow Switch

1. McDonnell - Miller

2.02 AUTOMATIC AIR VENT

- A. Float actuated, brass body, positive shut-off against negative pressure, suitable for maximum operating pressure of 150 psig and maximum operating temperature of 250 F, similar to Bell & Gossett model 107A.

2.03 EXPANSION TANK

- A. Pre-charged steel expansion tank with replaceable bladder, 0.302"-32 charging valve connection, fitted with lifting rings and floor mounting skirt for vertical installation, ASME rated for 125 psig working pressure.



2.04 AIR SEPARATOR

- A. Vortex air separator constructed in accordance with section VIII, Div 1 or the ASME Boiler and Pressure Vessel Code.
- B. Provide with NPT vent connection on top and NPT connection on bottom for blow down.
- C. Provide with a carbon steel system strainer with a free area of not less than 4 times the cross section area of the connection pipe.
- D. Cast iron body and ANSI flanges.

2.07 PUMP INLET FLOW STRAIGHTENING FITTING

- A. Angle type cast iron body and cover with suitable NPT, flanged, or grooved pipe connections, straightening vanes, orifice cylinder, 16 mesh bronze start-up strainer, and EPDM O-ring seals, suitable for 175 psig working pressure and 300 F operating temperature. Provide extra set of O-ring seals for start-up strainer removal.

2.08 PRESSURE REDUCING VALVE

- A. All bronze, spring and diaphragm, manual adjustment for outlet water pressure, integral strainer, female thread connections, similar to Bell & Gossett model #12.

PART 3 EXECUTION

3.01 AIR VENT

- A. There is a single automatic air vent required atop the air separator. Only manual air vents are to be used at high points throughout the remainder of the system.
- B. Manual air vents consist of a ball valve, GHT, cap chained to the handle.
- C. Provide 1/4" valves at the high points of all mains and risers for system venting. Provide 1/4" overflow to nearest drain.
- D. Provide vent tubing to nearest drain for automatic air vents and air vents in concealed locations.
- E. Provide access to all air vents.

3.02 PUMP INLET FLOW STRAIGHTENING FITTING

- A. Support fittings with floor mounted pipe and flange supports. Remove start-up strainer after 30 days operation.

3.03 FLOW SWITCH

- A. Install in horizontal section of piping.
- B. Provide a minimum of 2'-0" lineal feet of horizontal pipe upstream and downstream of the flow switch.

**END OF SECTION**

**SECTION 232123**

**HYDRONIC PUMPS**

**PART 1 GENERAL**

**1.01 WORK INCLUDED**

- A. Vertical In-line Pump.
- B. Pumps provided as integral to a piece of equipment (ie: Glycol Feed Tank) are not included in the scope of this specification section.

**1.02 SUBMITTALS**

- A. Furnish manufacturer's submittal data for:
  - 1. Vertical In-line Pump
- B. Submit performance curves with operating point plotted.
- C. Submit worst case pressure loss calculations for each snowmelt system which shall include the pressure loss of each length of piping, boiler pressure losses, fittings throughout entire systems, control valve pressure losses, etc.

**1.03 DESIGN RESPONSIBILITY**

- A. It is the installing snowmelt contractor's responsibility to provide 2 pump snowmelt main pumps in the boiler room on the Torian Plum snowmelt project.
- B. The snowmelt system pumps shall be provided with variable frequency drives (VFD's). VFD's shall be provided by the pump manufacturer.
- C. The snowmelt system pumps and VFD provided for the Torian Plum snow melt shall be compatible with the VFDs and Pump controls package that will be used on the promenade project.

**PART 2 PRODUCTS**

**2.01 ACCEPTABLE MANUFACTURERS**

- A. Vertical In-Line Pump
  - 1. Armstrong
  - 2. Bell and Gossett
  - 3. Grundfos

**2.02 GENERAL**

- A. Statically and dynamically balance rotating parts.

- B. Construction shall permit complete servicing without breaking piping or motor connections.
- C. Pump connections shall be flanged.
- D. Heating pumps: Suitable for handling water at 230 F.
- E. Size pump motor to not be overloaded at any point along impeller curve.
- F. Select pump to allow minimum increase of one impeller size in field.
- G. Provide coupling guards.
- H. Provide renewable bronze wearing rings for all bronze construction pumps.

2.03 VERTICAL IN-LINE PUMP

- A. Type: Centrifugal, single stage or multi-stage, direct connected, suitable for horizontal or vertical operation.
- B. Casing: Cast iron, rated for 175 psig working pressure, suction and discharge gauge ports, drain plug.
- C. Impeller: Bronze, fully enclosed, keyed to shaft, secured with locknut.
- D. Shaft: Stainless steel or carbon steel with bronze or stainless steel sleeve through seal chamber.
- E. Seals: Carbon rotating against Silicon Carbide. Secondary seal shall be Viton or equivalent

PART 3 EXECUTION

3.01 INSTALLATION

- A. Support piping adjacent to pump such that no weight is carried on pump casing. Provide supports under elbows on pump suction and discharge line sizes 4" and over.
- B. Check, align, certify pumps prior to start-up.
- C. Align pump assembly with the use of dial indicator with a written report indicating the acceptable tolerance per the manufacturer's requirements. Indicate before and after readings, total amount of shimming at each corner of the pump and any shortcomings. The report shall be submitted to the Engineer for acceptance of installation.

**END OF SECTION**

**SECTION 232513**

**GLYCOL SYSTEM**

**PART 1 GENERAL**

**1.01 WORK INCLUDED**

- A. Fill tank, pressure sensor, pressure relief valve, check valve.
- B. Propylene glycol solution.
- C. Feed pump.

**1.02 SUBMITTALS AND SHOP DRAWINGS**

- A. Furnish shop drawings and manufacturer's submittal data for glycol and equipment.

**1.03 DESIGN RESPONSIBILITY**

- A. It shall be the responsibility of the installing snowmelt contractor to provide propylene glycol as required for the systems and project as well as chemical treatment of the snowmelt systems.
- B. The intent of the drawings and specifications is to provide a packaged glycol feed tank with integral pump and alarms. The packaged system shall be capable of providing for the project associated with the Torian Plum boiler room.

**1.04 WARRANTY**

- A. Replace glycol solution lost from system during the construction process. Glycol solution shall be at required system concentration prior to project closeout.
- B. Warranties as described in the Promenade specifications shall remain in the promenade scope of work. The snowmelt system contractor shall coordinate the warranty period and requirements for equipment provided under SSRC's scope of work with SSRC's property management.

**PART 2 PRODUCTS**

**2.01 ACCEPTABLE MANUFACTURERS**

- A. Aquachem
- B. Calcium Control
- C. Axiom
- D. Neptune

**2.02 PROPYLENE GLYCOL SOLUTION**

- A. The system fill concentration shall be 50% propylene glycol, 50% domestic water. "Creek Water" shall not be used.
- B. Corrosion Protection: Less than or equal to 5 mil per year when laboratory tested to ASTM D1384.

**2.03 GLYCOL FEEDER SYSTEM**

- A. Tank: Polyethylene, minimum 55 gallon capacity, suitable for 180 F operating temperature, with hinged cover, level gauge, level markings on side of tank in gallons, hose bibb drain and low water level switch with dry contacts for remote alarm and pump shut-off.
- B. Pump: Positive displacement rotary gear type, all bronze construction, 1.5 GPM at 100 psig, 1750 RPM, 115/60/1, adjustable pressure switch. Do not locate the adjustable pressure switch on the pump.
- C. Adjustable Pressure Switch: Honeywell, Pressuretrol, Model L604A, 5 PSI to 50 PSI set point, 4 PSI to 12 PSI differential.

2.04 CHEMICAL FEED EQUIPMENT FOR CLOSED SYSTEMS

- A. Provide chemical bypass filter feeder, rated at 175 psig, for the following closed systems:
  - 1. Snowmelt Sytems.
- B. Filter feeder shall be of two (2) gallon capacity with a, metal basket, cloth media filter, and 3/4" drain connection.
- C. Cloth media filter shall 20 micron with a spare media filter of 5 micron. The spare media filter shall be installed after cleaning operations have been accomplished and the Engineer accepts the hydronic system as being properly cleaned.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Perform laboratory glycol solution strength tests before system is turned over to Owner and at end of first year of operation. Replenish as required.
- B. Submit a copy of laboratory report to Owner.

**END OF SECTION**

## SECTION 235216

### CONDENSING BOILERS

#### PART 1 GENERAL

##### 1.01 WORK INCLUDED

- A. This section includes packaged, factory-fabricated and assembled, gas-fired, fire-tube water-tube condensing boilers, trim, and accessories for generating hot water.

##### 1.02 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of condensing boilers and are based on the specific system indicated. Refer to Design Responsibilities for more information.
- B. Electrical Components: Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. ASME Compliance: Fabricate and label condensing boilers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. ASHRAE/IESNA 90.1 Compliance: Condensing boilers shall have minimum efficiency according to Table 10-8.

##### 1.03 SUBMITTALS

- A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.
  - 1. Wiring Diagrams: Detail power, signal, and control wiring.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Operation and Maintenance Data: For condensing boilers to include in emergency, operation, and maintenance manuals. Include maintenance of condensing boilers in the service agreement as outlined in specification section 230513.
- C. If alternate manufacturer's are chosen (see design responsibilities) the installing contractor shall submit a 1:10 scale drawing indicating conformance to the chosen manufacturer's clearances to combustibles, service clearances, etc for each boiler room and each system.

##### 1.04 DESIGN RESPONSIBILITIES

- A. The boiler for use under this project shall be compatible and compliant with the specifications for the project. The intent is that (2) 2,000 MBH boiler be provided for snowmelt of the Torian Plum Deck and that the boiler installed under this project be fully capable of being used in the complete promenade build snowmelt systems in the future.
- B. The following specifications are specific to the Torian Plum boiler room and it's requirements and shall be coordinated by the installing contractor with the promenade drawings and specifications.

1. The Torian Plum boiler room will be roughed-in with (2) 8” diameter flues of AL29-4C material.
2. The dimensions of the room are critical for the boiler manufacturer to be able to provide a 2 boiler system that will fit and be in compliance with these specifications as well as the specifications and intent of the project.
3. Boiler’s which require a draft damper in the flue piping are not acceptable for use in the Torian Plum boiler room. The flue and combustion air system shall be completely separated from communicating with the air inside the boiler room.
4. Boilers that operate as primary-secondary loop system are not being considered at this time.
5. The boilers provided under this project shall have their own controller and be capable of communicating and being controlled by the controls package specified for the promenade project.

1.05 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement and framework requirements are specified in Division 032000 “Concrete Reinforcing”.

1.06 WARRANTY

- A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of condensing boilers that fail in materials or workmanship within specified warranty period.
- B. Warranty Period for Fire-Tube Condensing Boilers:
  1. Leakage and Materials: 10 years from date of final completion.
  2. Heat Exchanger Damaged by Thermal Stress and Corrosion: Prorated ten years from date of final completion.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
  1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified or as shown meeting the design intent.

2.02 FIRE-TUBE CONDENSING BOILERS

A. Manufacturers:

1. AERCO International, Inc.

B. Description: Factory-fabricated, assembled, and tested fire-tube condensing boiler with heat exchanger sealed pressure-tight, built on a steel base; including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. Snowmelt service only.

C. Boiler Characteristics and Capacities:

1. Heating Medium: 50% Propylene Glycol/Water Mixture.
2. Maximum Design Pressure Rating: 150 psig.
3. Gas Operating Pressure: 4" WC minimum and 2 PSI maximum.

D. Fire-Tube Boiler Components:

1. Heat Exchanger: Nonferrous, corrosion-resistant combustion chamber.
2. Pressure Vessel: Carbon steel with welded heads and tube connection.
3. Burner: Natural gas, forced draft.
4. Turndown Ratio: 15:1.
5. Direct Vent Capabilities
6. Blower: Centrifugal fan to operate during burner firing sequence and to prepurge and postpurge the combustion chamber.
7. Gas Train: Combination gas valve with manual shutoff and pressure regulator. Include 100 percent safety shutoff with electronic flame supervision.
8. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.
9. Casing:
  - a. Jacket: Sheet metal, with snap-in or interlocking closures.
  - b. Control Compartment Enclosures: NEMA 250, Type 1A.
  - c. Finish: Baked-enamel protective finish.
  - d. Insulation: Minimum 2-inch thick fiberglass insulation surrounding the heat exchanger.
  - e. Combustion-Air Connection: Inlet and vent collars.
10. Mounting base to secure boiler to concrete base.

2.03 HOT-WATER BOILER TRIM

- A. Aquastat Controllers: Operating, firing rate, and high limit.
- B. Safety Relief Valve: ASME rated. 125 psig.
- C. Altitude and Temperature Gage: Minimum 3-1/2" diameter, combination water pressure and temperature gage. Gages shall have operating pressure and temperature ranges so normal operating range is at approximately 50 percent of full range.
- D. Boiler Air Vent: Automatic.
- E. Drain Valve: Minimum 3/4" hose end ball valve.
- F. Neutralizing Trap: Provide PVC neutralizing trap as indicated on the drawings. Neutralizing trap (tank) shall be IAMPO stamped and certified.



2.04 BURNER OPERATING CONTROLS

- A. Description: To maintain safe operating conditions, burner safety controls limit the operation of burner.
  - 1. High Cutoff: Automatic reset stops burner if operating conditions rise above maximum boiler design temperature.
  - 2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be manual reset type.
  - 3. Blocked Inlet Safety Switch: Manual reset pressure switch field mounted on boiler combustion air inlet.
  - 4. Alarm Bell: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.

2.05 BOILER OPERATING CONTROLS

- A. Boiler operating controls supplied by boiler manufacturer shall include the following devices and features.
  - 1. Control Transformer: 115V; completely integrated microprocessor based control system for multiple boilers compatible with DDC controls.
  - 2. Sequence of Operations: Electric, factory fabricated, and field installed panel to control burner rate to reset supply water temperature to +/- 2 degrees F inversely with outside air temperature.
    - a. Include automatic, alternating firing sequence for multiple boilers.
- B. DDC System Interface: Factory installed hardware and software to enable project owner to monitor and control hot water set point and display boiler status and alarms (see controls specification for more information).

2.06 VENTING

- A. Refer to specification section 15575, Chimney and Breeching for more information.
- B. Vent(s) shall comply with the boiler manufacturer's requirements for Category III and IV venting requirements. Provide wall sleeves, roof thimbles, sealant, etc as required by the boiler and vent piping manufacturer's requirements.
- C. The Combustion Air Intake(s) shall conform to the boiler manufacturer's requirements. It is the intent of these specifications that combustion air is ducted from the outside directly to the boiler in a direct vent sealed combustion flue combustion air system as allowed by the Benchmark series boilers by Aerco. Should an alternate manufacturer have differing requirements than that shown on the plans, the contractor shall provide and install combustion air intakes as required by the boiler manufacturer. Combustion air ductwork shall be insulated with 1-1/2" duct wrap insulation.

2.07 SOURCE QUALITY CONTROL

- A. Test and inspect factory assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code: Section 1, for high pressure boilers and Section IV, for low pressure boilers.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Before boiler installation, examine roughing in for concrete equipment bases, anchor bolt sizes

and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.

1. Final boiler locations indicated on the drawings are approximate. Determine exact locations before roughing in for piping and electrical connections.

- B. Examine mechanical spaces for suitable conditions where boilers will be installed. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02

#### CONNECTIONS

- A. Piping installation requirements are specified in other in other Division 230550 Sections. Drawings indicate general arrangement of piping, fittings and specialties.
- B. Connect gas piping full size to boiler gas-train inlet with union.
- C. Connect hot-water piping to supply- and return-boiler tapings with shutoff valve and union or flange at each connection.
- D. Install piping from safety relief valves to nearest floor drain.
- E. Connect breeching full size to boiler outlet. Refer to Division 230550 “Breechings, Chimneys, and Stacks” for venting materials.
- F. Install piping adjacent to boiler to allow service and maintenance.
- G. Tighten electrical connectors and terminals according to manufacturer’s published torque-tightening values. If manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.03

#### STARTUP SERVICE

- A. Engage a factory-authorized service representative to test, inspect, and adjust boiler components and equipment installation and to perform startup service.
- B. Perform installation and startup checks according to manufacturer’s written instructions.
- C. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
- D. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
- E. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Adjust initial temperature set points.
- G. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- H. Occupancy Adjustments: When requested within 12 months of date of Final completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose, without additional cost.
- I. Prepare written report that documents testing procedures and results.

3.04 CLOSEOUT PROCEDURES

- A. Owner's Instructions: Provide services of manufacturer's technical representative for (1) 8-hour day to instruct property owner's personnel in adjustment, operation and maintenance of condensing boilers. This class shall be video taped and shall be provided to each of property owner's at completion of the system on their property.

**END OF SECTION 15558**

## SECTION 260100

### BASIC ELECTRICAL REQUIREMENTS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. The General Conditions of the Contract, Supplementary Conditions of the General Contract, and requirements of other Divisions apply to work under this Division.
- B. Provide labor, materials, temporary facilities, equipment and services to install electrical systems as indicated or required, which includes but is not limited to, masonry, excavation and backfill, concrete, carpentry, painting, conduit sleeves and supports, anchors, vibration and sound isolation, access doors, cutting and patching, and similar work.
- C. Provide temporary electricity for electrical work and the work of other trades.

##### 1.02 QUALITY ASSURANCE

- A. The manufacturer's material or equipment listed first in the Specifications or on the Drawings are types to be provided for establishment of size, capacity, grade and quality.
- B. Additional manufacturer's materials or equipment listed are considered to be "other acceptable" manufacturers and the cost of changes in construction required by their use shall be borne by this Contractor.
- C. Review of Submittals for equipment supplied is mandatory as a condition of acceptance of work. Installation of equipment prior to review shall be at Contractor's risk.

##### 1.03 INTENT AND INTERPRETATIONS

- A. It is the intent of these Drawings and Specifications to result in a complete electrical installation in complete accordance with applicable codes and ordinances.
- B. Neither the professional activities of the Engineer nor the presence of the Engineer or its employees and subconsultants at a construction/project site shall relieve the Contractor of its obligations, duties, and responsibilities including, but not limited to, construction means, methods, sequence, techniques, or procedures necessary for performing, superintending, and coordinating the Work in accordance with the Contract Documents.
- C. Drawings are diagrammatic in character and do not necessarily indicate every required junction box, pull box, ell, etc. Items not specifically mentioned in the specification or noted on the Drawings, but which are obviously necessary to make a complete working installation, shall be included.
- D. Drawings and Specifications are complementary. Whatever is called for in either is binding as though called for in both. The more stringent requirements shall govern.
- E. Drawings shall not be scaled for rough-in measurements or used as submittals. Where drawings are required for these purposes or have to be made from field measurements, take the necessary measurements and prepare the drawings.
- F. Symbols used on the Drawings are defined in the Electrical Legend on the Drawings. Symbols indicated on the Legend may not necessarily be required for the Project.
- G. Prior to ordering equipment, determine that equipment shall adequately pass through building

openings and passage ways providing unobstructed access to final equipment location. Equipment shall be manufactured and shipped in sections for assembly in final equipment location when inadequate building openings and passage ways limit access. Submittals shall indicate sectionalized manufacture of equipment.

- H. Before ordering equipment and before work is installed, determine that equipment shall properly fit the space; that required clearances can be maintained and that electrical equipment can be located without interferences between systems, with structural elements or with the work of other trades.
- I. If conflicts are discovered in Contract Documents as work progresses, a set of prints marked with red pencil showing recommended modifications shall be submitted to the Architect/Engineer for approval prior to installation.
- J. The Drawings indicate the general arrangement of circuits and outlets, locations of switches, panelboards and other work. However, rearrangement and re-circuiting shall not be permitted without specific acceptance.
- K. Incidental equipment such as tools, scaffolding, consumable items, testing equipment, appliances and the like shall be provided whether listed or not. Labor, fees, licenses, start-up and checkout services shall also be provided.
- L. The terms "the Contractor" or "this Contractor" when used in this Division of specifications, shall be construed to mean Contractor for electrical work.
- M. Instructions such as "provide the outlets..." shall mean the same as though the words "This Contractor shall" preceded each instruction. "Provide" shall mean "furnish and install." Where the words "accepted" or "acceptable" are used, such "accepted" or "acceptable" action by the Architect/Engineer denotes that the work or equipment item is in conformance with the design concept of the Project and, in general, complies with the pertinent information given in the Contract Documents.
- N. In the event that discrepancies exist or required items or details have been omitted, notify the Architect in writing of such discrepancy or omission at least five days prior to bid date. Failure to do so shall be construed as willingness to supply necessary materials and labor required for the proper completion of this work. For discrepancies which are not reported by Contractor the most stringent requirement shall apply.
- O. In the event that additional information is required during construction, request such information from the Architect in writing prior to performing related work. The request for information shall include an explanation of the information required including references to related portions of the Documents and Contractor's recommendations.

#### 1.04 JOB CONDITIONS

- A. Examine the premises and become familiar with existing conditions prior to bidding. No allowance shall subsequently be made for not following this procedure.
- B. Protect work, materials, and equipment against theft, injury, or damage until it has been installed, tested, and accepted.
- C. Be responsible for damage to the property of the Owner or to the work of other trades due to the electrical work during the construction and warranty period.
- D. Ascertain the scope of other trades' responsibilities and determine if the installation of proposed equipment shall affect the operation or code compliance of equipment. Relocate, modify or otherwise revise equipment as required to maintain operational integrity and code compliance.
- E. Be responsible for the safety of the workers and others on the construction site.

1.05 REGULATORY REQUIREMENTS

- A. Errors and omissions in the Contract Documents do not relieve the Contractor from providing the work in accordance with regulatory requirements.
- B. Execute and inspect work in accordance with Underwriters, local and state codes, rules and regulations applicable to the trade affected as a minimum, but if the plans or specifications call for requirements that exceed these rules and regulations, the greater requirement shall be followed. Follow requirements of IBC, IFC, IMC, IPC, IECC NFPA, NEC, OSHA, NEMA, ANSI, UL, EIA/TIA, and applicable state, local or federal specifications.
- C. Comply with standards in effect at the date of these Contract Documents, except where a standard or specific date or edition is indicated.
- D. Conform to guidelines and requirements of local utility companies.

1.06 PERMITS AND FEES

- A. Obtain permits required for the electrical work on this Project.
- B. Pay fees, including service installation and connection charges, aid-to-construction fees, and permit fees.
- C. No work shall be started prior to obtaining necessary permits and payment of required fees. Work installed prior to obtaining proper permits shall, if required by permitting authority, be redone in compliance with requirements.
- D. Notations made on permit or review documents shall be observed. Additional requirements noted by jurisdictional authority shall be made part of the requirements for construction of the Project. Additional costs for implementing jurisdictional authority's requirements, if any, shall be submitted to the Architect prior to construction for review.

1.07 SUBSTITUTIONS

- A. Material and equipment used in bids shall be as specified. Proposed substitutions shall be reviewed after award of contract during submittal review. Proposed substitutes shall be clearly labeled as a substitute. Submittals shall include data necessary for complete evaluation of the proposed substitution. Substitution materials and equipment used in bids shall be at Contractor's risk, and as such are subject to rejection during submittal review. The Contractor shall be responsible for fees for re-design incurred by the Engineer resulting from the use of substitution materials. Such extra fees shall be deducted from payment to the Contractor.
- B. Where "other acceptable" manufacturers are named, their products may be used provided they totally meet the Specifications and are dimensionally suitable and operationally identical to the specified item. The decision as to whether or not such items are equal to the specified items shall be made by the Engineer during submittal review.

1.08 SUBMITTALS

- A. The purpose of Submittals is to ensure that Contractor understands design requirements and demonstrates understanding by indicating and detailing intended materials, methods, and proper installation practices. If discrepancies between Submittals and Contract Documents are discovered either prior to or after Submittals are reviewed, requirements of Contract Documents shall take precedence. Submittals which are submitted, but which are not required by Contract Documents, shall be returned Not Reviewed.
- B. Review of Submittals and action recommended as result of review is a courtesy extended to

Contractor by Engineer. This review is intended to minimize delivery to job site and installation of materials and equipment that do not meet intent of Construction Documents. Submission of material for review does not alter Contractor's obligation to follow intent of Construction Documents, nor Contractor's responsibility to comply therewith regardless of action noted in Engineers review.

- C. Submit a schedule indicating items to be submitted with respective dates prior to submittals. Submittals shall be submitted to allow the Engineer's possession of such for a minimum of two week(s).
- D. Product data submittals shall include catalog cut-sheets, manufacturer's data sheets, written descriptions, specification sheets detailing the associated product, item, assembly and installation. Highlight characteristics and features within product data submittals with a yellow highlighting marker to identify compliance with the Drawings and Specifications. Indicate characteristics and features which are missing or vary from the Drawings and Specifications.
- E. Submittals include details, installation drawings, assembly drawings, fabrication drawings, diagrams, etc., which show adaptation or installation of Contractor-furnished products or materials for overall Project. Electronic files, if required for preparation of Submittals, shall be compatible with software and software version as decided by Architect at time of Submittal production. Electronic files if required for preparation of Submittal may be obtained from Architect, at which time an indemnification form releasing the Architect and Engineer from liability for the Contractor's record drawing changes on such files shall be executed. Include the following:
  - 1. Legend: Match Contract Documents.
  - 2. Format: Sheet size to match Contract Documents with title block indicating Project name, manufacturer's name and logo, date of submittal, content of sheet, and sheet number.
  - 3. Wiring and Control Diagrams: System and equipment wiring diagrams and control diagrams include multiple floor and building separation lines, sizes of conduits, size and number of conductors in each conduit, wiring color code, and identification of terminals and interconnections. Differentiate clearly between factory and field installed wiring. Make diagrams specific to this Project.
  - 4. Floor Plans: Plan titles, scales, north arrows, column lines, and room names and numbers shall match Contract Documents.
- F. Submit samples of equipment as indicated or requested.
- G. Prior to ordering equipment or beginning installation work, assemble, prepare, and submit shop drawings required for Project. Submit Submittals as required by individual Sections of Specifications. As a minimum, provide product data submittals for equipment indicated on the Drawings whether mentioned in these Specifications or not.
- H. Contractor shall thoroughly check Subcontractors' or vendors' Submittals and, after approving Submittals, provide Submittals for review. Partial or incomplete submittals will not be reviewed by the Engineer and will be returned Not Reviewed. Submittals that do not bear Contractor's review stamp shall be returned Not Reviewed.
- I. Each set of Submittals submitted or re-submitted shall bear a unique Contractor's submittal number. Submit a minimum of seven copies, two of which will be retained by the Engineer. After review, Submittals shall be returned together with Submittal Review Sheet which indicates comments on Submittals with specific actions such as: No Exception Taken; Make Corrections Noted, Re-submittal Not Required; Make Corrections Noted, Re-submittal Required; Rejected; Not Reviewed. Continue to re-submit Submittals until No Exception Taken or Make Corrections Noted, Re-submittal Not Required action is indicated. Provide a copy of the original submittal review comments for re-submitted items.
- J. The Contractor shall be responsible for extra fees incurred by the Engineer resulting from subsequent review(s) of submittals which fail to meet the requirements herein. Such extra fees shall be deducted

from payment to the Contractor.

1.09 RECORD DOCUMENTS

- A. Keep in custody during entire period of construction, a current set of documents indicating changes that have been made to the Contract Documents. Changes to be noted on the documents shall include but shall not be limited to, panelboard, luminaire, equipment, and other schedules; circuiting; equipment, luminaires, or conduit located more than 2 feet (0.61 meters) from where shown on Drawings; electrical equipment ratings; modifications to Specifications. Incorporate Addenda, accepted Alternates, Change Orders, and other Document revisions which occurred after the award of the General Contract or the start of construction activities into the Record Documents. Notations and changes shall be done in a neat and legible manner in accordance with Architect's instructions. Changes shall be noted in red, deletions in green, and notes in blue.
- B. At the completion of the Project, mark equipment designations on the documents. Designations shall match the engraving on the tags installed as called for elsewhere in these specifications.
- C. Upon completion of work, submit the complete set of Record Documents to the Architect. The Contract Documents set the standard for content and methods of presentation for the changes shown.
- D. The Contract shall not be considered completed until these Record Documents have been reviewed and accepted by the Architect.

1.10 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

- A. Make provisions for receiving and storing materials, including Owner furnished materials to be installed under this Division. Carefully mark and store materials. Carefully check and inspect materials furnished for installation, and furnish a receipt acknowledging acceptance of delivery and condition of the materials received. Do not use received materials which contain cracks, dents, abrasions, or other defects. Mark such materials rejected and remove from site or return to supplier for replacement.
- B. Protect materials and equipment from physical damage, construction dirt, and the elements from the time they are delivered until final acceptance. The Contractor installing the equipment or materials shall be responsible for their protection.

1.11 EXTRA MATERIALS

- A. Furnish extra materials, packaged with protective covering for storage, and identified with labels describing contents. Deliver extra materials to the Owner.

1.12 COORDINATION

- A. Schedule work to coordinate with that of other trades to minimize delays.
- B. Coordinate service installations requirements with the local serving utility companies and Owner.
- C. Coordinate with Owner and utility company outages due to interfacing electrical equipment. Outages must be scheduled at least five days in advance and shall be at a time and duration acceptable to the Owner. Outages at a time other than normal working hours, shall not entitle the Contractor to additional overtime or compensation beyond that in the bid.
- D. Locations of devices, outlets, etc., as shown on the Drawings are approximate unless dimensioned or otherwise noted. Where locations of devices, outlets, etc., are dimensioned or noted on the Drawings, verify location with Architect's representative or with equipment to be supplied. Exact locations of devices, outlets, etc., shall be coordinated with field conditions. Ensure that switches or other electrical devices are mounted such that they are not "trapped" behind opened doors or otherwise



rendered inaccessible, regardless of locations indicated on Drawings.

- E. Where locations of devices and equipment are not specifically mentioned in the specifications or indicated on the Drawings, verify locations with Architect or Owner prior to rough-in.
- F. Prior to rough-in for service to equipment furnished or provided by others, coordinate with other trades and Owner to verify rough-in locations, connection requirements, electrical service to equipment size and characteristics, and obtain a schedule of equipment electrical loads. Schedules shall be for verifying electrical services, controls, disconnects, fuses, and overload protection. Coordinate with Architect, Engineer, authority having jurisdiction, and other appropriate Divisions as needed.
- G. Verify the physical dimensions of each item of electrical equipment to fit the available space and promptly notify the Architect prior to roughing-in if conflicts appear. Be responsible for coordination of equipment to the available space and to the access routes through the construction. Confer and cooperate with other trades and coordinate the work in proper relation with theirs. Coordinate ceiling cavity space carefully with other trades.
- H. Refer to Division 23 and the Mechanical and Electrical Coordination Schedule for coordination of electrical and mechanical work.

#### 1.13 OPERATING AND MAINTENANCE MANUALS

- A. Make up the operating and maintenance manuals as specified and submit no later than 2 weeks prior to the completion of the Project.
- B. Information contained in the operating and maintenance manuals consist of submittal materials reflecting equipment as supplied and installed, test reports, warranties, description of required testing and testing methods, description of routine maintenance, cleaning, adjustments, and service required, suggested frequency of testing and maintenance, and recommended replacement parts with a list of names, addresses, and telephone numbers of service organizations that carry stock of such replacement parts. Manuals shall be 8-1/2 inch x 11 inch (21.59 cm x 27.94 cm) in size. Catalog pages and data in manuals shall be neat, clean copies. Larger drawings shall be accordion folded to above size. An index shall be provided which shall list contents in an orderly manner. Each copy of the operating and maintenance manual shall be bound in hard back or loose-leaf binder with hard cover, shall be adequately labeled for identification, and shall include plastic tabs coordinated with Index. Provide a separate tabbed section, with a list of testing required to maintain warranty for products and systems provided as part of this project.
- C. Submit one copy of the manual to the Architect for review prior to preparation of final copies. After review, make changes as noted and prepare 3 final copies of manual to be turned over to the Owner.
- D. This contract shall not be considered completed nor shall final payment be made until specified material, including test reports and warranties are received in this operating and maintenance manual and the manual is approved by the Architect.

#### 1.14 ABBREVIATIONS

- A. These specifications include conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  - 1. Abbreviated Language: Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be interpreted as the sense requires. Singular words shall be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicates.
  - 2. Abbreviations and Names: Trade association names and titles of general standards are

frequently abbreviated. Where abbreviations and acronyms are used, they mean the recognized name of the trade association, standards-generating organization, authorities having jurisdiction, or other entity applicable to the context of the text provision.

## PART 2 - PRODUCTS

### 2.01 STANDARDS

- A. Unless otherwise specified, materials and equipment shall be of domestic (USA) manufacture.
- B. Unless otherwise specified, materials and equipment shall be the manufacturer's current model and bear manufacturer's name and model number.
- C. All electrical equipment shall be listed and labeled with the Underwriters Laboratory tag or other listing as approved by the local jurisdictional authority. Custom designed items shall be fabricated of UL approved materials and UL listed as a complete assembly as required.
- D. Throughout Specifications, various materials, equipment, apparatus, etc., are specified by manufacturer, brand name, type or catalog number. Such designations are to establish standards of desired quality and construction and shall be the basis of the bid. Substitutions shall be allowed only as specified herein.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Workmanship shall be first quality throughout and shall be in complete accordance with the applicable codes. The appearance of the work shall be of equal importance to its operation. Lack of quality workmanship shall be considered sufficient reason for rejection of a system in part or in whole.
- B. All ground- or floor-mounted electrical distribution equipment, including switchboards, distribution panels, motor control centers, transfer switches, generators, and transformers, shall be installed and firmly anchored to a 4 inch high (10.16 cm) concrete housekeeping pad. Pad shall extend no more than 2 inches beyond the equipment footprint.

### 3.02 SUPERVISION

- A. Supervise work so it shall proceed in proper sequence without delay to other trades. The superintendent shall be on the Project site for the duration of the Project to ensure that Contract Documents are being followed. A ratio of not less than 1:1 shall be maintained between journeymen and apprentices.
- B. Submit resume of qualifications and experience of the superintendent for review by the Architect. Superintendent shall have as a minimum five years of continuous experience on projects of similar size. Resume shall include a listing of experience, projects, and references. Superintendent for this Project may not be changed without approval.
- C. The Architect may have an observer on the site whose interpretations of the Contract Documents shall be followed.

### 3.03 HOUSEKEEPING

- A. At the conclusion of each day's work, remove empty boxes, crates and rubbish and leave the area where the work has been done broom clean.

### 3.04 DEMOLITION

- A. Provide labor, materials, equipment, and services for existing electrical equipment which is to be removed, abandoned, or relocated.
- B. Comply with State and Federal regulations for the removal, hauling and disposal of materials.
- C. Verify that feeders and branch circuits have been disconnected and safely capped from equipment to be relocated, demolished or removed.
- D. Remove existing electrical equipment as noted on the drawings or as otherwise required.
- E. Remove electrical equipment to be relocated and ensure that such equipment is in acceptable condition for reuse. These items shall be tagged, protected from damage, and stored as directed by the Architect. A list of items stored shall be turned over to the Architect.
- F. At the completion of remodel work or when directed by the Architect, stored items not reused or retained by the Owner shall be removed from the premises. Disposition of items not reused shall be by the direction of the Architect.
- G. Lamps, ballasts, and other electrical equipment which contain hazardous materials shall be properly removed and disposed. Pay fees for disposal.
- H. Report the existence of hazardous materials unrelated to electrical equipment to the Architect immediately.
- I. The locations of existing equipment, circuiting, etc. shown on the drawings have been taken from existing drawings and obtained from field surveys and are, therefore, only as accurate as that information. Existing conditions shall be field verified with necessary adjustment being made to the drawing information.
- J. Where core drilling or concrete demolition is required as work of this trade or other trades, determine the location of existing encased or buried conduits and circuits in the area of the work using metal detectors, circuit tracers and judgment prior to commencement of drilling or demolition. Turn off all circuits which might feed through conduits and wiring in the area of the work.
- K. Where items are indicated on the drawings to be removed, removal of the item shall include removal of power circuits, control circuits, overcurrent devices, grounding, accessory devices, raceway and hardware unless noted otherwise.
- L. Ensure that the continuity of feed through circuits is maintained.
- M. Ensure that no electrical boxes or equipment other than conduit and connectors are rendered inaccessible by proposed construction. Relocate such equipment as required.
- N. Tag circuits remaining in junction boxes with Brady wire markers as to circuit number, panel, or device feeder.
- O. Leave sufficient slack wire in junction boxes for future reconnection where required.
- P. Where circuits to be removed are exposed during construction, completely remove wire, conduit, and supports as required. Where circuits to be removed are concealed or embedded in concrete, remove wiring back to junction point.
- Q. Abandoned conduit, left in place, shall have pull tape installed and shall be labeled at each end identifying origin, destination and abandonment. Labels shall be semi-permanent.
- R. Where circuits which are not in conduit or raceway exist in future air plenum areas, verify that

insulation is properly rated for plenum application. Where such non-rated circuits exist, notify the Engineer immediately for instructions.

- S. Removal and relocation of electrical equipment shall include patching and painting as required to refinish building surfaces. Coordinate patching and repainting with Architect.
- T. The record drawings shall reflect any existing electrical locations different from what is shown on the drawings.

### 3.05 EQUIPMENT MODIFICATION

- A. Where existing equipment is to be modified, furnish materials and labor necessary to modify or add to the equipment. Modifications shall be done neatly with factory parts and assemblies approved for the application. Provide equipment supplier with information of existing equipment, including serial number, date of manufacture, and special requirements. Modification shall in no way jeopardize the compliance of existing equipment with governing codes, underwriters listings or other regulations.
- B. Field verify existing equipment with submittals to ensure modifications are workable. Report to the Architect discrepancies between designed requirements and existing conditions.
- C. Modifications that are not factory approved shall be submitted to the Architect for review prior to modification.
- D. All new and modified electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers, that are in other than dwelling occupancies, and are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment per NEC 2017, article 110.16.

### 3.06 EXISTING EQUIPMENT

- A. Existing equipment that is removed and is to be reused shall be cleaned and serviced before being reinstalled.
- B. Existing luminaires that are to be removed and are to be reused shall be cleaned, relamped, relensed, and reballasted prior to reinstallation.
- C. Revised distribution equipment shall have new identification plates indicating new conditions.
- D. Panelboards which have circuits affected by work shall be completely circuit traced and the panelboard directories updated with the room and load served (i.e., RCPT-B250 through B260, LTG-A65-A75, COFFEE-C180, RCPT-ROOF, etc.).
- E. Revised panelboard schedules shall be neatly typed on new cards and installed in each revised panelboard.
- F. Where remodeling interferes with existing circuits and equipment which is not to be removed, such circuits and equipment shall be reworked and relocated as required to complete the Project. Circuit integrity of equipment in adjacent areas shall be left intact.

### 3.07 CUTTING, PATCHING, OPENINGS, SLEEVES, INSERTS AND HANGERS

- A. Furnish and install sleeves and boxes required for openings in the structure for installation of electrical work. Be responsible for proper placement of sleeves and boxes.
- B. Provide inserts and hangers required to support conduit, cables, boxes, fixtures, etc. Provide

independent support for all electrical equipment.

- C. Properly size and locate holes and chases required for work under this Division as construction progresses. Before beginning sleeving or installation work, carefully study Contract Drawings and check conduit, boxes and equipment locations for interference with other trades. If conflicts are discovered in Drawings or as work progresses, a set of prints marked with red pencil showing recommended installation methods shall be submitted to the Architect for review prior to installation. Cutting, repairing and required structural reinforcing for installation of this work shall be done in conformance with the Architect's directions. Cutting shall not be done without the Architect's approval.
- D. Cutting of concrete or other building materials shall be avoided where possible. Have a workman qualified in the electrical trade present at the pouring of concrete or the building of masonry containing electrical work to avoid cutting of concrete or other building material.
- E. Sleeves and chases are prohibited in structural members except where approved by the Architect in writing. If openings necessary for this work are not installed at the time of construction, or if an opening is required in existing construction, provide the opening.
- F. Patching in every instance consists of completing the work to match and blend in with the adjoining existing work insofar as methods, materials and colors, and workmanship are concerned. Patches which are not properly blended shall be rejected and ordered redone. Execute patching in full compliance with the provision of the Specifications relating to the type of work involved by craftsmen qualified and skilled in the particular type of work involved.
- G. Openings for electrical work shall be carefully caulked or grouted as required. Spare conduits shall be tightly capped.
- H. Holes and voids created to extend electrical systems through fire rated floors, walls, and ceilings shall be sealed with an intumescent material.
- I. Costs of cutting and patching caused by improper coordination shall be paid for by the Contractor regardless of the responsibilities set forth in these Contract Documents for new work.

### 3.08 EQUIPMENT IDENTIFICATION

- A. Labels shall be etched lamacoid tags, black with white core. Lettering shall be 1/4 inch (0.64 cm) upper-case, unless otherwise noted. Attach label tags to equipment with sheet metal screws. Emergency equipment labels shall be the same as above except tags shall be red with white core.
- B. Power distribution equipment furnished under Division 26 including, but not limited to, engine generator systems, transfer switches, transformers, switchgear, switchboards, panelboards, motor control centers, and disconnects are labeled to include the following:
  - 1. Key name as indicated on Drawings with 1/2 inch (1.27 cm) lettering.
  - 2. Ampere, voltage, phase, conductor color coding and AIC ratings.
  - 3. Other labeling as indicated or required.
- C. Main and Branch disconnects for switchboards, distribution panelboards, and motor control centers shall be clearly identified as to service frame size, circuit breaker trip setting or fuse size and type.
- D. Label junction, splice and terminal box interiors and covers. Labeling shall be by way of permanent marking pen and include panel name and circuit number. Labels shall be located on the back interior surface of boxes. In finished areas locate labels on the interior surface of covers. On junction boxes above ceilings or in unfinished areas, locate labels on the exterior surface of covers.
- E. Label outlet box interiors. Labeling shall be by way of permanent marking pen and include panel

name and circuit number. Locate labels on the back interior surface of outlet boxes.

- F. The exterior surface of fire alarm system junction, splice and terminal box covers shall be painted red.
- G. Unless otherwise indicated, wires and cables of each communication system shall have unique colors which follow a color coding documented within the head-end equipment of each system.
- H. Wire and cable identification shall be installed at points of termination in distribution equipment, junction boxes, splice boxes, terminal boxes, outlets boxes, and load connections. Such identification shall be by means of cloth, split sleeve or tubing type labels. Feeder labels shall include name of equipment from which feeder originates, name of equipment which feeder serves, and gauge of conductor. Wire and cables for branch circuit identification shall include circuit number, panelboard name, and gauge of conductor.
- I. For exterior underground power, signal, and communication lines, install continuous underground plastic line marker tape located directly above such lines. Marker shall be permanent, bright-colored, continuous-printed, vinyl tape not less than 4 mils thick by 6 inches wide (0.102 mm thick by 152 mm wide) with an embedded continuous metallic strip or core. Marker printing indicates type of underground line. Locate 6 to 8 inches (150 to 200 mm) below finished grade, unless otherwise indicated. Where multiple lines installed in a common trench or concrete encased do not exceed an overall width of 16 inches (400 mm), use a single line marker with printing indicating the multiple lines.

### 3.09 SPECIAL PROJECT PROVISIONS

- A. Overhead or Underground Power Service: The power utility company shall provide the primary conductors, service transformer, current transformers, meter and meter wiring. Contractor shall provide connection cabinet, meter base, current transformer enclosure, and other secondary work. Install secondary service conductors only after conduit has been thoroughly cleaned. Final service terminations to transformer shall be by power utility company.
- B. Overhead or Underground Communication Services: Contractor shall provide service entrance raceways for service cable supplied and installed by the communication utility company. Service entrance conduit shall be rigid metallic or rigid non-metallic type as directed by communication utility company and of the size indicated. Service entrance conduit shall be spaced a minimum of 1 foot (0.305 m) from the electrical service. Conduit shall have pull cord installed. Contractor shall also provide backboards for the utility company's use as indicated or required. Backboards shall be 4'-0" x 8'-0" x 3/4" (1.22 m x 2.44 m x 1.9 cm) plywood. Mount backboards with 8'-0" (2.44m) dimension oriented vertically on wall and top 8'-0" (2.44m) above floor. Paint backboards with three coats of gray enamel.
- C. Wiring for Equipment Furnished by Others: Provide electrical services to equipment furnished by others. Provide final connections unless otherwise noted. Where final connections are to be made by others, install outlet box and pull in conductors leaving 8 inch (20.32 cm) pigtails for each conductor. Conductors shall be taped and appropriate cover plate installed over box. Control and alarm wiring for such equipment shall be provided by the equipment supplier or trade providing equipment unless otherwise noted.
- D. Unless otherwise noted, provide 120 volt wiring to nearest panelboard, including circuit breaker, conduit, wire and connections for new mechanical equipment control panels, and accessory equipment. Coordinate quantity and location with Division 23.

### 3.10 PAINTING

- A. Scratched, chipped, or otherwise marred electrical equipment shall be repainted to match original finish at no additional cost to the Owner.

- B. Equipment received from manufacturer with a prime coat of paint shall be cleaned, sanded and furnished with a final coat of paint.
- C. Panelboards, disconnects, and boxes for life safety systems including emergency power and fire alarm equipment shall be painted red.

### 3.11 INSTALLATION

- A. Install equipment and materials in accordance with manufacturers' recommendations unless local codes or regulations take precedence.
- B. Install so that equipment can be easily serviced. Maintain, as a minimum, code required clearances.
- C. Place or replace equipment identification in locations where they can be seen and read without difficulty.
- D. Perform work in accordance with good commercial practice. The appearance of the finished work shall be of equal importance to its operation.

### 3.12 QUALITY ASSURANCE

- A. Arrange and oversee inspections by governing authorities. Upon completion of the work, deliver certificates of inspection and final approval to the Architect.
- B. Testing of electrical systems shall be in accordance with the manufacturer's recommendations and in accordance with applicable codes and standards for that system as required and as referenced in this Specification.
- C. Testing of electrical systems involving compliance to specific standards, including but not limited to UBC, UFC, ANSI, NFPA, ICEA, NEC, IEEE, LPI, NETA, and OSHA shall require the submittal of a completed test report, certified by the installer, testing agency or manufacturer. Test reports shall be complete and in accordance with the appropriate standard.
- D. Project site testing of equipment prior to installation, where called for in the specifications, shall include performance testing to establish the applicability of equipment for its intended purpose. Where required, Installer shall:
  - 1. Establish required test procedures from required standard or manufacturer's recommendation.
  - 2. Provide necessary test equipment, power, consumables to perform test.
  - 3. Notify Architect of test schedules at least one week in advance of testing.
  - 4. Perform tests.
  - 5. Provide necessary documentation to Architect.
- E. Installation of work shall be observed by the Architect. Work found to be in non-compliance with the specifications shall be redone. The Architect shall be consulted for direction for questions regarding suitability of the installed work. The Architect shall be notified at least one week prior to the covering up of work so that observation of work may be scheduled. Work shall not be covered up or enclosed until work has been tested by Contractor and has been observed by proper authorities including State/local inspectors and Architect. Should work be covered up or enclosed before such observation or test, it shall be uncovered, tested and reviewed and shall be restored by Contractor to finished condition at Contractor's own expense.
- F. Final testing and start-up of electrical systems shall include the testing and checkout of equipment and systems to establish their proper capacity, operation, maintenance and code compliance. Where required, Installer shall:

1. Provide the services of manufacturer's representative for systems to be tested and started up.
2. Establish required test procedures from required standard or manufacturer's recommendation.
3. Provide necessary test equipment, power, consumables to perform test.
4. Notify Architect of test schedules at least one week in advance of testing.
5. Perform tests and start-up functions.
6. Provide necessary documentation of completed tests and fully functional systems to Architect.

### 3.13 COMPLETION

- A. Test systems and place in proper working order prior to demonstrating systems to Owner.
- B. Instruct Owner's representative(s) once, in the presence of the Architect, on the proper operation, testing, and maintenance of the electrical systems. As a minimum, participants shall include contractor and major equipment manufacturers' representatives. Not less than a total of four hours shall be allowed for an instruction period. Use final version of operating and maintenance manual as a training aid. Instruction dates and times shall be coordinated with the Owner. Instruction shall as a minimum include items contained in the operating and maintenance manual.
- C. After tests and adjustments have been made and systems pronounced satisfactory for permanent operation, refinish damaged finish and leave everything in proper working order and of the intended appearance at the final completion of the Contract.
- D. On completion of work, remove tools, scaffolding, debris, etc., from the grounds and leave the premises perfectly clean. Equipment and facilities shall be thoroughly cleaned inside and out and residue removed. Equipment shall be turned over to the Owner in perfect, unblemished condition. Remove temporary labels and stickers.
- E. Reestablish original grades, landscaping, and other grade finishes.
- F. Load balance test the distribution system. Unbalance between phases shall not exceed 10% with full lighting and mechanical loads. Correct unbalanced load conditions exceeding this limit. Corrections shall be indicated on Record Drawings.

### 3.14 PROJECT CLOSE-OUT

- A. Upon written request from the Contractor certifying that the work is complete and ready for inspection, the Engineer shall prepare punchlist of items determined to be incomplete or otherwise not in compliance with intent of Contract Documents.
- B. When required, subsequent visit to review completion of punchlist work shall be made after receipt of written statement from Contractor indicating punchlist work is complete. Include copies of intermediate observation reports and final punchlists with individual items initialed by Contractor to attest that individual work items are completed.
- C. Contractor shall pay Engineer's costs at the billing rates in effect at the time the services are performed for subsequent punchlist visits required due to lack of completion of prior punchlist.

### 3.15 WARRANTY

- A. Warranty materials, workmanship and the successful operation of equipment installed for a period of 1 year from the date of acceptance of the entire work. Guarantee to repair or replace at Contractor's expense, work which may show defect during that time, provided such defect is, in the opinion of the Engineer, due to imperfect material or workmanship and not due to the Owner's carelessness or improper use.



- B. Provide testing and maintenance of equipment and systems per manufacturer's requirements during warranty period to adhere to warranty requirements.
- C. Exceptions - Incandescent and Fluorescent lamps shall be warranted for a period of one month from date of acceptance.

**END OF SECTION**

## SECTION 260500

### COMMON WORK RESULTS FOR ELECTRICAL

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Provide complete raceway systems for conductors unless otherwise specified.
- B. Provide complete system of conductors as required for raceway systems. Where quantities of conductors are not specifically indicated, provide necessary number to maintain circuits and function.
- C. Provide metal boxes for use as outlet boxes, pull boxes, or junction boxes. Boxes to include pressed steel boxes, masonry boxes, and weatherproof cast steel or aluminum boxes.
- D. Provide support for conduit, wireway, junction boxes, pull boxes, and related equipment.
- E. Provide fire sealing of holes and voids through fire rated barriers.

##### 1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.03 DESIGN RESPONSIBILITY

- A. Wire and cable sizes indicated are copper. Aluminum may be used where approved prior to commencing construction by Engineer for service and feeder conductor sizes #2 AWG and larger, unless otherwise indicated. Should aluminum be used, the Contractor is responsible for determining revised:
  - 1. Conductor sizes to achieve the same ampacity and voltage drop as copper sizes indicated.
  - 2. Raceway, boxes and equipment sizes and locations.
  - 3. Short circuit current values and AIC ratings of equipment.
- B. Resolve, to the satisfaction of the Engineer, problems that are a direct result of the use of aluminum conductors in lieu of copper.
- C. Where AHJ requests updated wet stamped & sealed drawings from the Engineer of record for changes to Aluminum, electrical contractor shall pay for fees associated with making those changes.

##### 1.04 SUBMITTALS

- A. Product Data: For the following:
  - 1. Conduit, fittings, and supports.
  - 2. Wires, cables, connectors and splices.
  - 3. Boxes
  - 4. Fire seals
- B. Design Data: Should aluminum wire and cables be used, provide a revised one-line and partial plans indicating revised:
  - 1. Conductor, raceway, box and equipment sizes and locations.
  - 2. Fault calculations.

3. AIC ratings of equipment.

1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. NEMA Compliance: Comply with applicable portions of NEMA standards pertaining to metallic and nonmetallic electrical raceway.
- D. UL labels: Provide electrical raceways, boxes, conductors, and connectors which have been approved, listed and labeled by UL.
- E. ANSI/ASTM Compliance: Provide electrical raceways and conductors which comply with applicable portions of ANSI/ASTM standards for construction of raceways and conductors.
- F. NEMA/ICEA Compliance: Provide conductors which comply with applicable portions of NEMA/ICEA standards pertaining to material, construction, and testing of conductors.
- G. Federal Specification: Provide electrical raceways and conductors which meet applicable portions of Federal Specification.

1.06 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
  - 1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- C. Coordinate electrical service connections to components furnished by utility companies.
  - 1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
  - 2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
- D. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Division 8 Section "Access Doors."
- E. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
- F. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

## PART 2 - PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURER

- A. Manufacturer with at least five (5) years experience in manufacturing product.

### 2.02 CONDUIT

- A. Rigid metal conduit (RMC) shall be steel, galvanized inside and outside. Factory made threads shall be full cut and galvanized after threading. The conduit shall be UL listed and shall meet the requirements of UL 6 and ANSI C80.1.
- B. Electrical metallic tubing (EMT) shall be hot-dipped galvanized or electro-galvanized steel with an inner coating to protect cables and to aid pulling. The conduit shall be UL listed and shall meet the requirements of UL 797 and ANSI C80.3.
- C. Flexible metal conduit (FMC) shall be composed of one spirally wound continuous strip of interlocked galvanized steel. The conduit shall conform to Federal Specification WW-C-566C and shall meet the requirements of UL 1.
- D. Liquid tight flexible metal conduit (LFMC) shall be galvanized steel with an oil and sunlight resistant polyvinyl chloride jacket bonded or extruded onto the exterior. Liquid tight flexible metal conduit shall be approved for grounding. Liquid tight flexible metal conduit shall meet UL Standard For Safety, UL 360.
- E. Rigid polyvinyl chloride conduit (PVC), unless otherwise noted, shall be Schedule [40] rigid plastic, rated for use with 90 degree C wire and shall be UL listed and conform to UL 651 and NEMA TC-2.
- F. Rigid nonmetallic type EB-20 conduit shall be ETL listed, tested to UL-651-A, and meet the requirements of NEMA TC-6 and ASTM F-512.

### 2.03 CONDUIT FITTINGS

- A. Fittings for rigid metal conduit shall be galvanized or cadmium plated. Fittings shall be threaded. Couplings shall be of galvanized steel. Locknuts and bushings shall be steel or malleable iron. Bushings shall have nylon insulated throat.
- B. Connectors, couplings and combination couplings for EMT shall be steel set screw or steel compression type. Insulated throat connectors shall be used for sizes 1 inch (DN27) and smaller. Un-insulated connectors with insulated bushing shall be used for sizes larger than 1 inch (DN27).
- C. Fittings for flexible metal conduit and liquid tight flexible metal conduit shall be of a type specifically designed for the purpose.
- D. Fittings for rigid nonmetallic conduits shall be of same material and manufacturer as conduit. Non-metallic fittings shall be UL listed and conform to UL 514.
- E. Expansion fittings across structural joints shall be of a design to compensate for expansion and contraction and shall be sealed to prevent entrance of water or moisture. Expansion fittings shall be approved for grounding duty.
- F. Adapters for joints between PVC and steel conduits shall be UL listed Carlon E942 and E943 series.

### 2.04 WIRE AND CABLE

- A. Conductors shall be new and unused. Wire and cable shall be copper single conductor type with 600V insulation, unless otherwise noted. Conductor shall be soft annealed Class B, per ASTM B-3

for solid wire and ASTM B-8 for stranded wire. Conductors shall be minimum 98% conductive.

- B. Aluminum conductors shall be an aluminum alloy that is listed or labeled by UL as "component aluminum-wire stock (conductor material)." Type EC/1350 aluminum is not acceptable. Conductors shall be "Stabiloy" as manufactured by Alcan.
- C. Number 10 AWG and smaller wire except for motor circuits shall be solid with Type THHN, or THWN insulation. Larger wire and motor circuit feeders shall be stranded with Type THHN, or THWN insulation. Conductors for service entrance use or where used underground shall be type XHHW only. Grounding conductors shall be copper.
- D. Insulation shall be flame retardant, heat resistant polyvinyl chloride (PVC), ethylene propylene (EP) or polyethylene (PE) with minimum insulation thicknesses per table 310-13 of the NEC. The insulation shall conform to the requirements of UL 83 ICEA S-68-516 for EP, ICEA S-61-402 for PVC and PE.
- E. Type THWN or THHN wire and cable shall have an outer nylon jacket conforming to UL-83. Cables shall be manufactured to meet the standards of Insulated Cable Engineer's Association (ICEA).
- F. MC Cable shall be UL listed, and consist of color-coded insulated conductors wrapped surrounded with a moisture resistant tape and enclosed in a galvanized steel interlocked cladding. Each cable shall contain a full sized ground wire.
- G. NM cable shall be UL listed, and consist of color-coded thermoplastic insulated conductors enclosed in a polyvinylchloride plastic overall jacket. Each cable shall contain a full sized ground wire.
- H. All homeruns shall be in EMT. Electrical contractor shall obtain written approval from design engineer for the use of type MC and AC cabling. Type MC and AC cable shall be permitted for branch circuit wiring in approved locations only and installed per the latest adopted edition of the National Electrical Code, NFPA 70.
- I. Wire-pulling lubricant shall be equal to Ideal "Aqua Gel CW" or Dow Corning compound #7.

## 2.05 CONNECTORS AND SPLICES

- A. For solid wire size #10 and smaller, "Scotchlok" insulated twist-on connectors or compression type, 600 V insulated or acceptable substitution.
- B. For stranded wire, "Burndy Hydent" hydraulic compression type, taped to 600 V insulation level.

## 2.06 PULL AND JUNCTION BOXES

- A. Provide code gauge sheet metal boxes with suitable covers, trims, etc. Boxes to be sized, per the NEC, by number and size of conduits and conductors, unless otherwise noted.

## 2.07 OUTLET BOXES

- A. Boxes shall be zinc or cadmium-plated code gauge pressed steel and of the knock-out type. Depth may vary to suit requirements of location.
- B. Boxes shall accommodate devices to be installed and shall be sized as required by the NEC for number and size of conduits and conductors entering and leaving. Round boxes shall not be permitted, except where specifically called for.
- C. Special oversized outlet boxes shall be code gauge steel and of the knock-out type. Boxes shall have screw mounted covers for surface or flush mounting. Boxes shall be sized as indicated or as required by the National Electrical Code. Special outlet boxes shall accommodate the equipment served.

- D. Weatherproof boxes shall be cast aluminum with threaded hubs. Boxes shall have screw mounted, gasketed covers.

## 2.08 SUPPORTS

- A. Hangers, straps and supports shall be of corrosion resistant or galvanized steel.
- B. Support channels shall be as manufactured by:
  - 1. B-Line
  - 2. Kindorf
  - 3. Unistrut
  - 4. Acceptable Equivalent

## 2.09 CONDUIT SUPPORTS

- A. Single Runs: Galvanized malleable-iron conduit straps for surface mounting or 3/8 inch (0.95 cm) threaded rod with steel one bolt conduit clamps for all suspended runs.
- B. Multiple Runs: Channel support for surface mounting or trapeze style hangers of 1-5/8 inches by 1-5/8 inches (4.13 cm by 4.13 cm) galvanized steel channels, supported by 3/8 inch (0.95 cm) threaded rod for all suspended runs. Size hangers to allow for 25 percent additional conduits.
- C. Supports and hardware shall be galvanized steel, except that high carbon spring steel supports may be used in steel stud walls to support horizontal and vertical conduit up to 3/4 inch (DN21).
- D. Perforated plumbing tape is not permitted in any support application.

## 2.10 ANCHOR METHODS

- A. Hollow Masonry: Toggle bolts or spider type expansion anchors.
- B. Solid Masonry (excluding concrete): Steel expansion bolts.
- C. New Concrete: Preset inserts with machine screws and bolts.
- D. Existing Concrete: Steel expansion bolts or explosive powder driven inserts.
- E. Wood Surfaces: Wood screws.
- F. Steel: Welded threaded studs or galvanized steel clamps.
- G. Light Steel: Sheet metal screws.

## 2.11 FIRE SEALS

- A. Fire seals for walls and floors shall be an intumescent material capable of expanding to fill voids when exposed to temperatures beginning at 250 degree F (121 degree C). The seal system shall be U.L. classified and have ICBO, BOCA, and SBCC ratings to 3 hours. The seal system fire rating shall equal or exceed the fire rating of the penetrated surface to comply with NEC Section 300-21.
- B. Where light fixtures, speakers or other device are installed penetrating a fire-rated assembly, a means of tenting the fixture shall be provided either with a construction of a gypsum board tent around fixture or pre-manufactured UL listed fire-rated cover. Tenting shall meet or exceed the fire-rating of the assembly.

## PART 3 - EXECUTION

### 3.01 TYPES OF CONDUIT INSTALLATION

- A. Buried raceways, except where concrete encased, shall be rigid metal conduit or rigid nonmetallic conduit.
- B. Raceways embedded in slab shall be approved and coordinated ahead of time with both the electrical engineer and the structural engineer. Raceways embedded in concrete slabs at or below grade level shall be rigid nonmetallic conduit, except in classified hazardous areas.
- C. Raceways in concrete encased duct banks shall be type EB-20 rigid nonmetallic conduit.
- D. Where rigid nonmetallic conduit is used for buried or encased and buried conduit runs, use a minimum of 5 feet (1.52 m) of rigid metallic conduit at foundation and manhole penetrations.
- E. Raceways embedded in slab shall be approved and coordinated ahead of time with both the electrical engineer and the structural engineer. Raceways embedded in concrete slabs above grade level shall be rigid metal conduit, electrical metallic tubing, or rigid nonmetallic conduit.
- F. Hazardous areas raceways shall be rigid metal conduit only.
- G. Raceways outdoors, in utility tunnels, in crawl spaces, and in locations subject to mechanical injury shall be rigid metal conduit.
- H. Motor, vibrating equipment, and rooftop mounted heating, ventilating, and air conditioning equipment connections shall be made with PVC jacketed liquid tight flexible metallic conduit for the last 2 feet (0.61 m) with liquid tight connectors. Similar equipment connections in environmental air plenums shall be made with flexible metal conduit.
- I. Raceways in other areas shall be electrical metallic tubing unless otherwise noted.

### 3.02 CONDUIT SIZES

- A. Minimum size allowable for galvanized rigid metal conduit or EMT shall be 1/2 inch (DN16).
- B. Minimum size allowable for liquid tight flexible metal conduit shall be 1/2 inch (DN16).
- C. Minimum size allowable for flexible metal conduit shall be 1/2 inch (DN16) except for luminaire and control wiring for which 3/8 inch shall be allowed.

### 3.03 CONDUIT INSTALLATION

- A. Unless noted as aluminum, conductor and conduit sizes shown on Drawings are based on the use of copper conductors.
- B. Wire and cable shall be run in metal raceways, except where nonmetallic raceways have been specifically approved.
- C. Conduit shall be run parallel to walls, ceilings, and building lines wherever possible.
- D. Conduit shall be installed in finished walls and above suspended ceilings. Conduit routed above suspended ceilings shall be surface mounted to the structural ceiling. When above suspended ceilings, route conduits above suspended lay-in ceiling instead of suspended hard ceilings wherever possible. Coordinate the routing of all other conduit with the Architect prior to rough-in.
- E. Where flexible metal conduit is used for equipment connections or other special (approved) situations,

ground continuity shall be provided in accordance with the NEC. Liquid tight flexible metal conduit shall be used for flexible equipment connections in damp and wet areas except where installed in environmental air plenums where flexible metal conduit shall be used.

- F. Do not cut, notch or drill structural framing members for the installation of conduit without the Architect's approval in each case.
- G. Where rigid metal conduit enters a box, fitting or device through a knockout, double locknuts and an insulated metallic bushing shall be used. EMT shall terminate at knockouts with an insulated throat fitting and one locknut. Connectors shall be made up tight to ensure electrical continuity of the raceway system. Provide grounding bushings at each junction box, pull box, or enclosure as required by the NEC.
- H. Rigid metal conduit shall be reamed after threads are cut. Joints shall be cut square and shall butt solidly into couplings. Running threads shall not be permitted. Cut ends of EMT shall also be reamed.
- I. Bends in rigid metal conduit and EMT runs larger than 1-1/4 inches (DN35) shall be factory-made elbows unless otherwise specifically approved. Bends in 1-1/4 inch (DN35) and 1 inch (DN27) runs shall be made in an approved bending machine or factory made. Hickey bends shall not be permitted in conduits larger than 3/4 inch (DN21). Field bends shall be in accordance with the requirements of the NEC.
- J. Conduits run in masonry shall be placed at least 1 inch (DN27) from the surface.
- K. Install expansion fittings where conduit crosses an expansion joint in structure or is in an environment where temperature changes combined with conduit run length produce expansion or contraction stress on the installation. Ends of conduit shall be provided with insulated grounding bushings. Copper ground rings or a flexible bonding jumper, equal to at least three times the nominal width of the joint, shall be provided to insure a continuous ground between conduit and fitting.
- L. Provide completely separate raceway system for circuits, outlets, luminaires, etc., that are connected to the emergency system.
- M. Provide separate code-sized ground conductor for each run of conduit. Conduit shall be sized to accommodate ground conductor.
- N. Install under floor conduit below floor slab.
- O. Install buried or encased and buried conduits in accordance with Sections 300-5 of the NEC. Slope conduit to drainage point at least 4 inches (10.16 cm) per 100 feet (30.48 m).
- P. Adjustments in line and grade for direct buried or encased and buried conduits shall be via long sweeps with minimum of 48 inch (121.92 cm) radius. Route such conduits below existing or new gas lines.
- Q. Multiple runs of conduit below grade under slab shall be installed in trenches backfilled with sand. Each layer of conduit shall be installed separately, backfilled with sand, and compacted to the depth needed to provide continuous support for the next layer of conduit. Sand shall be spread evenly and compacted to grade level for coverage of the final layer of conduit. Offset joints to maintain uniform spacing between conduits.
- R. Direct buried or encased and buried conduits shall first be swabbed out and then shall be capable of passing a rigid ball 1/4 inch (0.64 cm) smaller than the inside diameter of conduit. Such conduits for future use shall be capped to prevent entry of dirt and debris.
- S. Provide roof jacks for waterproofing conduit penetrations of roof. Conduit routing and mounting on



roofs shall be coordinated with the Architect. Unless otherwise indicated or required, conduit shall be mounted 12 inches (30.48 cm) above the finished surface of flat roofs on redwood or treated wood standoffs. Conduits shall be permanently attached to standoffs. Standoffs shall rest freely on roof without being anchored to roof surface.

- T. Joints for rigid nonmetallic conduit shall be solvent cemented in strict accordance with manufacturer's recommendations.
- U. Elbows from below grade conduit to above grade shall be PVC jacketed rigid metal conduit and shall extend 6 inches (15.24 cm) above grade or finished floor.
- V. Conduit extending from below grade to above grade, or conduit stubbing out of floors, shall be rigid metal conduit for a minimum of 12 inches (30.48 cm) above grade or finished floor.
- W. Wherever conduits enter structure through foundation below ground level, grout around conduit with waterproof grout or install wall and floor entrance seals. Seals shall be OZ/Gedney WS series for new construction and OZ/Gedney CSM series for existing structures.
- X. Conduits which pierce air tight spaces or plenums shall be sealed to prevent leakage.
- Y. Care shall be taken to avoid placing conduits where they shall be subjected to excessive heat. Locate conduits a minimum of 12 inches (30.48 cm) from flues, steam lines, hot water lines, etc.
- Z. Conduit ends shall be capped using standard capped bushings to prevent entrance of foreign materials during and after construction. When conduit installation is not in progress close open ends of conduit with temporary plugs or caps.
- AA. Clean conduits prior to installation of wires. Install a nylon pulling line in each conduit run assembly or after completion of each conduit run assembly for installation of wires or for future use.
- BB. Wire shall not be installed until work which might cause damage to conduit or wire has been completed.
- CC. PVC-coated rigid metal conduit shall be installed by a manufacturer-certified installer.

### 3.04 WIRE AND CABLE INSTALLATION

- A. Minimum wire size for lighting and power circuits shall be #12. Signal and control circuits may use #14 except as noted. Wiring shall be installed in conduit, unless otherwise noted.
- B. Unless otherwise indicated, the maximum number of branch circuits allowed in each conduit shall be three. In such cases, the branch circuits shall also be of different phases.
- C. Unless otherwise indicated or required, the following schedule shall be adhered to for conductor sizes:

<u>CIRCUIT OVERCURRENT DEVICE RATING</u>	<u>COPPER CONDUCTOR SIZES</u>
20 A or Less	#12 AWG
30 A	#10 AWG
40 A	# 8 AWG
50 A	# 6 AWG
60 A	# 4 AWG
70 A	# 4 AWG
80 A	# 3 AWG
90 A	# 2 AWG
100 A	# 1 AWG

- D. To limit voltage drop, 120 V branch circuits with length from panel to first outlet exceeding 75 feet (22.86 m) shall be #10 or larger. For 277 V branch circuits with length from panel to first outlet exceeding 175 feet (53.34 m) shall be #10 or larger. Wire sizes for other branch circuits shall be sized to limit voltage drop to 3%.
- E. Conductors from outlet to incandescent luminaire sockets and where run in fluorescent luminaire channels shall be type THHN or as approved by the NEC.
- F. Solid wire #10 and smaller shall be connected as specified herein and shall be made tight in conformance with manufacturers recommendations.
- G. Stranded wire shall be connected as specified herein and thoroughly taped with "Scotch" #33 or acceptable substitution approved equal electrical tape.
- H. Provide equipment lugs compatible with wire sizes indicated. Lugs shall not be rated less than equipment rating. Provide box sizes to accommodate wire bending radius requirements. Revise feeders as needed, maintaining the ampere rating and fault current values indicated, for compatibility with equipment lugs, UL listings, or manufacturer's recommendations.
- I. Install wiring after concrete, plastering, etc., work is complete. Carefully pull wire unspliced between outlets. Use approved pulling lubricant as necessary to prevent insulation cutting or nicking. Branch circuit and feeder wiring shall be color coded in accordance with NEC and in accordance with the following schedule:

Conductor Color Coding

Conductor Insulation Color

Conductor	240/120V, <u>1 Phase</u>	208Y/120V, <u>3 Phase</u>	480Y/277V, <u>3 Phase</u>
Phase A	Black	Black	Brown
Phase B	Red	Red	Orange
Phase C	---	Blue	Yellow
Neutral	White	White	White
Ground	Green	Green	Green

- J. Motor circuits and feeders shall utilize stranded conductors.

### 3.05 PULL AND JUNCTION BOX INSTALLATION

- A. Locate pull boxes and junction boxes above removable ceilings or in electrical room, utility rooms, or storage areas.
- B. Pull and junction boxes shall be supported independently of the conduit system and shall be plumb. Supports shall be noncombustible and corrosion resistant. Suspended pull and junction boxes shall be supported with threaded rod hangers and galvanized steel clamps, or trapeze hangers of Unistrut or Kindorf channel.
- C. Pull and junction boxes shall be accessible.

### 3.06 OUTLET BOX INSTALLATION

- A. Each lighting outlet, switch, convenience outlet, communication outlet, or other miscellaneous device

shall be provided with a suitable box.

- B. Convenience outlets and telephone and data outlets shall be provided with single gang boxes and single device trim plates where single devices are indicated.
- C. Where two or more similar type devices occur adjacent to each other, they shall be in a gang type box with a gang type cover. Where different type devices occur adjacent to each other, space outlet boxes so that finish plates shall be spaced 1 inch (2.54 cm) apart.
- D. Install outlet boxes securely in place, plumb with building lines in accordance with NEC. Recess outside edge and associated trim plates from finished surface in accordance with NEC. Provide blank covers, which match device plates in area, for outlets not specified with covers. Outlets in plastered, paneled, and furred finishes shall be equipped with trim plates and extensions of such depths as to bring outlets flush with final surface finish.
- E. Wall outlets in exposed block or masonry construction shall have extension and device mounting straps as required to provide only such wall openings as may be covered by device plates without the use of mortar or other filler material.
- F. Sectional boxes shall not be used where outlet boxes occur in concrete.
- G. Boxes shall be supported independently of the conduit system and shall be plumb. Supports shall be noncombustible and corrosion resistant. Suspended boxes shall be supported with threaded rod hangers and galvanized steel clamps, or trapeze hangers of Unistrut or Kindorf channel. Where the suspended ceiling system is approved for the application, outlet boxes may be supported with bar hangers attached to the ceiling channels.
- H. Install additional straps or cross-bracing to ensure complete rigid installation in steel stud system, bracing prior to installation of wall finish material.
- I. "Back-to-Back" outlets in the same wall, or "thru-wall" type boxes shall not be permitted. Provide 12 inch (30.48 cm) (minimum) long nipple to offset outlets shown on opposite sides of a common wall to minimize sound transmission.
- J. Outlet boxes on opposite sides of fire rated walls and partitions shall be separated by a horizontal distance of at least 24 inches (60.96 cm).
- K. Unused knockouts in boxes shall be left sealed.
- L. Provide luminaire outlets with 3/8 inch (0.95 cm) no bolt fixture stud where required.
- M. Telephone outlets shall be mounted at the same height as adjacent receptacle outlets unless noted otherwise.
- N. Refer to architectural plans for heights of outlets.
- O. Mount outlets horizontally or vertically as directed by the Architect. Above counter outlets shall be mounted horizontally, unless otherwise noted or directed.

### 3.07 SUPPORT INSTALLATION

- A. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide all hardware as required for hanger assemblies and for securing hanger rods to conduits.
- B. Multiple runs of conduits on ceilings and walls shall be mounted on Unistrut or Kindorf channels. Perforated plumbers tape shall not be used.

- C. Caddy clips with support wires using not less than No. 14 wire may be used only for single suspended runs of EMT or rigid conduit up to 3/4 inches (DN21).
- D. Conduit and box support installation shall prevent displacement of conduit in any direction.
- E. In steel stud walls, high carbon steel spring clips may be used to support conduits up to 3/4 inch (DN21), and boxes to metal studs.
- F. Supports, whether for single or multiple runs, regardless of type shall have strength adequate to support at least four times the present load, a minimum of 200-lb (90 kg) design load.

3.08 FIRE SEAL INSTALLATION

- A. Fire seal installations shall be performed per manufacturer's recommendations and shall conform to standard UL fire stop system details.
- B. All cables or conduits shall be firmly secured and cleaned where penetrating the fire rated surface. Fire seals shall not act as supports.
- C. Where cables are required to maintain specific distances between each other they shall be firmly secured to maintain this distance at penetrations.
- D. Where light fixtures, speakers or other device are installed penetrating a fire-rated assembly, a means of tenting the fixture shall be provided either with a construction of a gypsum board tent around fixture or pre-manufactured UL listed fire-rated cover. Tenting shall meet or exceed the fire-rating of the assembly. Tenting shall be coordinated with other trades prior to installation. Fire-rated covers shall be installed per manufacturer recommendations.

**END OF SECTION**

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## SECTION 260526

### GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. Provide a complete grounding system in accordance with the Specifications, and Drawings. Drawings do not necessarily indicate every requirement. Items not specifically mentioned in the Specifications or Drawings, but which are necessary to make a complete installation shall be included.
- B. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements govern.

##### 1.02 SUBMITTALS

- A. Documentation from field tests before system is energized.
- B. Documentation supporting independent testing agency qualifications.

##### 1.03 QUALITY ASSURANCE

- A. Independent Testing Agency Qualifications:
  - 1. A full member company of NETA, or a NRTL. Agency shall have a minimum of five years commercial or industrial grounding testing experience.
  - 2. Use persons regularly employed by testing agency and currently certified by NETA or the National Institute for Certification in Engineering Technologies to supervise on-site testing.

#### PART 2 - PRODUCTS

##### 2.01 WIRE AND CABLE GROUNDING CONDUCTORS

- A. Equipment and Bonding Jumper Conductors: Copper and insulated with green insulation or marking unless otherwise noted.
- B. Isolated Equipment Grounding Conductors: Copper and insulated with green insulation or marking and yellow tracer or marking.
- C. Grounding-Electrode Conductors: Copper stranded cable, unless otherwise indicated.
- D. Underground Grounding Conductors: Copper, bare, tinned, and stranded, unless otherwise indicated.
- E. Main Bonding Jumper: Factory installed with service entrance equipment when possible, otherwise field installed conductor.

##### 2.02 CONNECTOR PRODUCTS

- A. Pressure Connectors: High-conductivity-plated units.
- B. Bolted Clamps: Heavy-duty type.
- C. Exothermic Weld Connections: Provided in kit form and selected per manufacturer's recommendations for specific types, sizes, and combinations of conductors and connected items.

## 2.03 MADE ELECTRODES

- A. Grounding Rods: Copper-clad steel, 3/4 inch by 120 inches (19 mm by 3000 mm).

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Grounding Conductors: Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Conductors shall be formed to the contour of equipment and firmly supported.
- B. Underground Grounding Conductors: Bury at least 24 inches (600 mm) below grade. If installed near the base of a structure, it shall be in earth and as far from the structure as the excavation permits but not closer than 6 inches (150 mm).
- C. Metal Water Service Pipe: Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Do not install a grounding jumper across dielectric fittings.
- D. Water Meter Piping: Use bonding jumpers to electrically bypass water meters. Connect to pipe with grounding-clamp connectors.
- E. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NEC. Bond grounding conductor to reinforcing steel in at least 4 locations, and to anchor bolts.
- F. Grounding Rods: Drive until tops are 2 inches (50 mm) below finished floor or final grade. Connections to rods shall be by exothermic weld, unless as otherwise indicated. Make these connections without damaging copper coating or exposing steel.
- G. Equipment Grounding Conductors: Provide a separate equipment grounding conductor with all feeder and branch circuit conductors, unless otherwise indicated. A properly sized common equipment grounding conductor may be used for multiple feeders or branch circuits routed within a single conduit.
- H. Isolated Equipment Grounding Conductor: Terminate at the isolated equipment grounding-conductor terminal of the panelboard, applicable derived system or service, except as otherwise indicated.
- I. Metallic Building Components: Bond all metal piping, metal air ducts, and exposed interior structural steel to grounding electrode system.
- J. Signal and Communication Systems: For telephone system, fire alarm and detection system, data system, card access system, public address system, security system, clock and program system, and other communication systems, provide a No. 4 AWG minimum insulated grounding conductor in raceway from grounding-electrode system to each communication system service terminal cabinet, wiring closet, or central equipment location.
  - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a ground bus.
  - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
  - 3. Provide grounding in accordance with manufacturer's recommendations.
- K. Metal Poles Supporting Outdoor Lighting Fixtures: Ground pole to metal reinforcing within concrete pole base using No. 6 AWG conductor. Thermoweld connection between ground conductor and metal reinforcing. For precast concrete pole bases, ground pole to a local ground rod with No. 6

AWG conductor. Provide made electrode within 6 feet of pole base. Thermoweld connection between ground conductor and ground rod.

### 3.02 CONNECTIONS

- A. General: Make connections so the possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact with earth will be galvanically compatible.
  - 1. Use electroplated or hot-tin-coated materials to assure high conductivity and to make contact points closer in order of galvanic series.
  - 2. Make connections at points of clean, bare metal.
- B. Exothermic Weld Connections: Use for connections to structural steel and for underground connections. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable. Installer shall be certified.
- C. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- D. Equipment Grounding-Wire Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with pressure-type connectors.
- E. Install grounding bushings, grounding studs, and grounding jumpers at switchboards, panelboards, pull boxes, and other electrical enclosures.
- F. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. Where these requirements are not available, use those specified by UL.
- G. Connect the ground terminal on each non-isolated ground type outlet receptacle to the branch circuit grounding conductor and to the metallic raceway system with bonding jumpers.
- H. Connect the grounding stud on each luminaire to the branch circuit grounding conductor and to the metallic raceway system with bonding jumpers.
- I. Ground connections to equipment and ground buses shall be by ground lugs or clamps. Connections to enclosures not provided with ground buses or ground terminals shall be by clamp type lugs added under permanent assembly bolts or under new bolts drilled and added through enclosures or by grounding locknuts or bushings. Ground cable connections against gaskets, paint, or varnish; or on bolts holding removable access covers shall not be permitted.
- J. Moisture Protection: Where insulated grounding conductors are connected to grounding rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

### 3.03 FIELD QUALITY CONTROL

- A. Continuity Test: On all circuits before energizing.
- B. Megger Tests: Subject the completed grounding system to test. Measure ground resistance not less than 2 full days after the last trace of precipitation, and without the soil being moistened by any means

other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the 3-point method according to IEEE Standards. The system, when tested, shall yield a maximum 5 ohms ground. If this value is not obtained for the systems when tested, modifications shall be made to obtain this value without additional cost to the project. Make additional tests as required after modifications to verify value is achieved.

- C. Report: Results of all tests shall be recorded before the system is energized. Prepare test reports, certified by the testing organization, of ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

**END OF SECTION**



## **SECTION 260800**

### **COMMISSIONING OF ELECTRICAL SYSTEMS**

#### **PART 1 - GENERAL**

##### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Design Phase Commissioning Manual applies to this section
- C. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.
- D. Division 1 Section 01 91 13 – “General Commissioning Requirements” for general commissioning process requirements.
- E. Division 26 Section 26 08 11 – “Commissioning of Lighting and Lighting Control Systems.”

##### **1.02 SUMMARY**

- A. The purpose of this Section is to define Contractor responsibilities in the commissioning process, which are being directed by the Contractor. Other electrical system testing is required under other Division 26 Specification Sections. National Electrical Installation Standards (NEIS) NECA 90-2004, “Recommended Practice for Commissioning Building Electrical Systems”, 27<sup>th</sup> Volume of the NEIS Series, provides additional guidance for the commissioning of electrical systems.
- B. Commissioning requires the participation of the Contractor to ensure that all systems are operating in a manner consistent with the Contract Documents. General Commissioning requirements and coordination are detailed in Division 01. Division 26 shall be familiar with all parts of Division 01 and the Commissioning Plan issued by the Contractor and shall execute all Commissioning responsibilities assigned to them in the Contract Documents and include the cost of Commissioning in the Contract price.
- C. Electrical systems to be commissioned include the following:
  - 1. Refer to list of commissioned equipment and systems in Section 01 91 13 – General Commissioning Requirements.
  - 2. Lighting Fixtures and Controls (Refer to Section 26 08 11)

##### **1.03 REFERENCE STANDARDS**

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards.

##### **1.04 REFER TO SECTION 01 19 13**

## 1.05 SUBMITTALS

- A. Contractor shall prepare Prefunctional Checklists and Functional Performance Test (FPT) procedures and execute and document results. All Prefunctional Checklists and tests must be documented using specific, procedural forms in Microsoft Word or Excel software developed for that purpose. Prior to testing, Contractor shall submit those forms to the Owner for review and approval.
- B. Contractor shall provide Owner with documentation required for Commissioning work. At minimum, documentation shall include: Detailed Start-up procedures, Full sequences of operation, Operating and Maintenance data, Performance data, Functional Performance Test Procedures, Control Drawings, and details of Owner-Contracted tests.
- C. Contractor shall submit to Owner installation and checkout materials actually shipped inside equipment and actual field checkout sheet forms used by factory or field technicians.
- D. Contractor shall review and approve other relative documentation for impact on FPT's of the systems:
  - 1. Shop Drawings and product submittal data related to systems or equipment to be commissioned. The Subcontractor responsible for the FPT shall review and incorporate comments from the Owner and AE via the Contractor.
  - 2. Incorporate manufacturer's Start-up procedures with Prefunctional checklists.
  - 3. Draft Electrical Testing Agency (ETA) Reports: Review and provide comments to Owner.
  - 4. Factory Performance Test Reports: Review and compile all factory performance data to assure that the data is complete prior to executing the FPT's.
  - 5. Completed equipment Start-up certification forms along with the manufacturer's field or factory performance and Start-up test documentation: Subcontractor performing the test will review the documentation prior to commencing with the scheduled FPT's.

Final ETA Reports: Subcontractor performing the test will review the documentation prior to commencing with the scheduled FPT's.

- 6. Operating and Maintenance (O&M) information per requirements of the Technical Specifications and Division 01 requirements: To validate adequacy and completeness of the FPT, the Contractor shall ensure that the O&M manual content, marked-up record Drawings and Specifications, component submittal drawings, and other pertinent documents are available at the Project Site for review.

## PART 2 – PRODUCTS

### 2.01 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

### 2.02 TEST EQUIPMENT

- A. Provide all specialized tools, test equipment and instruments required to execute Start-up, checkout, and testing of equipment.
- B. All specialized tools, test equipment, and instruments required to execute Start-up, checkout, and testing of equipment shall be of sufficient quality and accuracy to test and/or measure system performance within specified tolerances. A testing laboratory must have calibrated test equipment

within the previous twelve (12) months. Calibration shall be NIST traceable. Contractor must calibrate test equipment and instruments according to manufacturer's recommended intervals and whenever the test equipment is dropped or damaged. Calibration tags must be affixed to the test equipment or certificates readily available.

C. Infrared Thermographic Scanner:

## PART 3 – EXECUTION

### 3.01 PREPARATION

A. Construction Phase:

1. In each purchase order or subcontract that is written for changes in scope, include the following requirements for submittal data, Commissioning documentation, testing assistance, Operating and Maintenance (O&M) data, and training, as a minimum.
2. Attend Pre-Commissioning Meeting(s), Pre-Installation Meeting(s), and other Project meetings scheduled by the Contractor to facilitate the Commissioning process.
3. Provide manufacturer's data sheets and shop drawing submittals of equipment.
4. Provide additional requested documentation to the Contractor, prior to O&M manual submittals, for development of Prefunctional Checklist and Functional Performance Tests procedures.
  - a. Typically, this will include detailed manufacturer's installation and Start-up, operating, troubleshooting and maintenance procedures, full details of any Owner-contracted tests, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified.
  - b. In addition, the installation, Start-up, and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Contractor.
  - c. This information and data request may be made prior to normal submittals.
5. With input from the BMS Provider and AE, Clarify the operation and control of commissioned equipment in areas where the Specifications, EMCS control drawings, or equipment documentation are not sufficient for writing detailed test procedures.
6. Prepare the specific Functional Performance Test procedures specified. Ensure that Functional Performance Test procedures address feasibility, safety, and equipment protection and provide necessary written alarm limits to be used during the tests.
7. Develop the Commissioning Plan using manufacturer's Start-up procedures and the Prefunctional Checklists. Submit manufacturer's detailed Start-up procedures and the Commissioning Plan and procedures and other requested equipment documentation to Owner for review.
8. During the Start-up and initial checkout process, execute and document related portions of the Prefunctional Checklists for all commissioned equipment.
9. Perform and clearly document all completed Prefunctional Checklists and Start-up procedures. Provide a copy to the Owner prior to the Functional Performance Test.
10. Address current AE and Owner punch list items before Functional Performance Tests. Air and water test, adjust and balance shall be completed with discrepancies and problems remedied before Functional Performance Tests of the respective air or water related systems are executed.
11. Provide skilled technicians to execute starting of equipment and to assist in execution of Functional Performance Tests. Ensure that they are available and present during the agreed-upon schedules and for a sufficient duration to complete the necessary tests, adjustments, and problem solving.

12. Correct deficiencies (differences between specified and observed performance) as interpreted by the Owner's Project Manager and AE and retest the system and equipment.
13. Compile all Commissioning records and documentation to be included in a Commissioning and Closeout Manual.
14. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
15. During construction, maintain as-built marked-up Drawings and Specifications of all Contract Documents and Contractor-generated coordination Drawings. Update after completion of Commissioning activities (include deferred tests). The as-built drawings and specifications shall be delivered to the Owner both in electronic format and hard copies as required by the Owner.
16. Provide training of the Owner's operating personnel as specified.
17. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

B. Warranty Phase:

1. Execute seasonal or deferred tests, witnessed by the Owner, according to the Specifications.
  - a. Complete deferred tests as part of this Contract during the Warranty Period. Schedule this activity with Owner. Perform tests and document and correct deficiencies. Owner may observe the tests and review and approve test documentation and deficiency corrections.
  - b. If any check or test cannot be completed prior to Substantial Completion due to the building structure, required occupancy condition, or other condition, execution of such test may be delayed to later in the Warranty Period, upon approval of the Owner. Contractor shall reschedule and conduct these unforeseen deferred tests in the same manner as deferred tests.
2. Correct deficiencies and make necessary adjustments to O&M manuals, Commissioning documentation, and as-built drawings for applicable issues identified in any seasonal testing.

C. Electrical Testing Agency (ETA)

1. In general, testing of systems, including NETA testing, is the responsibility of the contractor as specified in division 26, 27, and 28 specifications. When requested by Owner, the Contractor shall retain an independent Electrical Testing Agency (ETA). Their specific testing responsibilities are delineated in Section 26 00 10. This generally requires checking and testing of the electrical power distribution equipment per National Electrical Testing Association (NETA).
2. Attend Pre-Commissioning Meeting(s), Pre-Installation Meeting(s), and other Project meetings scheduled by the Contractor to facilitate the Commissioning process.
3. Obtain all required manufacturer's data to facilitate tests.

Provide assistance to the Contractor in preparation of the specific Prefunctional Checklist and Functional Performance Test procedures specified. Generally ETA shall provide their standard forms to document the NETA tests to be incorporated into the Prefunctional Checklist and Functional Performance Tests record.

4. During related tests, execute and document the tests in the approved forms and/or test record.
5. Perform and clearly document all completed Start-up and system operational checkout procedures, providing a copy to the Contractor.
6. Clearly indicate any deficiencies identified during testing and add to an action list for resolution and tracking. The field technicians shall keep a running log of events and issues. Submit hand-written reports of discrepancies, deficient or uncompleted work by others, Contract interpretation requests and lists of completed tests to the Contractor at least twice a week and provide technical assistance in the resolution of deficiencies.

7. Provide skilled technicians to execute testing. Ensure that they are available and present during the agreed-upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem solving.
8. Warranty Phase: Perform thermographic imaging of loaded panel at time designated by Electrical SubContractor or Contractor.

### 3.02 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.

### 3.03 TESTING

- A. Prefunctional Checklists and Start-up:
  1. Follow the Start-up and initial checkout procedures listed in this Section and in Division 01. Start-up and complete systems and sub-systems so they are fully functional, meeting the requirements of the Contract Documents.
  2. Prefunctional Checklists shall be complete prior to commencement of a Functional Performance test.
  3. Refer to the "Design Phase Commissioning Manual" for specific details on required Prefunctional Checklists.
- B. Functional Performance Tests:
  1. Functional Performance Tests are conducted after system Start-up and checkout is satisfactorily completed.

Refer to the "Design Phase Commissioning Manual" for specific details on the required Functional Performance Tests.

- C. Coordination Between Testing Parties:
  1. Factory Start-ups: Factory Start-ups are specified for certain equipment. Factory Start-ups generally are Start-up related activities that will be reviewed and checked prior to Functional Performance Tests. All costs associated with factory Start-ups shall be included with the contract price unless otherwise noted. Notify the Commissioning Team of the factory Start-up schedule and coordinate these factory Start-ups with witnessing parties. The Commissioning Team members may witness these Start-ups at their discretion.
  2. Independent Testing Agencies: For systems that specify testing by an independent testing agency, the cost of the test shall be included in the Contract price unless otherwise noted. Testing performed by independent agencies may cover aspects required in the Prefunctional Checklists, Start-ups, and Functional Performance Tests. Coordinate with the independent testing agency so that Owner and/or AE can witness the test to ensure that applicable aspects of the test meet requirements.

### 3.04 TRAINING

- A. Submit a written training plan to the Owner and Architect/Engineer for review and approval. Contractor's training plan shall cover the following elements:
  1. Equipment included in training.
  2. Intended audience.

3. Location of training.
  4. Objectives.
  5. Subjects covered.
  6. Duration of training on each subject.
  7. Instructor for each subject.
  8. Methods (classroom lecture, video, Site walk-through, actual operational demonstrations, written handouts, etc.).
  9. Instructors and qualifications.
- B. Contractor shall have the following training responsibilities:
1. Provide a training plan ten (10) calendar days prior to the scheduled training, in accordance with Division 01.
  2. Provide Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned electrical equipment or system.
  3. Training shall start with classroom sessions, if necessary, followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including Start-up, shutdown, fire/smoke alarm, power failure, etc.
  4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
  5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This representative may be the Start-up technician for the piece of equipment, the installing contractor, or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.
  6. The training sessions shall follow the outline in the Table of Contents of the O&M manual and illustrate whenever possible the use of the O&M manuals for reference.
7. Training shall include:
- a. Usage of the printed installation, operation and maintenance instruction material included in the O&M manuals.
  - b. Review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include Start-up, operation in all modes possible, shutdown, seasonal changeover and any emergency procedures.
  - c. Discussion of relevant health and safety issues and concerns.
  - d. Discussion of warranties and guarantees.
  - e. Common troubleshooting problems and solutions.
  - f. Explanation of information included in the O&M manuals and the location of all plans and manuals in the facility.
  - g. Discussion of any peculiarities of equipment installation or operation.
  8. Hands-on training shall include Start-up, operation in all modes possible, including manual, shutdown, and any emergency procedures and maintenance of all pieces of equipment
  9. Training shall occur after Functional Performance Tests are complete and shall be scheduled with the Owner's Project Manager.
- C. Provide training on each system/piece of equipment according to the following schedule:

**END OF SECTION**

## SECTION 26 08 11

### COMMISSIONING OF LIGHTING AND LIGHTING CONTROL SYSTEMS

#### PART 1 – GENERAL

##### 1.01 SUMMARY

A. This Section includes:

1. Requirements for commissioning the lighting system and its subsystems and equipment. This Section supplements the general requirements specified in Division 01 Section 01 91 13 – General Commissioning Requirements.

##### 1.02 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to the Work of this Section. Specific commissioning requirements are given in the following sections of these specifications.

1. Section 01 91 13 – General Commissioning Requirements
2. Section 260800 – Commissioning of Electrical Systems
3. Section 260923.2 – Lighting Controls System
4. Section 265100 - Lighting

B. “Design Phase Commissioning Manual”. A separate manual including the Owner’s Project

##### 1.03 SUBMITTALS

A. General:

1. Comply with Division 01 Section “ELECTRONIC SUBMITTAL PROCEDURES”.
2. See submittal requirements in Division 01 Section 01 91 13 – General Commissioning Requirements.

##### 1.04 COORDINATION

A. The Contractor shall coordinate all major equipment installation inspection, startup and checkout with the Commissioning Agent (CxA).

#### PART 2 – PRODUCTS

##### 2.01 DESIGN DOCUMENT AND SUBMITTAL REVIEWS

A. General:

1. As described in Section 01 91 13.

2.02 SEQUENCE OF OPERATIONS OF LIGHTING AND LIGHTING CONTROLS

- A. Sequences of Operation submitted shall describe in detail operation of building control system and its components. The sequences provided in the contract drawings and specifications provide a good overview, but they shall be supplemented by finalized sequences used to program the system. Sequences of operation should address all critical system interactions in detail to enable their verification and troubleshooting.

2.03 START-UP AND CHECKOUT TEST REPORTS

- A. Provide system/area based lighting checkout lists. These sheets shall serve as verification of installation and programming of lighting systems serving areas indicated.

2.04 FUNCTIONAL PERFORMANCE TESTS

- A. General:
  - 1. As described in Section 01 91 13.

2.05 OPERATION & MAINTENANCE MANUAL AND PERSONNEL TRAINING REVIEWS

- A. As described in Section 01 91 13.

2.06 SYSTEMS MANUAL

- A. As described in Section 01 91 13.

PART 3 – EXECUTION

3.01 TESTING PREPARATION

- A. General procedures are described in the Division 01 Section 01 91 13 – General Commissioning Requirements.
- B. Prefunctional Checklists
  - 1. Contractor shall fill out and sign prefunctional checklists for the following equipment and systems:
    - a. Electric lighting systems
    - b. Occupancy-sensor lighting controls
    - c. Daylighting controls
    - d. Time-of-day lighting controls
- C. Prerequisites for Testing:
  - 1. Contractor shall certify that lighting systems are controlled by EMCS and are operating according to the Contract Documents.



2. Contractor shall certify that other electrical systems that have been identified for functional performance testing have been completed and calibrated and are operating according to the Contract Documents.

### 3.02 PREFUNCTIONAL CHECKLISTS

#### A. General

1. The checklists are provided for the Contractor's information and may be updated by the Commissioning Agent during the construction phase.

### 3.03 TESTING

- A. General procedures are described in the Division 01 Section 01 91 13 – General Commissioning Requirements.
- B. Contractor shall perform the functional performance tests described in the following sections under observation of the Commissioning Agent.
- C. Prior to functional testing contractor shall turn in filled out and signed prefunctional checklists to the CxA.
- D. The details of these functional performance tests shall be reviewed and refined during the construction phase by the Commissioning Agent.

### 3.04 ELECTRIC LIGHTING FUNCTIONAL PERFORMANCE TESTS

#### A. Occupancy Sensor Lighting Controls

1. Verify 100% of occupancy sensors cover the entire space at its mounting location and adjusted angle. In addition, confirm the following for each type of occupancy sensor.
  - a. Passive infra-red sensor
    - 1) Verify lens is adjusted for the space geometry and size of space
    - 2) Verify sensitivity is adjusted for coverage of entire space.
  - b. Ultrasonic sensor
    - 1) Verify sensitivity is adjusted for coverage of entire space.
2. Verify sensitivity adjustment for both types of sensors does not trigger nuisance trips from air diffusers close to the sensor.
3. Verify sensitivity adjustment eliminates trips from movement in an adjacent space
4. After room lighting circuit is triggered on from an occupancy sensor, confirm programmed delay off time is functional. Temporarily reprogram the delay off time to

expedite testing. If reprogrammed, verify final programmed delay off time matches specifications.

5. Verify all types of sensors installed have an additional contact for use by the HVAC control system if so specified.
6. Simulate a power failure of the lighting system to confirm power-up restart functions are operating as specified.
7. Sampling strategy applied to all occupancy sensor issues unless noted otherwise.
  - a. Of the total controlled room lighting circuits, 10% or a minimum of 3 shall be tested to confirm functions as listed. If 10% of the first group fails the test, select another 10% or a minimum of 3 of the total room lighting circuits. If 10% of these rooms fail, test all remaining rooms.

B. Electric Lighting Illumination

1. Average light levels in the space at the work elevation shall not be less than 10% below nor greater than 30% above the specified light level range for the space.
2. Light fixtures with dimming capability will be adjusted to maintain light levels in compliance of 3.A.4 above during the nighttime.
3. Sampling strategy applied to all general indoor light level issues
  - a. Of the total controlled room lighting circuits, 10% or a minimum of 3 shall be tested to confirm functions as listed. If 10% of the first group fails the test, select another 10% or a minimum of 3 of the total room lighting circuits. If 10% of these rooms fail, test all remaining rooms.

C. Lighting Sweep Controls

1. Either simulate sweep function by changing settings thru EMCS GUI or by witnessing sweep function at the programmed times of occurrence. If the sweep function is simulated, verify programmed time of occurrence meets specifications by visually viewing programming screens.
2. Verify that time of sweep functions programmed in EMCS meets specifications for weekdays, weekends and all holidays.
3. Verify EMCS control of all time clocks and their time & date setting.
4. Verify EMCS GUI interface access codes are set.
5. If sweep function is implemented for 10 or more independently controlled room lighting circuits with identical control hardware and software, utilize a sampling strategy to implement functional testing.
6. Verify sweep function is operational for 50% of the room lighting circuits or a minimum of 2 circuits per controller or controlled relay.

7. Verify override function is operational by turning lights back on after a sweep with a minimum of 25% of the local override switches or 4 switches, whichever is greater.
8. Verify 100% of the local override switches are installed and located as specified.
9. Verify telephone and remote keypad override functions operate as specified.
10. For the conditions, specified sequences and modes tested, the sweep controls, integral components and related equipment respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.
11. Sampling strategy should be applied to all sweep functions unless noted otherwise.
12. Of the total controlled room lighting circuits, 10% or a minimum of 3 shall be tested to confirm functions as listed. If 10% of the first group fails the test, select another 10% or a minimum of 3 of the total room lighting circuits. If 10% of these rooms fail, test all remaining rooms.
13. Simulate a power failure of the lighting system to confirm power-up restart functions are operating as specified.

D. Daylighting Function

1. Verify all space furnishings and interior finishes as being installed before functional testing or logging begins
2. Light levels:
  - a. Light levels in the space shall meet requirements of the specification throughout the functional area of the space.
  - b. Light levels at 30 in. above finished floor (the work level) shall meet requirements as specified. If no requirements are specified, use 50 foot-candles as the suggested requirement.
  - c. Light levels on all vertical work surfaces shall meet requirements as specified. If no requirements are specified, use 15 foot-candles as the suggested requirement.
  - d. Functional area of the space will exclude a 3 foot border around the perimeter of the room.
  - e. Light levels will be measured in a 5 foot grid pattern to determine compliance with these requirements.
  - f. Sampling strategy
    - 1) For rooms with identical exposures, shapes, furnishings, sources of natural and electrical lighting and daylighting controls, light levels will be evaluated in one room randomly selected.

3. Variation in light level intensity:
  - a. Variations in light level intensity throughout the space shall conform to average to minimum ratio of 4:1 or less.
  - a. Variation in light level intensity throughout the space shall conform to maximum to minimum ratio of 8:1 or less.
  - b. Light levels will be measured in a 5 foot grid pattern to determine compliance with these requirements.
  - d. Sampling strategy
    - 1) For rooms with identical exposures, shapes, furnishings, sources of natural and electrical lighting and daylighting controls, light levels will be evaluated in one room randomly selected.

E. Daylighting Control

1. Verify all new lamps were burned in by operating at full power for a minimum of 100 hours.
2. Closed loop system – photocell measures combination of electric and natural lighting. Verify the following for 100% of the photocells;
  - a. Verify the photocell is of the closed loop type.
  - b. Verify photocell mounting location in the space and orientation is such that it measures light level typical of the space work level away from the point of natural light entry into the space.
  - c. Confirm spacer layout and material reflective properties have been finalized and remain the same after adjustment of the photocell.
3. Open loop system – photocell measures natural light level entering space. Verify the following for 100% of the photocells;
  - a. Verify photocell is of the open loop type.
  - b. Verify photocell mounting location and orientation is such that it measures natural light level entering space.
4. Verify all types of dimming light fixtures match specifications with regard to dimming ability.
5. Verify all dimming light fixtures match specifications with regard to mounting locations.
6. Simulate reduced natural light levels or perform test at dawn to verify dimming fixtures are functioning. Measure amperage draw change during dimming process to confirm functionality of at least one fixture per zone.

7. Verify or adjust daytime light level setpoint to comply with item 3.A.2 above. For zones with similar geometry and natural light entry paths, replicate the calibrated setpoints in the similar zones.
8. Verify or adjust rate of change function to be not noticeable.
9. Verify 100% of dimming override location(s) to be as specified.
10. Verify dimming override feature(s) to be functional.
11. Verify dimming does not cause lower than specified light levels in adjacent “non-dimmed” spaces.
12. Verify manual dimming upper and lower limit range is set as specified.
13. Verify programmed length of override function meets specifications
14. Simulate a power failure to confirm power-up restart functions are operating as specified.
15. Sampling strategy should be applied to all daylighting functions unless noted otherwise.
  - a. Of the total controlled room lighting circuits, 10% or a minimum of 3 shall be tested to confirm functions as listed. If 10% of the first group fails the test, select another 10% or a minimum of 3 of the total room lighting circuits. If 10% of these rooms fail, test all remaining rooms.

**END OF SECTION**

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## **SECTION 262416**

### **PANELBOARDS**

#### **PART 1 - GENERAL**

##### **1.01 SUMMARY**

- A. Provide panelboards in accordance with the Drawings and Specifications.

##### **1.02 SUBMITTALS**

- A. Product Data: For panelboard and overcurrent protection device types and necessary accessories.
- B. Shop Drawings: For each panelboard, include:
  - 1. Schedules indicating individual components and ratings. As a minimum, include ampere, voltage, phase, and AIC ratings.
  - 2. Drawings shall contain overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions, conduit entrance sizes and locations, arrangement of overcurrent protection, and installation details indicating mounting.
  - 3. Scaled plans and elevations for installed space of panelboard indicating clearances and service space relative to adjacent surfaces.

##### **1.03 QUALITY CONTROL**

- A. Panelboards and switchboards throughout the project shall be of the same manufacturer.

#### **PART 2 - PRODUCTS**

##### **2.01 ACCEPTABLE MANUFACTURERS**

- A. Cutler-Hammer/Eaton Corp
- B. General Electric
- C. Siemens Energy & Automation
- D. Square D

##### **2.02 INTERIORS**

- A. Panelboard AIC ratings as indicated or required are established by the lowest rated component of each panelboard. Series rating is not permitted unless otherwise noted. Each panelboard shall be certified by the manufacturer as having been tested as a complete unit under fault conditions to withstand the AIC rating indicated or required. Standard tests per UL standards.
- B. Panelboards shall have 100 percent rated aluminum buses for each phase and neutral. Ground buses shall have rating and number and size of circuit connections per UL requirements for connection to equipment grounding system. Provide 100 percent rated copper ground bus for panelboards rated 225 amperes and less. Panelboards shall be suitable for use as service equipment where indicated.

- C. Interior trim shall be of dead-front construction.
- D. Nameplate information shall include catalog number or factory order number, date of manufacturing, UL Listed label, ampere, voltage, phase, and AIC ratings.
- E. Main overcurrent protection and main lug interiors shall be field convertible for top or bottom incoming feed. Interior leveling provisions shall be provided for flush mounted applications.
- F. Enclosures shall be NEMA 1 type unless NEMA types 3R, 3S, 5, and 12 are indicated or required. Enclosures shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
- G. Doors shall have cylindrical tumbler type locks with catch and spring-loaded stainless steel door pull. All lock assemblies shall be keyed alike. Provide 2 keys with each lock.
- H. A circuit directory frame and card with clear plastic covering shall be mounted on the inside of door.

## 2.03 BRANCH CIRCUIT PANELBOARDS

- A. Column-width type panelboards, and panelboards 14 inches (35.56 cm) wide and smaller, are not permitted unless otherwise indicated. Provide auxiliary wiring gutters adequately sized for wiring connections.
- B. UL Listed panelboards with 200 percent rated solid neutral shall be plated copper for non-linear load applications. Panelboards shall be marked for non-linear load applications.
- C. Isolated ground panelboards shall have separate isolated grounding lug and 50 percent rated copper isolated ground bus for connection to isolated equipment grounding system.
- D. Multiple section panelboards shall have required feed through lugs (or factory busing) for interconnection.
- E. Fronts shall be hinged 1-piece with door. Mounting shall be flush or surface as indicated on Drawings.
- F. Fronts shall be flat with concealed door hinges and trim screws. Front shall not be removable with the door locked.
- G. Each section of a multiple section panelboard shall be the same size. For two section panelboards, the left side shall be "left hinged" and right side shall be "right hinged" unless hinging restricts code egress clearances.

## 2.04 CIRCUIT BREAKER DISTRIBUTION PANELBOARDS

- A. UL Listed panelboards with 200% rated solid neutral shall be plated copper for non-linear load applications. Panelboards shall be marked for non-linear load applications.
- B. Fronts shall be hinged 1-piece with door. Mounting shall be flush or surface as indicated on Drawings.

## 2.05 FUSIBLE DISTRIBUTION PANELBOARDS

- A. Fronts shall be 4-piece surface.



B. Fusible Switches:

1. Switches shall be quick-make quick-break type and have dual mechanical cover interlocks to prevent the opening of the cover when the switch is in the ON position. The cover interlock shall also prevent the switch from being turned ON with the cover open. A manual interlock override shall be provided for testing purposes. Switch cover shall include a hasp by which the cover can be padlocked in the closed position. The operating handle shall have lock-off means with provisions for three padlocks.
2. There shall be two forms of visible ON/OFF indication: A dual-color operating handle and an ON/OFF nameplate with international markings. The universal nameplate shall be readable regardless of the switch orientation. Each nameplate shall furnish an easily removable circuit directory card.
3. Switches shall have standard and maximum horsepower ratings.
4. Equip with fuse rejection clips as applicable. Provide UL listed field installable blown fuse indicator and electrical interlock accessories as indicated or required.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Mount panelboards with top of trim 6.5 feet above the finish floor, unless otherwise indicated.
- B. The fire rated integrity of walls in which flush mounted panelboards are installed shall be maintained.
- C. Field check phase loading and reconnect circuits as necessary for phase balance.
- D. Prior to energizing, retighten all field connections to manufacturer's torque specifications, check that all grounding connections are proper, exercise devices to make certain that they operate properly.
- E. A separate neutral conductor shall be installed with each branch circuit fed from panelboards having a double or 200% neutral bus, unless otherwise indicated.
- F. A separate neutral conductor shall be installed with each branch circuit protected by an arc-fault circuit interrupter circuit breaker.
- G. Provide facilities for future connection of additional loads. Two 1 inch spare conduits shall be stubbed out above ceiling or run to an accessible location from each flush mounted branch circuit panelboard. Two 2 inch spare conduits shall be stubbed out above ceiling or run to an accessible location from each flush mounted distribution panelboard.
- H. Directory cards shall be completely filled out with all circuits adequately marked and shall be typewritten. Room numbers shall be confirmed prior to completion. Spares shall be marked "SPARE" in pencil. Spaces shall be marked "SPACE" in pencil.

END OF SECTION

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**SECTION 26 24 19**

**MOTOR STARTERS AND CONTROLS**

**PART 1 - GENERAL**

**1.01 WORK INCLUDED**

- A. Manual motor starter switches, Magnetic motor starters, and Combination starters and disconnects integral with mechanical equipment shall be provided with mechanical equipment under Division 22 and 23 unless noted otherwise on the drawings. Electrical connections shall be made under Division 26.
- B. Magnetic motor starters not integral with mechanical equipment shall be provided under Division 22 and 23 unless noted otherwise on the drawings. Installation and final connections shall be made by Division 26.
- C. Manual motor starter switches and combination starters and disconnects not integral with mechanical equipment shall be provided under Division 26 unless noted otherwise on the drawings. Installation and final connection shall be made under Division 26.
- D. Motor starters are not always shown symbolically on the plans. Refer to schedules on the drawings for quantities and types to be provided.

**1.02 SUBMITTALS**

- A. Submittals shall be submitted in accordance with Section 26 01 00 and shall, as a minimum include the following:
  - 1. Manufacturer's descriptive catalog data.
  - 2. Short circuit ratings.
  - 3. Wiring diagrams and schematic ladder diagrams.
  - 4. Nameplate data and legends.

**PART 2 - PRODUCTS**

**2.01 ACCEPTABLE MANUFACTURERS**

- A. Manual motor starter switches shall be as manufactured by:
  - 1. Square D
  - 2. General Electric
  - 3. Allen Bradley
  - 4. Cutler-Hammer
- B. Magnetic motor starters shall be as manufactured by:
  - 1. Square D – type S with Motor Logic solid state overload relay
  - 2. General Electric – 300 line with CR324X solid state overload relay
  - 3. Allen Bradley– Bulletin 509 with SMTP-2 solid state overload relay
  - 4. Siemens Energy & Automation
  - 5. Sprecher-Schuh

**2.02 MANUAL MOTOR STARTER**

- A. Manual motor starter switches shall be flush-mounting type except where conduits are run exposed or

as otherwise noted. Manual motor starter switches shall be complete with properly sized melting alloy type thermal overload relay protection and a neon pilot light. Manual motor starter switches shall be equivalent to Square D Class 2510 with stainless steel plates.

2.03 MAGNETIC MOTOR STARTERS

- A. Magnetic motor starters shall be NEMA ICS-2, AC, General Purpose Class A, rated in horsepower for induction motors. IEC style starters regardless of rating, are prohibited. Coil operating voltage shall be as required and a maximum of 120 volts. Include solid state overload relay, pushbutton operator in front cover with operation indicating lights.
- B. Provide magnetic motor starters for all motors that are interlocked with external pilot duty devices, and for all 3 phase motors. Magnetic motor starters shall have overload protection on all current phases, and shall include low voltage release. Magnetic motor starters and overload protection shall be size coordinated with the driven equipment.
- C. Special attention is drawn to specific motor controller components or ratings as may be diagrammed or scheduled on the mechanical and electrical drawings. All components or ratings shall be furnished for motors indicated.
- D. Overload relay assemblies shall be solid state type with an adjustable dial or dip switch, settable to motor manufacturer's suggested overload amperage. Each overload unit shall be factory calibrated as a unit. Overload devices shall be fully ambient compensated. Class 10 tripping time shall be provided except where long acceleration time of a high inertia load requires the use of a Class 20 trip time. Motor overload protection shall include current sensing single phase protection which trips the starter within three seconds upon detection of a single phase condition. Overload devices that utilize bi-metal devices or melting alloy devices to sense motor overload are not acceptable.

- E. Contactor, solenoid, and control circuit devices shall be supplied for operation with 120 volt control power, unless noted otherwise. Provide factory installed control transformers with UL Class CC primary fuse protection and secondary fuses, in accordance with the latest edition of the National Electrical Code, within the starter enclosure for all voltage systems that do not allow for direct access to 120 volts, including 208 volt, 3 phase, 3 wire systems. Control power shall be so arranged as to de-energize the control circuits whenever the operating power supplied to the particular equipment is disconnected.
- F. Furnish all motor starters with auxiliary contacts as required by the application or as shown on the drawings. In addition to auxiliary contacts required for operation, furnish one normally open and one normally closed contact for future use. Provide an alarm contact, electrically separate from the trip contact, for remote annunciation of thermal overload trip condition.
- G. Coordinate with Division 22 and 23 and provide auxiliary contacts as required for application of fire alarm system interface.
- H. Where combination starters and disconnects are required by the application or by drawings, they shall have the following features:
  - 1. Combination motor starters shall include overcurrent protection by means of fused disconnect switch, circuit breaker, motor circuit protector, or as indicated on drawings. Combination starters shall be a package starter and overcurrent protection in same enclosure. Combination starters shall be equipped with padlockable lock-off feature and front accessible defeatable door interlock disconnect mechanism.
  - 2. Mount pilot devices on the unit. Pilot devices shall not be mounted on the door. Pilot devices shall be accessible with door closed. Overload relays shall be reset from outside the enclosure by means of an insulated bar or button.
  - 3. Fused disconnects shall be NEMA standard Type Heavy-Duty, "HD," 100 percent duty rated. Motor and circuit disconnects shall have quick-make, quick-break, visible blade operating mechanisms. Disconnects shall be enclosed, UL listed, and horsepower rated for the loads served. Motor and circuit disconnects shall have copper current carrying parts and removable arc suppressors. Disconnects, when fusible, shall be equipped with Class R, fuse rejection clips. Disconnects shall include equipment ground lug. Disconnects shall include solid neutrals in 4-wire applications.

4. Circuit breakers shall be HACR type, thermal-magnetic, quick-make, quick-break, trip-free and trip indicating. Multi-pole breakers shall be common trip, use of tie bars or pins is not acceptable. Minimum interrupting rating shall be 10,000 amperes or 14,000 amperes for 208Y/120 volts or 480Y/277 volts respectively.
5. Motor circuit protectors shall be HACR type, magnetic only, with a single adjustment which simultaneously sets the magnetic trip level of each individual pole. Motor circuit protectors shall comply with NEC requirements for providing motor circuit protection when installed as part of a listed controller having motor overload protection. The interrupting ratings shall be established when they are used in combination with motor starters with properly sized overload devices. Motor circuit protectors shall be quick-make, quick-break, trip-free and trip indicating. Motor circuit protectors shall be common trip, use of tie bars or pins is not acceptable. Minimum interrupting rating shall be 10,000 amperes or 14,000 amperes for 208Y/120 volts or 480Y/277 volts respectively.
- I. UL NEMA 1 enclosures shall be used in indoor locations and dry, UL NEMA 3R enclosures shall be used in exterior or wet locations. UL NEMA 12 or 12X enclosures shall be utilized where required. Enclosures shall be finish painted except where NEMA standards conflict.
- J. Motor starters shall be fully NEMA rated for service for which they are applied. NEMA ratings shall be used.
- K. Contactors shall be capable of withstanding the available short circuit current at their point of connection. Where available short circuit currents exceed the ratings of contactors, current limiting fuses or other current limiting means shall be employed to protect contactors. Coordinate with Division 26 for available short circuit current values at connections.
- L. Provide "Hand-Off-Auto" selector switches for automatically controlled motor starters and push button switches for manually controlled motor starters, per drawings and as required by control specifications. Selector switches shall be of heavy duty, 600 volt, oil-tight construction, with appropriate nameplates.

## Torian Plum Parking Structure – Phase 2

- M. Provide pilot lights for magnetic motor starters as indicated on the drawings and control specifications, and for all motors 10 horsepower and larger. Pilot lights shall be heavy duty, oil-tight, transformer type, push-to-test, with long life 6 volt lamps. Pilot light lens colors shall be as follows:

<u>MODE</u>	<u>COLOR</u>
Running	Red
On	Red
Auto	Amber
Off	Green
High Speed	White*
Low Speed	White*

\*Red lenses to be provided if separate "Running" or "On" pilot light is not provided.

- N. For motors 7-1/2 horsepower and larger, supplemental devices to protect the motor against loss of phase (phase rotation and single phasing protection) shall be provided. Devices to meet this requirement shall be of the current sensing type and shall be provided as a separate device. Units shall have manual or automatic reset and adjustable limits. Units shall be TimeMark Corporation 257 series or acceptable substitution.
- O. SCR type solid state starters shall be provided as required or as scheduled on the drawings. Whether indicated on the drawings or not, provide SCR reduced voltage solid state starters for all 200 volt, three phase motors 30 horsepower and larger, and for all 460 volt, three phase motors 60 horsepower and larger. Reduced voltage starters shall be derated for site conditions. SCR type solid state reduced voltage starters shall have the following features:
1. Current Limit: The current limit feature shall limit the motor current to a preset level at all times during start and run conditions. Current limit shall be adjustable between 150 percent and 425 percent of motor full load current (MFLC) via a potentiometer located behind the cover.
  2. Acceleration Ramp Time: Provide a linear voltage ramp during acceleration to provide a smooth, soft start. Acceleration ramp time shall be adjustable between 0.5 and 30 seconds.

3. Solid State Overload Protection: Solid state overload protection with external manual reset shall be included as an integral part of the starter. Trip settings shall be made via DIP switches located behind the cover, eliminating the need for separate thermal unit selectivity. Approximate trip times shall be 75 seconds at 2 times maximum full load current and 15 seconds at 4.25 times maximum full load current per NEMA Class 10 trip characteristics.
  4. Phase Loss: If one or more phases fail, shutdown shall occur, starting shall be inhibited, and the phase loss LED shall illuminate. Correcting the phase loss condition shall automatically reset the starter.
  5. Shorted SCR Detection: The shorted SCR circuitry shall be activated when control power and line power are available and the starter is turned off. If one or more shorted SCRs are detected, starting shall be inhibited and the shorted SCR LED shall illuminate. Shorted SCR detection shall be inhibited via a DIP switch setting behind the cover. In this mode, the starter shall be able to be operated, but the shorted SCR LED shall continuously flash on and off.
  6. Diagnosis: Flush-mounted, red light-emitting diodes (LEDs) shall be provided for monitoring of motor and starter status. The LEDs shall indicate: control power (available), starter on, overload trip, phase loss, and shorted SCR.
- P. Reduced voltage starters shall be provided for all 200 volt, three phase motors 30 horsepower and larger, and for all 460 volt, three phase motors 60 horsepower and larger. Reduced voltage starters shall be of autotransformer type with fully adjustable time relays and autotransformer over-temperature sensing device.
- Q. Two speed starters shall be either two speed single winding (consequent pole) or two speed two winding type to match the motors provided with the driven equipment. Two speed starters shall be provided with either a four position oil-tight switch "Auto-Off-Low-High," or with "Hand-Off-Auto" and "High-Off-Low" oil-tight switches as indicated on drawings and control specifications, and shall have an integral automatic decelerating time relay to prevent rapid switching from high to low speed. Timer shall be field set to allow the motor to coast from high to below low speed before energizing at low speed. Pilot lights shall be heavy duty oil-tight, transformer type, push-to-test, with long life 6 volt bulbs and shall be provided for both speeds.



R. Accessories

1. For all 10 horsepower motors and above, provide the following accessories:

- a. Undervoltage protection relay.
- b. Overvoltage protection relay.
- c. Ammeter.

S. Provide timing relays, metering, etc. as called for on the drawings or as required by this specification section, specification divisions 22 & 23, and the controls specifications.

T. Provide engraved lamacoid nameplates, screwed on the door of each control unit for identification of equipment controlled. Do not use abbreviations for equipment.

PART 3 - EXECUTION

3.01 INSTALLATION

A. In finished areas, mount manual motor starter switches flush and install suitable coverplate. In unfinished areas, mount manual motor starter switches adjacent to associated driven equipment. Provide mounting hardware, unistrut rack and accessories as required for the application.

B. Install magnetic motor starters and combination motor starter and disconnects immediately adjacent to associated driven equipment and within site of motor and drive equipment. Provide mounting hardware, unistrut rack, and accessories as required for the application.

C. In utility areas, mount manual motor starter switches, magnetic motor starters, and combination motor starter and disconnects on adjacent walls maintaining NEC required access. Where required, due to access requirements, mount manual motor starter switches, magnetic motor starters, and combination motor starter and disconnects on free standing unistrut stands adjacent to equipment.

D. On roofs, or other exterior locations, mount manual motor starter switches, magnetic motor starters, and combination motor starter and disconnects on equipment or provide free standing unistrut stand adjacent to equipment. Coordinate locations with Engineer prior to installation.

E. Motor and starter wiring shall be done in complete accordance with wiring diagrams provided by the supplier. Interlock wiring shall also be provided as required in each case. Control wiring shall be minimum of 14 gauge, Class B stranded labeled, or color coded, copper conductor with SIS, THHN, or XHHW insulation.

F. Furnish and install labels and nameplates in accordance with Section 26 01 00. Provide neatly typed label inside motor starter enclosure identifying motor served, nameplate horsepower, full load amperes, code letters, and service factor.

G. Check the rotation of all three phase motors and reconnect same where necessary to provide the proper direction of rotation as required for the driven unit. Check all starters for proper overload settings.

H. Provide fuses, including spare fuses, as indicated on the drawings and as indicated in Section 26 28 16 for all fused combination magnetic motor starters.

I. Touch-up scratched or marred surfaces to match original finish.

J. Verify and document that control sequences, time delay, and adjustments are as indicated on the drawings.

- K. Provide shop drawings in accordance with Article 1.02 and Section 26 01 00.

**END OF SECTION**

**SECTION 26 27 26**

**WIRING DEVICES**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Provide wiring devices and accessories in accordance with the Drawings and Specifications.

**1.02 DEFINITIONS**

- A. 1,2: Single-Pole and Double-Pole, respectively.
- B. 3,4: Three-Way and Four-Way, respectively.
- C. GFI, GFCI: Ground Fault Circuit Interrupter
- D. IG: Isolated Ground.
- E. K: Key-Operated.
- F. P: Pilot Light - Load On.
- G. PO: Pilot Light - Load Off.
- H. TR: Tamper Resistant.
- I. TVSS: Transient Voltage Surge Suppressor.
- J. V: Variable Speed.
- K. WR: Weather Resistant

**1.03 SUBMITTALS**

- A. Product Data: For each product specified.
- B. Samples: As requested.

**1.04 QUALITY ASSURANCE**

- A. Wiring Devices and accessories shall be of the same manufacturer insofar as possible.
- B. Device plates and accessories shall match corresponding wiring devices.
- C. Devices shall comply with UL 943 (Safety for Ground Fault Circuit Interrupters).

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Wiring Devices and Device Plates:

1. Cooper Wiring Devices
2. Hubbell
3. Leviton

B. Weatherproof Enclosure:

1. Hubbell
2. Taymac
3. Thomas and Betts
4. Raco

2.02 RECEPTACLES

- A. Straight-Blade-Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498. Standard and WR types shall be heavy-duty, specification grade, 20A, unless otherwise indicated or required. Devices to be Hubbell 5362 series or approved equivalent.
- B. Straight-Blade-Type Receptacles TR type shall be commercial specification grade, 20A, unless otherwise indicated or required. Devices to be Hubbell CR series or equivalent.
- C. Straight-Blade and Locking Receptacles: Heavy-Duty grade. NEMA configuration as shown on drawings.
- D. GFI, GFCI Receptacles: Straight blade, non-feed-through type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle; complying with UL 498 and UL 943. Design units for installation in a 2-3/4-inch- deep outlet box without an adapter.
- E. IG (Isolated-Ground) Receptacles: Straight blade duplex receptacle, with equipment grounding contacts connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap.
1. Devices: Listed and labeled as isolated-ground receptacles.
  2. Isolation Method: Integral to receptacle construction and not dependent on removable parts.

F. USB Charger Receptacles: Hubbell USB8300W or equal.

1. Two USB ports 3 Amp, 5V DC, type A, class 2.0 Tamper-Resistant decorator 20A duplex receptacle Green LED indicator to show USB power available Compatible with USB 1.1/2.0/3.0 devices, including Apple® products. cULus listed to UL498 and UL1310 Hospital Grade NEMA® WD-6 Compliant.

## 2.03 SWITCHES

- A. General: 1, 2, 3, 4, K, P (red polycarbonate lighted handle), PO (clear polycarbonate lighted handle) types shall be Hubbell 1221 series, heavy-duty, specification grade, 20A, unless otherwise indicated or required.
- B. 30A Type: 1, 2, and 3 types shall be Hubbell 3031 series, heavy-duty, specification grade, unless otherwise indicated or required.
- C. Body Color: 20A, red.
- D. Momentary Contact Type: Three position, two circuit, center off type shall be Hubbell 1557 series, heavy-duty, specification grade, 20A, with toggle or key as indicated.
- E. Maintained Contact Type: Three position, two circuit, center off type shall be Hubbell 1385 series, heavy-duty, specification grade, 20A, with toggle or key as indicated. Single or double pole as indicated.
- F. V Type: Single pole slide AC type, with white device color. Hubbell or equivalent.

## 2.04 WIRING DEVICE COLOR

- A. Wiring device color to be gray unless otherwise indicated or required. Verify color with Architect prior to submittals. Special condition colors:
1. Emergency red.
  2. IG receptacles, orange.
  3. TVSS receptacles, blue.

## 2.05 DEVICE PLATES

- A. Securing Screws: Metal with finish to match device plate.

- B. Nylon: Gray unless otherwise indicated. Verify color with Architect prior to submittals. Special condition colors:
  - 1. Emergency red.
  - 2. IG, orange.
  - 3. TVSS, blue.
- C. Stainless steel: 0.04-inch-thick (1-mm-thick) type 302 stainless steel.
- D. Brass: 0.04-inch-thick (1-mm-thick) brass (70% copper, 10% zinc), smooth satin finish (without lines) appearance.
- E. Aluminum: 0.05-inch-thick (1.3-mm-thick) aluminum, smooth clear anodized satin finish (without lines) appearance.
- F. Brass plated Steel: 0.03-inch-thick (.8-mm-thick) brass plated steel, smooth satin finish (without lines) appearance, coated to inhibit oxidation.
- G. Chrome plated Steel: 0.03-inch-thick (.8-mm-thick) chrome plated steel, smooth satin finish (without lines) appearance, coated to inhibit oxidation.

#### 2.06 WEATHERPROOF ENCLOSURES

- A. NEMA 3R rating while in use when used with manufacturer's recommended outlet box. Gaskets are closed-cell foam. Meets OSHA lockout and tagout requirements. Enclosures shall have latching covers and cord openings. UL listed and CSA certified with clearly marked logos. Covers include gasket and mounting screws. Lids have gasketless design. Holes for padlocks are 1/4 inch (0.635 cm). Provide padlocks for all enclosures that are keyed alike. Provide two keys.
- B. Non-metallic type shall be of impact resistant polycarbonate with transparent cover which provides visibility to the connection.

#### 2.07 WHILE-IN-USE COVERS

- A. Thomas and Betts # CKLSVU(1-gang) and #2CKU (2-gang)
- B. 1-gang Silver Large Universal While-In-Use Extra-Duty Vertical weatherproof Receptacle Cover for use with single receptacles.
- C. 2-gang Silver Large Universal While-In-Use Extra-Duty Vertical weatherproof Receptacle Cover for use with duplex receptacles.
- D. Die-cast metal construction.
- E. NEMA 3R rating ensures protection against falling rain, sleet and external ice formation when used with appropriate device boxes.
- F. Complies with National Electrical Code Article 406.8 (B) for unattended in use plugs in wet locations.
- G. Powder coated finish, painted silver.
- H. Number of gangs to match devices on plans.
- I. Inside dimensions (inches) 4 3/4

### PART 3 - EXECUTION

#### 3.01 GENERAL

- A. Receptacles over-counter shall be mounted horizontally, and vertically mounted elsewhere, unless otherwise indicated. Mount horizontal receptacles with neutral blade slot up, and mount vertical receptacles with ground prong hole up.
- B. Where receptacles are installed within one stud spacing width from a switch, the convenience outlet

and switch shall align vertically.

- C. Switches shall be located as indicated on drawings, arranged singular or in gangs and within 18 inches (45.72 cm) of door jamb on the strike side of the door openings. Group adjacent switches under single multi-gang wall plate. Verify the door swings with the Architectural drawings prior to rough-in.
- D. Match receptacles and special purpose outlets to Owner-furnished equipment, unless otherwise indicated.
- E. Install emergency switches separate from normal power switches. Do not include in the multiple gang configurations.
- F. Switch and receptacle combinations shall be as above in a 2-gang box where both are of the same voltage. Provide barrier in box between switch and receptacle where different voltages are present.
- G. Install device plates as required for all device boxes and blanked outlet boxes.
- H. Install devices and device plates plumb and secure.
- I. Device plates shall be marked on the inside indicating panelboard and circuit number to which the device is connected.
- J. Device plates for two or more switches indicated at the same location shall be marked on the outside to identify the load and location of load which each switch controls.
- K. Device plates for P type toggle switches shall be marked on the outside of each switch to identify the load and location of load which the switch controls.
- L. Device plates for special purpose outlets shall be marked on the outside to identify the load and NEMA configuration of the receptacle.
- M. Devices indicated as weatherproof shall have a weatherproof enclosure unless otherwise noted. Weatherproof enclosures for receptacles shall be marked on the outside "SUITABLE FOR WET LOCATION WHILE IN USE."
- N. All 15 ampere and 20 ampere, 125 volt and 250 volt, non-locking receptacles installed in damp or wet locations shall be listed as weather resistant (WR).
- O. Labeling of device plates on the inside shall be by way of indelible marker. Labeling of device plates on the outside shall be by way of adhesive labels.
- P. Adhesive labels shall be of clear or white Kroy, Brother, or Brady tape with black 1/4 inch (0.635 cm) minimum height upper-case letters. Red letters on white tape shall be used for emergency applications on red nylon plates.
- Q. Factory engraved labels shall be of black 1/4 inch (0.635 cm) minimum height recessed upper-case letters. White letters shall be used for emergency applications on red nylon plates.
- R. All exterior weather proof receptacles shall be installed with aluminum "While-in-use" covers.

### 3.02 FIELD QUALITY CONTROL

- A. Protect wiring devices and assemblies during painting. Install device plates when painting is complete.
- B. Internally clean devices, device outlet boxes, and enclosures. Replace stained, damaged, or defective components.

## Torian Plum Parking Structure - Phase 2

- C. Test receptacles for proper polarity and ground continuity. Operate each receptacle at least six times and replace receptacles which are damaged or defective.
- D. Operate each switch at least six times and replace switches which are damaged or defective.
- E. Test GFCI receptacles with both local and remote fault simulations according to manufacturer recommendations.
- F. Test TVSS receptacle indicating lights for normal operation.

**END OF SECTION**



**SECTION 26 28 00**

**LOW VOLTAGE CIRCUIT PROTECTIVE DEVICES**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Provide fuses of type, size and manufacturer in accordance with the Drawings and Specifications.
- B. Provide circuit breakers of type, size and manufacturer in accordance with the Drawings and Specifications.

**1.02 SUBMITTALS**

- A. Project Data: Include the following for each product specified:
  - 1. Coordination curves for each fuse type and size.
  - 2. Coordination curves for each circuit breaker type protecting motors and feeders.
  - 3. Coordination study comparing all fuses and circuit breakers protecting motors and feeders. Include settings for electronic trip circuit breakers.
  - 4. If other than Bussmann fuses are provided, submit let-through values based upon the available short circuit current values indicated on the one-line diagram.

**1.03 QUALITY ASSURANCE**

- A. Obtain fuses from one source and by a single manufacturer.
- B. Obtain circuit breakers from one source and by a single manufacturer which is the same manufacturer as panelboard, switchboard, disconnecting device, etc.
- C. Provide overcurrent protection which is selectively coordinated to properly localize a fault condition by restricting outages to the equipment affected.

**1.04 EXTRA MATERIALS**

- A. Spare Fuses: Furnish quantity equal to 20 percent of each fuse type and size installed, but not less than 2 sets of 3 of each type and size.

**PART 2 - PRODUCTS**

**2.01 ACCEPTABLE MANUFACTURERS**

- A. Circuit Breakers:
  - 1. Cutler-Hammer/Eaton Corp.
  - 2. General Electric
  - 3. Siemens Energy & Automation
  - 4. Square D
- B. Fuses:

1. Cooper-Bussmann
2. Littlefuse
3. Ferraz-Shawmut

## 2.02 CIRCUIT BREAKERS

- A. Circuit breakers shall be molded case, thermal-magnetic, quick-make, quick-break, trip-free and trip indicating unless otherwise noted. Multi-pole breakers shall be common trip, use of tie bars or pins is not acceptable. Circuit breakers in distribution panelboards and switchboards with frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker.
- B. Standard Rated Electronic Trip Circuit Breakers: Molded case, microprocessor-based, true rms sensing type with the following features:
  1. Interchangeable rating plugs.
  2. Adjustments for:
    - a. Long Time Pickup.
    - b. Instantaneous Pickup.
    - c. Long Time Delay.
    - d. Short Time Pickup.
    - e. Short Time Delay ( $I^2t$  IN and  $I^2t$  OUT).
  3. LED long time pickup indication.
  4. Thermal magnetic backup protection.
  5. Long time and ground fault memory.

- C. 100% Rated Electronic Trip Circuit Breakers: Molded case, microprocessor-based, true rms sensing type with the following features:
  - 1. Interchangeable rating plugs.
  - 2. Meter/monitor compatible.
  - 3. Adjustments for:
    - a. Long Time Pickup.
    - b. Instantaneous Pickup.
    - c. Long Time Delay.
  - 4. LED long time pickup indication.
  - 5. Thermal magnetic backup protection.
  - 6. Long time and ground fault memory.
  - 7. Local trip indicators for overload , ground fault, and short circuit.
- D. Circuit breakers in panelboards shall be bolted-in type unless otherwise noted.
- E. Minimum interrupting rating shall be 10,000 amperes or as required to maintain the panelboard integrated short circuit rating in accordance with Drawings and Specification.
- F. Application listing shall be appropriate for application, including switching fluorescent lighting loads or heating, air-conditioning, and refrigerating equipment.

#### 2.03 FUSES

- A. Fuse types shall be as indicated on the drawings and equipment schedules.
- B. Provide Class "J" time delay for mechanical equipment supplied with IEC rated disconnects, starters, or combination starter.

#### 2.04 SPARE FUSE CABINET

- A. Cabinet: Wall-mounted, 0.05-inch- (1.27-mm-) thick steel unit with full-length, recessed piano-hinged door with key-coded cam lock and pull.
  - 1. Size: Adequate for orderly storage of spare fuses specified with 15 percent spare capacity minimum.
  - 2. Finish: Gray, baked enamel.
  - 3. Identification: Stencil legend "SPARE FUSES" in 1-1/2-inch (40-mm) letters on door.
  - 4. Fuse Pullers: For each size fuse.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Verify mechanical equipment overcurrent protective device size and type with name plate data and starter data.
- B. Install typewritten labels on inside door of each fused switch to indicate fuse replacement information.
- C. Install spare fuse cabinet near the main service equipment, unless otherwise noted, with neatly stored boxes of spare fuses within.
- D. Provide settings on circuit breakers per manufacturer's recommendations.

**END OF SECTION**

**SECTION 26 51 00**

**LIGHTING**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Provide luminaires, lamps, ballasts, and accessories in accordance with the Drawings and Specifications.
- B. Luminaires requiring caps, mounting spaces, hold-down clips or other accessory items shall be furnished complete with same whether the descriptions, catalog numbers, and notes on the Drawings include such items or not.

**1.02 RELATED DOCUMENTS**

- A. Section 260800 Commissioning of Electrical Systems
- B. Section 260811 Commissioning of Lighting and Lighting Control Systems

**1.03 DEFINITIONS**

- A. CCT: Correlated Color Temperature
- B. Luminaires CRI: Color Rendering Index.
- C. Fixture: See “Luminaire”.
- D. LED: Light-emitting diode.
- E. Lumen: Measured output of lamp and luminaire or both.
- F. Luminaire: Complete lighting unit, including lamp reflector and housing.

**1.04 SUBMITTALS**

- A. Product Data: For each luminaire and accessory specified including lamps and ballasts.
- B. Photometric reports performed by independent testing laboratory.
- C. Point-by-point computer generated calculations for area(s) and criteria indicated on Drawings.
- D. Samples: As requested.

**1.05 EXTRA MATERIALS**

- A. Lamps: 10 lamps for every 100 of each type installed, but not less than 1.
- B. Ballasts: 1 for every 100 of each type installed, but not less than 1.
- C. Lenses: 1 for every 100 of each type installed, but not less than 1.
- D. Guards: 1 for every 20 of each type installed, but not less than 1.

**1.06 WARRANTY**

- A. Warranty: Manufacturer and Installer agree to repair or replace luminaires and/or components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

- A. Luminaires shall be of manufacturer and type as indicated or scheduled on the Drawings.
- B. Lamps:
  - 1. General Electric
  - 2. Osram/Sylvania
  - 3. Philips
  - 4. Venture (for metal halide products)
- C. Fluorescent Ballasts:
  - 1. General Electric
  - 2. Osram/Sylvania
  - 3. Advance
  - 4. Universal Lighting Technologies

- D. Fluorescent Dimming Ballasts:
  - 1. Osram/Sylvania (Excluded for Compact Fluorescent)
  - 2. Advance
  - 3. Lutron
  - 4. Universal Lighting Technologies (Excluded for Compact Fluorescent)
- E. HID Ballasts:
  - 1. Advance
  - 2. Osram/Sylvania
  - 3. Universal Lighting Technologies
- F. Battery Pack Assemblies:
  - 1. Bodine
  - 2. Lightolier
  - 3. Lithonia

2.02 GENERAL

- A. Luminaires shall have manufacturer's standard finish unless otherwise noted. Provide "Damp Location" label where indicated or required.
- B. Recessed or semi-recessed luminaires shall be designed to be compatible with ceiling as installed. Furnish and install frames where required for proper installation. Supply with trim that is compatible with ceiling system in which it shall be installed.
- C. Luminaires shall have integral ballasts unless otherwise noted. Ballasts for recessed luminaires shall be fully accessible through ceiling opening of luminaire unless otherwise noted.
- D. Luminaires shall be of the prewired type with integral junction box.
- E. Luminaires shall be labeled with acceptable lamping. Labeling shall be in a location that is visible during re-lamping.

2.03 FLUORESCENT LUMINAIRES

- A. Luminaires may be connected with factory supplied whips of six foot lengths or less.

- B. Luminaires shall have metallic surfaces protected with rust-inhibiting white baked enamel. Reflective surfaces shall have minimum 85 percent reflectance, white enamel, high temperature baked. Provide all wiring channels, internal barriers, socket wiring covers, end caps, reflectors, etc.
- C. Acrylic diffuser type lenses shall be virgin acrylic, 0.125 inches thick minimum.
- D. Doors shall be capable of hinging from either side and gasketed to prevent leakage of light around door frame edges.

2.04 LED LUMINAIRE REQUIREMENTS

- A. CRI of 80, CCT of 4100K or as noted in luminaire schedule on drawings.
- B. Rated lamp life of 50,000 hours.
- C. Lamps dimmable from 100 percent to 10 percent of maximum light output.
- D. Internal driver.
- E. Nominal Operating Voltage: 277 V ac or as indicated on plans and luminaire schedule.

2.05 LAMPS

- A. If incandescent lamps are used, they shall be rated at 130 volts, and they shall be of the inside frost type unless otherwise noted.
- B. Fluorescent lamps shall utilize rare earth triphosphor technology.
- C. Fluorescent T8 and compact fluorescent lamps shall be 4100 K color temperature and Color Rendering Index of 82 or greater.
- D. Fluorescent T5 standard and high output lamps shall be 4100 K color temperature and Color Rendering Index of 82 or greater.
- E. High intensity discharge lamps shall be designed for mounting positions as required by the luminaire in which they are installed.
- F. Metal halide and high pressure sodium lamps shall be color corrected if luminaire photometrics are unaffected and acceptable to manufacturer.
- G. Mercury vapor lamps shall be deluxe white if luminaire photometrics are unaffected and acceptable to manufacturer.



- H. Ballast and lamp combination shall be compatible and deliver normal ballast and lamp life. Rated lamp output shall not vary in response to input voltage within 10% of rated voltage.

2.06 ELECTRONIC FLUORESCENT BALLASTS

- A. Unless otherwise noted, linear or U-tube lamp ballasts shall be fully electronic, integrated circuit, solid-state, programmed rapid-start, full-light-output, energy-efficient type. The ballast shall be physically interchangeable with a standard core and coil electromagnetic ballast.

1. Ballast shall operate lamps at a frequency of 40 Khz or higher without visible flicker.
2. Audible Noise Rating: Sound rating better than A.
3. Total Harmonic Distortion (THD): Less than 10 percent.
4. Power Factor: 0.98 or higher.
5. Ballast Factor: 0.88 or higher.
6. Crest Factor: 1.6 or less.
7. Certification by Electrical Testing Laboratory (ETL) or internally certified laboratory to ensure ballast meets ANSI specifications.
8. Conform to Federal Communications Commission (FCC) rules and regulations, Part 18, for non-consumer equipment.
9. Conform to ANSI C82.11 standards regarding harmonic distortion.
10. Conform to ANSI C62.41 Cat. A for transient protection.
11. UL listed Class P.
12. Minimum starting temperature of 0 degrees F.

- B. Compact fluorescent lamp ballasts shall be fully electronic, integrated circuit, solid-state, programmed rapid start, full-light-output, energy-efficient type. The ballast shall be physically interchangeable with a standard core and coil electromagnetic ballast.

1. Ballast shall operate lamps at a frequency of 40 Khz or higher without visible flicker.
2. Audible Noise Rating: Sound rating better than A.
3. Total Harmonic Distortion (THD): Less than 10 percent.
4. Power Factor: 0.98 or higher.
5. Ballast Factor: 0.95 or higher.
6. Crest Factor: 1.7 or less.
7. Certification by Electrical Testing Laboratory (ETL) or internally certified laboratory to ensure ballast meets ANSI specifications.

8. Conform to Federal Communications Commission (FCC) rules and regulations, Part 18, for non-consumer equipment.
  9. Conform to ANSI C82.11 standards regarding harmonic distortion.
  10. Conform to ANSI C62.41 Cat. A for transient protection.
  11. UL listed Class P.
  12. Minimum starting temperature of -5 degrees F.
- C. Dimmable ballasts for linear and U-tube lamps shall be fully electronic, integrated circuit, solid-state, programmed rapid start, full-light-output, energy-efficient type with 100-5% (100-10% for 4-lamp) dimming range. The ballast shall be physically interchangeable with a standard core and coil electromagnetic ballast.
1. Ballast shall operate lamps at a frequency of 40 Khz or higher without visible flicker.
  2. Audible Noise Rating: Sound rating better than A.
  3. Total Harmonic Distortion (THD): Less than 10 percent at full output and less than 20 percent at lowest light output.
  4. Power Factor: 0.98 or higher at full output and 0.95 or higher at lowest light output.
  5. Ballast Factor: 0.94 or higher for 1 or 2 lamp and 0.88 or higher for 3 or 4 lamp.
  6. Crest Factor: 1.7 or less.

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7. Certification by Electrical Testing Laboratory (ETL) or internally certified laboratory to ensure ballast meets ANSI specifications.
  8. Conform to Federal Communications Commission (FCC) rules and regulations, Part 18, for non-consumer equipment.
  9. Conform to ANSI C82.11 standards regarding harmonic distortion.
  10. Conform to ANSI C62.41 Cat. A for transient protection.
  11. UL listed Class P.
  12. Minimum starting temperature of 60 degrees F.
- D. Dimmable ballasts for compact fluorescent lamps shall be fully electronic, integrated circuit, solid-state, programmed rapid start, full-light-output, energy-efficient type with 100-1% dimming range. The ballast shall be physically interchangeable with a standard core and coil electromagnetic ballast.
1. Ballast shall operate lamps at a frequency of 40 Khz or higher without visible flicker.
  2. Audible Noise Rating: Sound rating better than A.
  3. Total Harmonic Distortion (THD): Less than 10 percent.
  4. Power Factor: 0.98 or higher at full output and 0.90 or higher at lowest light output.
  5. Ballast Factor: 0.88 or higher at full output and 0.05 or higher at lowest light output.
  6. Crest Factor: 1.7 or less.
  7. Certification by Electrical Testing Laboratory (ETL).
  8. Certified Ballast Manufacturers (CBM) certification and labeling that ballast has been performance tested by ETL to meet ANSI specifications.
  9. Conform to Federal Communications Commission (FCC) rules and regulations, Part 18, for non-consumer equipment.
  10. Conform to ANSI C82.11 standards regarding harmonic distortion.
  11. Conform to ANSI C62.41 Cat. A for transient protection.
  12. UL listed Class P.
  13. Minimum starting temperature of 50 degrees F.
- E. Manufacturer shall provide a five year warranty beginning at the time of Substantial Completion. The manufacturer shall replace any and all failed ballasts within 48 hours of notification. Manufacturer shall provide labor for warranty replacements, phone number, and fax number to report outages.
- F. Compact fluorescent type shall have circuitry designed to shut down the system reliably and safely when lamps have reached their end-of-life to protect against overheated bases and sockets, as well as

cracking of the lamp glass wall.

2.07 HIGH INTENSITY DISCHARGE BALLASTS

- A. Ballasts shall be high power factor constant wattage auto-transformer type.
- B. Exterior high intensity discharge ballasts shall be capable of starting lamps at minus 20 degrees F.

2.08 ACCESSORIES

- A. Battery Pack Assemblies: Fluorescent luminaires indicated to include battery packs shall contain a battery pack assembly consisting of a battery, charger, inverter, and electronic circuitry enclosed in one compact red case. Battery packs shall operate two lamps to produce a minimum of 1100 lumens unless otherwise noted. Luminaire shall have valid UL label with battery pack installed at luminaire manufacturer's factory.
  - 1. Test Switch and LED Indicator Light: Charging indicator light to monitor the charger and battery with test switch and hardware. Visible and accessible without opening fixture or entering ceiling space, and integral to luminaire unless otherwise noted.
  - 2. Battery: High-temperature, maintenance-free, nickel-cadmium type with minimum 10-year nominal life. Capable of operating lamp for a minimum of 90 minutes.
  - 3. Charger: Fully automatic, solid-state, constant-current type.
  - 4. Operation: Relay automatically turns lamp on when supply circuit voltage drops to 80 percent of nominal voltage or below. Relay disconnects lamp and battery and automatically recharges when normal voltage is restored.

5. Self-testing and Self-diagnostic: Continually monitors charging current and battery voltage, and automatically performs a minimum 30 second test and diagnostic routine at least once every 30 days and once a year for 90 minutes. Unit indicates failure by a status indicator light and audible alarm.
  6. Battery packs within egress lighting fixtures shall be connected to the uncontrolled hot leg of the local lighting circuit.
- B. Poles, bracket arms, appurtenances, and anchorage material shall be of matching color. Same shall be sufficient to support effective projected areas of luminaires and pole supplied without failure, permanent deflection, or damage to lamp filaments against steady winds of 100 mi/hr with a gust factor of 1.3.

### PART 3 - EXECUTION

#### 3.01 GENERAL

- A. Confirm compatibility and interface of other materials with luminaire and ceiling system. In the event of any discrepancy, immediately notify the Architect. Do not proceed with installation in areas of discrepancy until all such discrepancies have been resolved.
- B. Coordinate the installation of luminaires with the schedule of work of other trades to prevent unnecessary delays in the total work.
- C. Where luminaires are shown in conflict with locations of structural members, mechanical or other equipment, furnish and install all required supports and wiring to clear the encroachment.
- D. Luminaires shall be installed as indicated and/or noted and in accordance with the NEC and the manufacturer's recommendations. Where mounting dimensions are not shown, refer to Architectural drawings for installation details.
- E. Luminaires shall be located in accordance with architectural reflected ceiling plans unless otherwise indicated. Luminaire locations shall be exactly moduled with ceiling tile where same occurs.
- F. Recessed luminaires shall be complete with all required hardware and accessories in each case. Where "lay-in" luminaires cannot be used in suspended ceilings, recessed luminaires shall be installed complete with bar hangers and shall be supported from the ceiling suspension system.
- G. In areas with "lay-in" ceilings, support wires shall be used to connect recessed, surface, or pendant mounted luminaires to the structure above. Recessed and surface mounted luminaires shall also be positively attached to the suspension system of the "lay-in" ceiling assembly.
- H. Surface-mounted luminaires shall be supported from outlet box fixture studs, mounting brackets or mounting straps or shall be secured directly to the structural system. Outlet boxes and mounting brackets (or straps) shall be secured to a joist or similar structural unit or to an approved metal support which is secured to such a structural unit. The use of toggle bolts for luminaire support shall not be permitted.
- I. Wall-mounted luminaires shall be supported by wall brackets secured to luminaire studs in the outlet boxes or to outlet box "ears."
- J. Pendant mounted luminaires shall hang even regardless of uneven or sloping ceilings. Maximum pendant spacing shall be 4 feet where luminaires having 4 foot channels are used. "Twin" stem assemblies shall not be permitted.
- K. Installation of luminaires in mechanical rooms shall be coordinated with the ductwork and other

obstructions. Provide special hangers as required.

- L. Luminaires shall be provided with new lamps prior to final acceptance of the project. Any lamps used for more than ninety (90) days as temporary lighting shall be replaced by the contractor. Fluorescent lamps that are dimmed shall be “burned-in” without any dimming for 100 hours after installation and prior to Owner occupancy.
- M. Poles are to be set on structurally engineered concrete base provided by General Contractor. Concrete 24 inch extended bases shall be provided only where within confined parking areas or as indicated on plans. All other pole bases shall be adjusted to grade level. Contractor shall deliver anchor bolts and templates furnished with poles to General Contractor for setting in concrete base. Provide conduit sleeves in bases for conductors and grounds. Verify locations and type of base, extended or flush, with Architect prior to installation.
- N. Ballasts shall be integrally mounted in all luminaires unless otherwise noted.
- O. All fluorescent luminaires that utilize double-ended lamps and contain ballast(s) that can be serviced in place shall have a disconnecting means either internal or external to each luminaire per 2017 NEC, Article 410.130 G(1).
- P. Photocells shall be mounted in a protected area facing north and shall be shielded to prevent influence from other night lighting sources. Set relay contact closure at approximately 2 footcandles (20 lux).
- Q. Battery packs within egress lighting fixtures shall be connected to the uncontrolled hot leg of the local lighting circuit.
- R. Clean all luminaires of construction dirt and paint prior to project close out. Use methods and materials recommended by manufacturer.
- S. Dimmer switches for control of dimmable luminaires shall be coordinated with the type of ballast or LED driver to ensure compatibility.
- T. Where light fixtures are installed penetrating a fire-rated assembly, a means of tenting the fixture shall be provided either with a construction of a gypsum board tent around fixture or pre-manufactured UL listed fire-rated cover. Tenting shall meet or exceed the fire-rating of the assembly. Tenting shall be coordinated with other trades prior to installation. Fire-rated covers shall be installed per manufacturer recommendations.
- U. Where fixtures are mounted in areas where they could be damaged by flying objects such as gymnasiums, multipurpose rooms or similar rooms where sporting activities are performed, wireguards shall be provided.

**END OF SECTION**

## **SECTION 311000**

### **SITE CLEARING**

#### **PART 1 - GENERAL**

##### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply if provided, to this Section.

##### **1.02 SUMMARY**

- A. This Section includes the following:
  - 1. Protecting existing trees, shrubs, groundcovers, plants, grass, and other vegetation to remain or as designated by Owner in pre-construction conference.
  - 2. Removing existing trees, shrubs, groundcovers, plants, grass, and other vegetation.
  - 3. Clearing and grubbing.
  - 4. Stripping and stockpiling topsoil.
  - 5. Removing above- and below-grade site improvements.
  - 6. Disconnecting, capping or sealing, and abandoning site utilities in place.
  - 7. Removing existing fill.
- B. Related Sections include the following:
  - 1. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.
  - 2. Division 31 Section "Temporary Erosion and Sedimentation Control" for storm water erosion and sediment mitigation.

##### **1.03 DEFINITIONS**

- A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches (50 mm) in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.
- B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

##### **1.04 MATERIAL OWNERSHIP**

- A. Except for stripped topsoil or other materials indicated to be stockpiled or to remain on Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

##### **1.05 SUBMITTALS**

- A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.

- B. Record drawings, identifying and accurately locating capped utilities and other subsurface structural, electrical, and mechanical conditions. Information required may also be included in Division 1 Section "Project Record Documents."

1.06 QUALITY ASSURANCE

- A. Preconstruction Conference: Conduct conference at Project site as directed by Owner's Representative prior to start of construction. Contractor to comply with requirements, which may also be included in Division 1 Section "Project Management and Coordination."

1.07 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing indicated removal and alteration work on property adjoining Owner's property will be obtained by Owner before award of Contract. Authority and permits for performing indicated removal and alteration work on adjacent rights-of-way shall be obtained by Contractor.
  - 1. Do not proceed with work on adjoining property until directed in writing by Owner's Representative.
- C. Protect improvements on adjacent and Owner's property.
- D. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- E. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- F. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.
- G. Restore damaged improvements to their original condition, as acceptable to parties having jurisdiction.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

- A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 Section "Earth Moving," (PART 2 – PRODUCTS).



## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Protect and maintain benchmarks, survey control points, monuments, property line pins and other reference points from disturbance during construction. If disturbed or destroyed, restore or replace at no cost to Owner.
- B. Provide erosion control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust from leaving project site.
- C. Locate and clearly flag trees and vegetation to remain or to be relocated.
- D. Protect existing site improvements to remain from damage during construction.
  - 1. Restore or replace damaged improvements to their original condition, as acceptable to Owner.

### 3.02 TREE PROTECTION

- A. Erect and maintain temporary fencing around drip line of individual trees or around perimeter drip line of groups of trees to remain before starting site clearing. Remove fence when construction is complete.
  - 1. Do not store construction materials, debris, or excavated material within fenced area.
  - 2. Do not permit vehicles, equipment, or foot traffic within fenced area.
  - 3. Maintain fenced area free of weeds and trash.
- B. Do not excavate within tree protection zones, unless otherwise indicated.
- C. Where excavation for new construction is required within drip line of trees, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
  - 1. Cover exposed roots with burlap and water regularly.
  - 2. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.
  - 3. Coat cut faces of roots more than 1-1/2 inches (38 mm) in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
  - 4. Cover exposed roots with wet burlap to prevent roots from drying and backfill with soil as soon as possible.
- D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Owner's Representative.
  - 1. Employ a qualified arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
  - 2. Replace trees that cannot be repaired and restored to full-growth status, as determined by the qualified arborist.

### 3.03 UTILITIES

- A. Contractor will locate, identify, arrange for disconnect and seal or cap off utilities indicated to be removed before site clearing.

1. Verify that utilities indicated as abandoned have been disconnected and capped before proceeding with site clearing.
  2. Arrange with utility companies having jurisdiction to shut off indicated utilities.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify Owner's Representative not less than two days in advance of proposed utility interruptions.
  2. Do not proceed with utility interruptions without Owner's Representative's written permission.
- C. Excavate for and remove underground utilities indicated to be removed.
- D. Removal of underground utilities may also be included in Division 2 Sections covering site utilities. Removal of underground utilities may also be included in Division 15 Mechanical or Division 16 Electrical Sections.
- E. After removal of underground utilities, as indicated, properly cap and/or plug existing lines to remain in accordance with authorities having jurisdiction.

3.04

CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.
1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
  2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
  3. Grind stumps and completely remove roots, obstructions, and debris extending to a depth of 18 inches (450 mm) below exposed subgrade.
  4. Use only hand methods for grubbing within drip line of remaining trees.
  5. Chip removed tree branches and dispose of off-site.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earth moving is indicated.
1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches (200 mm), and compact each layer to a density equal to adjacent original ground.

3.05

TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered or as determined by Geotechnical Engineer in a manner to prevent intermingling with underlying subsoil or other waste materials.
1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  - 1. Limit height of topsoil stockpiles to 72 inches (1800 mm) unless authorized by Owner's Representative.
  - 2. Do not stockpile topsoil within drip line of remaining trees.
  - 3. Dispose of excess topsoil as specified for waste material disposal.
  - 4. Stockpile surplus topsoil to allow for respreading a thicker layer of topsoil.

3.06

#### SITE IMPROVEMENTS

- A. Remove existing above and below grade improvements as indicated and as necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated on plans.
  - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
  - 2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.
- C. Remove existing fill. Refer to Geotechnical Investigation and/or drawings for information regarding suitability for re-use and estimates of location/extent of existing fill.

3.07

#### DISPOSAL

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
  - 1. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION 311000

**SECTION 312000**

**EARTHWORK**

**PART 1 - GENERAL**

**1.01 WORK INCLUDED**

- A. Furnish and Install:
  - 1. Excavation, including haul
  - 2. Fill
- B. Execute finish grades complete, as shown, and as specified.

**1.02 RELATED WORK**

- A. Section 329113 – Soil Preparation

**1.03 QUALITY ASSURANCE**

- A. Testing Agency: All soils testing during construction will be conducted by an approved testing laboratory.
- B. All materials and operations under this section of the Specifications shall be executed under the supervision of an Owner's Representative employed by the Owner who will place qualified personnel on the site during earthwork operations, as necessary. Provide free access to work sites and facilities at all times and provide the equipment and manpower necessary for the Owner's Representative to perform his work at no additional cost to the Owner.
- C. Regulatory Requirements: Applicable codes, ordinances and regulations of authorities having jurisdiction.

**1.04 REFERENCES**

- A. Reference Standards: Comply with:
  - 1. Compaction standard: Standard Proctor Density, ASTM D-698-78.

**1.05 SUBMITTALS**

- A. Test reports of soils testing during construction will be distributed by the testing laboratory and/or Owner's Representative.
- B. Method of work, including equipment to be used on the garage.

**1.06 LAYOUT AND SURVEY**

- A. Licensed Surveyor or Civil Engineer: Employ a licensed surveyor or civil engineer to stake out lines and levels.
- B. Discrepancies: Right is reserved to make minor adjustments as necessary if discrepancies are found.

1.07 PROJECT CONDITIONS

- A. General: Visit, inspect, and become familiar with the site and the work required under this Section.
- B. Existing Utilities:
  - 1. Locate all existing underground utilities and pipes in the areas of work.
  - 2. Should pipes or utilities be encountered during excavation which had not been located or were incorrectly located, consult the utility company immediately and provide assistance and cooperation in repairing and restoring the utility service.
  - 3. Do not interrupt any existing utility service, except after obtaining written permission from both the utility company and the Owner. Provide acceptable temporary utility services during these interruptions.

1.07 WARRANTY

- A. Fill and Backfill: Settlement in fill, or paving built over backfill or fill, which may occur within the two year warranty period shall be corrected at no cost to the Owner. Restore any structures damaged by settlement to their original condition at no cost to the Owner.

PART 2 - PRODUCTS

2.01 IMPORTED FILL

- A. General: Fill material shall be approved as to type by the Owner's Representative before placement.
- B. Fill Material: Refer to Section 02920 – Soil Preparation and Section 02232 Aggregate Base Course.

2.02 HAUL

The transportation of unusable excavated material from the work site to a disposal area is required. Haul will not be paid separately and should be included the earthwork removal cost.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Site Visit: Visit and inspect the site and take into consideration known or reasonably inferable conditions affecting the work. Failure to visit the site will not relieve the Contractor of furnishing materials or performing the work required.

3.02 PREPARATION

- A. Field Engineering: See the drawings for benchmarks, monuments, reference points and layout of the work.
- B. Protection:

1. Barricade open excavations occurring as part of this work and post warning lights. Provide barricades and warning lights as recommended by authorities having jurisdiction.
2. Adequately protect all structures, utilities, sidewalks, pavements, and other facilities existing prior to this work from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork.
3. Restore any structure or facility existing prior to this work which is damaged during completion of this work to a condition as good as or better than existed before the work commenced, regardless if the damage was caused accidentally or through carelessness. Restoration shall be approved by the Owner's Representative or other parties having jurisdiction over the facilities and shall be at no additional cost to the Owner.

3.03

EXCAVATION

- A. General: Excavate existing materials to the lines and grades indicated.

Excavation to be hauled off as part of infrastructure, utility trench, water, sewer, and storm sewer systems construction is required but will not be paid for in unclassified excavation.

Actual quantities will vary due to unknown top of structure elevations. No additional payment will be made for this earthwork and shall be paid as part of the work required for the related construction item.

The Contractor shall make excavations in such a manner and to such widths as will give suitable room for building the footers and walls and to such grades that the final grades will be in accordance with part 3.08 of this section, "Finish Grading". The Contractor shall furnish and place all sheeting, bracing and supports and shall do all pumping and draining; and shall render the bottom of excavations firm and dry in all respects acceptable for construction as determined by the soils engineer. All retaining systems and excavations shall be constructed in accordance with OSHA guidelines.

- B. Excess Material:  
The Fill quantities include a 10 % factor in volume loss to compensate for compaction of material above natural ground compaction levels.
- C. Methods of Excavation: All equipment and methods of work on the structure shall be submitted prior to any work.

3.06

FILLING

- A. General: Fill and compact to levels required to complete the work indicated. Filling may require soil material in excess of quantities estimated. Some material may require adjustment of moisture and rehandling before placement.
- B. Placing Fill: Distribute material to avoid formation of lenses or layers of material differing substantially from surrounding material. Deliver material at uniform rate to permit satisfactory procedure to result in well and uniformly compacted fill. Avoid unnecessary concentration of travel causing ruts and uneven compaction. Regrade and compact ruts and hollows more than 6 inches deep before compacting. Spread fill material in horizontal

layers not greater than 8 inches thickness of loose material to within optimum moisture limits described below.

C. Environmental Conditions:

1. Under no condition shall fill be placed on frozen soil nor shall frozen fill or fill containing snow or ice be placed. Fill shall be material having a temperature of 33° Fahrenheit or more.
2. Fill placement during inclement weather shall be as approved by the Geotechnical Engineer.
3. Due to the site location and planned construction period, freezing conditions may be expected in the fill. Develop fill placement techniques which will prevent frozen fill conditions from developing. Removal and replacement of frozen fill shall be at the Contractor's expense.

D. Fill Moisture Content: Distribute uniformly and consistently as possible throughout the fill material. The moisture content of the fill shall be as specified below and the fill shall be at the specified moisture content prior to placement.

1. Moisten fill material by the addition of water, if fill moisture contents are below the moisture contents specified. Aerate and dry the fill material if fill moisture contents are above those specified. The addition of water or additional drying of fill material may be allowed after placement, prior to compaction, so long as such procedures provide a uniform and consistent fill moisture content as designated by the Owner's Representative.

3.07 COMPACTION

A. Pavement Section:

1. The base course placed at pavements shall be uniformly placed and compacted in 4 to 6 inch loose lifts to at least 95 percent of the maximum modified Proctor density and within +/- 2 percent of optimum moisture content as determined by ASTM D-698/AASHTO T – 99.

B. Compaction: After the backfill material has been brought to the specified moisture content and placed in the prescribed lifts, the material shall be compacted using the compaction equipment submitted by the contractor and approved by the Structural Engineer.

3.08 DAMAGED OR UNUSABLE MATERIAL

A. Topsoil that has been rendered unfit to receive planting due to concrete water, mortar or lime water dumped on it shall be removed from the site and replaced with clean topsoil.

3.08 FINISH GRADING

A. All earthwork shall be carried out in such a manner that final grades, after construction of surface improvements shall conform to those shown on the site grading plan. The final earthwork shall be considered acceptable, providing all final grade elevations do not vary from the designed elevations by more than the following tolerances:

1. Subgrade Under Paving: Finish grade to bottom elevation of aggregate base course or other material to be placed. Tolerance: (+/-) 0.05 foot.

2. Subgrade Under Landscaped Areas: Finish grade to elevations indicated. Tolerance (+/-) 0.1 foot.

3.09 FINE GRADING – FINISH GRADE

- A. Grade smooth all planting areas after weeding, soil preparation, and soil conditioning have been completed and soil has been thoroughly water settled and prior to seeding or planting.
- B. Provide all grades for natural runoff of water without low spots or pockets. Accurately set flow line grades at 2% minimum gradient unless otherwise noted in Drawings. Finish grades shall pitch away from structures. In no case shall drainage from the project site be so altered or controlled as to result in damage from erosion or flooding, or the potential for damage, to adjacent property or to any portion of the work executed under this Contract.
- C. Finish grades shall be smooth, even and on a uniform plane with no abrupt changes of surface. Slope uniformly between given spot elevations.
- D. Grades not otherwise indicated shall be uniform levels or slopes between points where elevations are given, or between points established by walks, paving, curbs or catch-basins.
- E. Tops and toes of all slopes shall be rounded to produce a gradual and natural-appearing transition between relatively level areas and slopes.
- F. Prior to acceptance of grades, hand rake to smooth, even surface, free of debris, clods, rocks and vegetable matter greater than 0.5 inch.
- G. Grades:
  1. Finished Grades of Shrub and Groundcover Areas: 1 in. below top of adjacent pavement, headers, curbs, or walls unless otherwise indicated on the Drawings.
  2. Finished Grades of Lawn and Grass Areas: ½ in. below top of adjacent pavement, curbs or headers.

3.09 FIELD QUALITY CONTROL

- A. Placement Method: Obtain the Owner's Representative's approval of the method of placing and compacting before starting compacted fill or backfill placement.

3.10 CLEAN-UP

- A. Keep all areas of work clean, neat and orderly at all times.
- B. Clean up and remove all equipment, deleterious materials and debris from the entire work area prior to Final Acceptance.

**END OF SECTION**



**SECTION 321123**

**AGGREGATE BASE COURSE**

**PART 1 - GENERAL**

**1.01 WORK INCLUDED**

The work specified herein shall consist of furnishing and placing of Aggregate Base Course materials in conformity with the construction plans.

**1.02 RELATED WORK**

- A. Section 033021 – Cast-in-Place Concrete
- B. Section 321413 – Concrete Unit Pavers

**1.03 SUBMITTALS**

- A. An Aggregate Base Course sieve analysis shall be submitted by the Contractor for review by the Owner's Representative prior to delivery to the site:

**PART 2 - PRODUCTS**

**2.01 MATERIALS**

- A. Aggregate Base Course, where required or indicated in the plans and specifications, shall conform to the gradation standards for Class 6 Aggregate Base Course. Aggregates for bases shall be crushed stone, crushed slag, crushed gravel or natural gravel that conforms to the quality requirements of AASHTO M 147.

Gradation for Class 6 Aggregate Base Course:

<u>U.S. Standard Sieve Size</u>	<u>Percent by Weight Passing Square Mesh Sieves</u>
3/4 inch	100
No. 4	30 – 65
No. 8	25 - 55
No. 200	3 - 12

**2.02 EQUIPMENT**

- A. Equipment shall be capable of legally performing the WORK as described in this SPECIFICATION. Equipment that is inadequate to obtain the results specified shall be replaced or supplemented as required to meet the requirements of this SPECIFICATION. Any equipment that is used in an improper manner may be cause for rejection of the WORK if in the opinion of ENGINEER the WORK fails to meet the requirements of this specification.
- B. Equipment used for compaction shall be the rolling type, vibratory type, or combination of both types, and shall be of sufficient capacity to meet the compaction requirements herein.

PART 3 - EXECUTION

3.01 GENERAL

- A. Subgrade. An earth subgrade shall be prepared by removing all vegetation, excavating and removing all existing aggregate base course, filling depressions, scarifying, shaping, smoothing and compacting to meet the required grade, section and density. Stones over six (6) inches in greatest dimension shall be removed.
- B. Placing. If the required compacted depth of the aggregate base course exceeds 6 inches, it shall be constructed in two or more layers of approximately equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches. When vibratory or other approved types of special compacting equipment are used, the compacted depth of a single layer may be increased to 8 inches upon request, provided that specified density is achieved and written approval is given.
- C. Mixing. The Contractor shall mix the aggregate by methods that insure a thorough and homogenous mixture.
- D. Shaping and Compaction. Compaction of each layer shall continue until a density of not less than 95 percent of the maximum density determined in accordance with AASHTO T 180 has been achieved. The surface of each layer shall be maintained during the compaction operations so that a uniform texture is produced and the aggregates are firmly keyed. Water shall be uniformly applied during compaction in the quantity necessary for proper consolidation. The surface of the base course will be tested with a 10 foot straightedge, or other approved device. The surface shall be tested prior to the application of any primer or pavement. The variation of the surface from the testing edge of the straightedge between any two contacts with the surface shall not exceed ¼ inch. All irregularities exceeding the specified tolerance shall be corrected to the satisfaction of the Owner's Representative at no additional cost to the Owner.

The foundation shall be prepared and constructed such that it will have a uniform density throughout. It shall be brought to the required alignment and cross section with equipment and methods adapted for the purpose. Upon completion of the shaping and compacting operations, the foundation shall be smooth, at the required density, and at the proper elevation and contour to receive the aggregate base course.

- E. Compaction at Building Entry - Compaction rating for the replacement of aggregate base course at the entry terrace adjacent to the building doorway should not exceed 80 percent proctor density. Mechanical piping exists underground at the entry to the building, use extreme caution when compacting aggregate base course to protect the pipe. Hand held compaction shall be used in this area to not damage the piping. Discuss alternative compaction methods with Project Manager prior to execution for approval.

END OF SECTION

**SECTION 321313**  
**CONCRETE PAVING**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply if provided, to this Section.

**1.02 SUMMARY**

- A. This Section includes constructing exterior concrete paving on prepared subgrade or base course in accordance with these specifications. This work shall be in conformity with the lines, grades, thicknesses and typical cross-sections shown on the plans for the following:
  - 1. Sidewalks, steps, ramps.
  - 2. Base material for unit paver.
  - 3. As detailed on the plans.
- B. Related Sections include the following:
  - 1. Divisions 31 Section "Earth Moving" for subgrade preparation, grading, and subbase course.
  - 2. Division 32 Section "Pavement Marking" for pavement striping and symbols.
  - 3. Division 32 Section "Concrete Pavement Joint Sealants" for expansion and contraction joints.

**1.03 REFERENCES**

- A. City of Steamboat Springs Standard Specifications for Design and Construction, latest edition.
- B. Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, current edition.

**1.04 DEFINITIONS**

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, expansive hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.
- B. CDOT: State of Colorado Department of Transportation.
- C. CDOT Specifications: Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, current edition.
- D. ADA Handbook: Americans with Disabilities Act Standards for Accessible Design, U.S. Department of Justice.
- E. ANSI A117.1: Standard for Accessible and Usable Buildings and Facilities, American National Standard Institute.
- F. Refer to ACI 301: (American Concrete Institute – Standard Specifications for Structural Concrete), for additional definitions.

1.05

SUBMITTALS

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixes: For each concrete pavement mix, and includes alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:
  - 1. Aggregates.
  - 2. Cement.
  - 3. Admixtures.
- D. Material Certificates: Signed by manufacturers certifying that each of the following materials used in the project complies with requirements:
  - 1. Cementitious materials and aggregates.
  - 2. Steel reinforcement and reinforcement accessories.
  - 3. Admixtures.
  - 4. Curing compounds.
  - 5. Applied finish materials.
  - 6. Bonding agent or adhesive.
  - 7. Joint fillers.
- E. Field quality-control test reports.
- F. Pavement Joint Layout Plan: Plan to show joint locations and typical dimensions for review and approval by engineer.
- G. Traffic Control Plan: For work in the public right-of-way.

1.06

QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed pavement work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94/C 94 M requirements for production facilities and equipment.
  - 1. Manufacturer must be certified according to the National Ready Mix Concrete Association's (NRMCA) Plant Certification Program.
- C. Testing Agency Qualifications: An independent agency qualified according to ASTM C1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
  - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.

- E. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by the requirements of the Contract Documents.
- F. Concrete Testing Service: The Contractor will engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures. Preconstruction Conference: Conduct conference at project site as directed by Owner's Representative prior to start of construction. Contractor to comply with requirements, which may also be included in Division 1 Section "Project Management and Coordination."
- G. Regulatory Requirements:
- H. Comply with the City of Greenwood Village standards for sidewalks, curbs, ramps, gutters, and driveway approaches or aprons, including standard dimensions, profiles, thicknesses, reinforcing, and compressive strength. In the event of conflict between the Contract Documents and the standards, the more stringent requirements will apply.
  - 2. Comply with applicable requirements of ADA Handbook, ANSI A117.1, and local and State codes and ordinances regarding walks, steps, ramps and curb ramps.

1.07 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Coordination and Scheduling: Coordinate with other trades and arrange scheduling to avoid damage to other work including grading, site utilities and piping, asphalt paving, landscaping and irrigation systems.
- C. Field Measurements: Verify dimensions and existing conditions shown on the drawings by taking field measurements prior to start of work. Report discrepancies to the Owner's Representative for clarification and make minor adjustments in layout as required by field conditions and as approved by the Owner's Representative, at no additional cost to the Owner.
- D. Environmental Requirements: Perform work only under suitable weather conditions. Comply with the environmental requirements of Section 3.6 for concrete placement.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
  - 2. Products: Subject to compliance with requirements, provide one of the products specified.
  - 3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
  - 4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

## 2.02 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
  - 1. Use flexible or curved forms for curves of a radius 100 feet or less.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

## 2.03 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Fabric: CDOT Section 709 and ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- B. Reinforcement Bars: CDOT Section 709 and ASTM A 615/A 615M, Grade 60, deformed. Cut bars true to length with ends square and free of burrs.
- C. Joint Dowel Bars: Plain steel bars, CDOT Section 709 and ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.
- D. Tie Bars: CDOT Section 709 and ASTM A 615/A 615M, Grade 60, deformed.
- E. Supports for Reinforcement: Chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
  - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

## 2.04 EXPANSION JOINT FILLER

- A. Sealed Joints: Preformed, compressible fiber or cork filler material complying with ASTM D1751 or D1752, Type II, guaranteed compatible with expansion joint sealant materials, ½-inches thick unless otherwise indicated. Provide high-impact polystyrene removable "void cap" to create ½-inches deep reveal for installation of sealant.
- B. Self-Sealing Joints: Preformed, compressible asphalt fiber joint filler complying with ASTM D994, ½-inches thick unless otherwise indicated. Do not use asphalt fiber filler in joints to receive elastomeric joint sealants.

## 2.05 CONCRETE MATERIALS

- A. Cementitious Material: Use one of the following cementitious materials, of the same type, brand, and source throughout the Project:
  - 1. Portland Cement: CDOT Section 701 and ASTM C 150, Type I/II.
    - a. Fly Ash: ASTM C 618, Class C.
    - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: CDOT Section 703 and ASTM C 33, coarse aggregate, uniformly graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 3/4 inch (19 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
3. Do not use fine or coarse aggregates containing substances that cause spalling.

C. Water: CDOT Section 712 and ASTM C 94/C 94M potable.

2.06

#### ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures.
- B. Air-Entraining Admixture: CDOT Section 711 and ASTM C 260.
- C. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
  1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  4. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
  5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  7. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.07

#### FIBER REINFORCEMENT

- A. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1 to 2-1/4 inches long.

2.08

#### CURING MATERIALS: CDOT SECTION 711

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq.yd. (305 g/sq.m) dry.
- B. Moisture-Retaining Cover: ASTM C 171, waterproof paper, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
- E. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type I, Class B.
  8. Provide material that has a maximum volatile organic compound (VOC) rating of 350 g/L.
- F. White Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type II, Class B.
  1. Provide material that has a maximum volatile organic compound (VOC) rating of 350 g/L.

2.09

CONCRETE MIXTURES

- A. Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
  - 1. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the trial batch method.
  - 2. Do not use Owner's field quality-control testing agency as the independent testing agency.
- B. Proportion mixes to provide concrete with the following properties:
  - 1. Compressive Strength (28 Days): 4,500 psi
  - 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45
  - 3. Slump Limit: 4 inches (100 mm).
  - 4. Minimum 564 lb. Cement per cubic yard. (CDOT Class P)
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 4.0 to 7.0 percent.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
  - 1. Use water-reducing admixture and plasticizing and retarding admixture in concrete, as required, for placement and workability.
  - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- F. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals as follows:
  - 1. Fly Ash: 20 - 30 percent Class F Fly Ash CDOT Section 601.02, Class P Concrete.
- G. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd.
- H. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions.

2.10

CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116. Furnish batch certificates for each batch discharged and used in the Work.

PART 3 - EXECUTION

3.01

EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.



- B. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.
  - 1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph (5 km/h).
  - 2. Proof-roll with a loaded 10-wheel tandem-axle dump truck weighing not less than 15 tons.
  - 3. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch (13 mm) require correction according to requirements in Division 2 Section "Earth Moving."
- C. Subgrade shall be tested by Geotechnical Engineer and pass required tests prior to concrete pavement placement.
- D. Proceed with concrete pavement operations only after non-conforming conditions have been corrected and subgrade is ready to receive pavement.

3.02 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.03 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form release agent to ensure separation from concrete without damage.

3.04 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendations in CRSI's "Placing Reinforcing Bars" for placing and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 12-inch (300-mm) overlap of adjacent mats.

## 3.05

## JOINTS

- A. General: Construct/install construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
  - 1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.
  - 2. Contractor to provide plan of joint placement for the Engineers approval.
  - 3. The distance between joints shall not exceed in feet, one times the pavement thickness in inches. (i.e.: 7-inches PCC pavement to utilize maximum 7-foot joint spacing.)
  
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour, unless pavement terminates at expansion joints.
  - 1. Contractor may utilize preformed galvanized steel or plastic keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
  - 2. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
  - 3. Provide tie bars at sides of pavement strips where indicated.
  - 4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
  
- C. Expansion Joints: Form expansion joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
  - 1. Locate expansion joints in pavement where indicated on plans.
  - 2. Extend joint fillers full width and depth of joint.
  - 3. Terminate joint filler no less than 1/2 inch or no more than 1 inch below finished surface for joint sealant.
  - 4. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
  - 5. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
  
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
  - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groover tool to the indicated radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
  - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
  - 3. Tied Contraction Joints: Install deformed bars and support assemblies at joints where indicated.

3.06

CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.
- D. Comply with ACI 301 and ACI 304R requirements and recommendations for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery to the project site.
- F. Do not add water to fresh concrete after testing.
- G. Do not add water to concrete surface during finishing operations.
- H. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- I. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.
  - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- J. Screed pavement surfaces with a straightedge and strike off.
- K. Commence initial floating using bull floats or darbies to form an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading dry-shake surface treatments.
- L. Curbs and Gutters: Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified with expansion joints at intervals of approximately 100 feet and tooled contraction joints at 10-foot intervals. When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements.
- M. Walks: Minimum 4-inches thick, with expansion joints at intervals of approximately 100 feet and tooled contraction joints at intervals equal to width of walks or maximum 5-foot intervals. Tool edges to rounded profile and finish as noted herein or shown on the drawings. Contractor may utilize sawed contraction joints. Pitch walks 3/16-inches per foot for drainage unless otherwise indicated.
- N. Ramps: Construct ramps similar to walks. Comply with applicable ADA Handbook, ANSI A117.1, and local and State codes, ordinances, and details including maximum

allowable slope not to exceed 1 foot vertical in 12 foot horizontal, with maximum rise not to exceed 30-inches between level landings.

- O. Steps: Minimum 6-inches thick at intersection of treads and risers, reinforced as indicated. Slope treads 1/4-inches to nosing, and tool nosings to uniform 1/2-inches radius. Finish as specified below.
- P. Paving: Minimum 7-inches thick unless otherwise indicated. Provide expansion joints as indicated on the drawings, and contraction joints at a minimum 7-feet -0-inches EWW. Provide fibermesh reinforcing. Place concrete paving over compacted subgrade as specified in Division 2 Section "Earth Moving". Provide minimum 1% slope for drainage unless otherwise indicated.
- Q. Driveway Approaches: Minimum 7-inches thick, unless otherwise indicated or required by local public works standards or building codes. Construct to radius of flare indicated, and taper or warp into alignment with adjacent curbs, gutters, and walks. Place approaches over compacted subgrade as specified in Division 2 section "Earth Moving." Refer to drawing and details for any reinforcing requirements.
- R. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.  
  
Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.
- S. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.
- T. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  - 1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
  - 2. Do not use frozen materials or materials containing ice or snow.
  - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.
- U. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows when hot-weather conditions exist:
  - 1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  - 2. Cover reinforcement steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
  - 3. Fog-spray forms, reinforcement steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.
- V. Wet-Weather Placement: Do not begin to place concrete while rain, sleet, or snow is falling unless adequate protection is provided and, when required, acceptance of protection is obtained.

3.07

FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch (6-mm) radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.
- C. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots, and fill low spots. Refloat surface immediately to uniform granular texture.
  - 1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
  - 2. Medium-to-Course-Textured Broom Finish: For use on roadways and streets only. Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.
- D. Pigmented Mineral Dry-Shake Hardener Finish: After initial floating, apply dry-shake materials to pavement surface according to manufacturer's written instructions and as follows:
  - 1. Uniformly spread dry-shake hardener at a rate of 100 lb/100 sq. ft. (49 kg/10 sq. m), unless greater amount is recommended by manufacturer to match pavement color required.
  - 2. Uniformly distribute approximately two-thirds of dry-shake hardener over pavement surface with mechanical spreader, allow to absorb moisture, and embed by power floating. Follow power floating with a second dry-shake hardener application, uniformly distributing remainder of material at right angles to first application to ensure uniform color, and embed by power floating.
  - 3. After final floating, apply a hand-trowel finish followed by a broom finish to concrete.
  - 4. Cure concrete with curing compound recommended by dry-shake hardener manufacturer. Apply curing compound immediately after final finishing.

3.08

CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection and follow the recommendations of ACI 305R for hot-weather protection during curing.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- D. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moist Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
  - a. Water.
  - b. Continuous water-fog spray.
  - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inchlap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

### 3.09

#### PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:
  1. Elevation: 1/4 inch.
  2. Thickness: Plus 3/8 inch, minus 1/4 inch.
  3. Surface: Gap below 10-foot- long, unlevelled straightedge not to exceed 1/8 inch.
  4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
  5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
  6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
  7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
  8. Joint Spacing: 3 inches.
  9. Contraction Joint Depth: Plus 1/4 inch, no minus.
  10. Joint Width: Plus 1/8 inch, no minus.

### 3.10

#### FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
  1. Testing Frequency: Obtain at least 1 composite sample for each 50 cu. yd. or fraction thereof of each concrete mix placed each day.
    - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each type of concrete mix. Perform additional tests when concrete consistency appears to change.
  3. Air Content: ASTM C 231, pressure method; one test for each composite strength test, but not less than one test for each day's pour of each type of concrete mix.

4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each set of composite strength specimens.
  5. Compression Test Specimens: ASTM C 31/C 31M; one set of four standard cylinders for each compressive-strength test, unless otherwise indicated. Cylinders shall be molded and stored for laboratory-cured test specimens unless field-cured test specimens are required.
  6. Compressive-Strength Tests: ASTM C 39; one set for each day's pour of each concrete class exceeding 5 cu. yd., but less than 25 cu. yd., provide at least two tests for every 100 cu.yd., (one set for each 50 cu. yd.). One specimen shall be tested at 7 days and two specimens at 28 days; one specimen shall be retained in reserve for later testing if required.
  7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, current operations shall be evaluated and corrective procedures shall be provided for protecting and curing in-place concrete.
- C. Strength of each concrete mix will be satisfactory if average of any 3 consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
- D. Test results shall be reported in writing to Owner's Representative, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, concrete type and class, location of concrete batch in pavement, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Owner's Representative, but will not be used as the sole basis for approval or rejection.
- F. Additional Tests: Testing agency shall make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by Owner's Representative. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.
- G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.11

#### REPAIRS AND PROTECTION

- A. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet requirements in this Section.
- B. Drill test cores where directed by Owner's Representative when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.

- C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION



## SECTION 321413

### CONCRETE UNIT PAVERS

#### PART 1 GENERAL

##### 1.01 RELATED DOCUMENTS

- A. The General Contract Conditions, Drawings, and Division - 1 Specification sections, apply to Work of this section.

##### 1.01 DESCRIPTION

- A. Provide all labor, materials and equipment necessary to install new concrete unit paver sidewalks and plazas.

##### 1.02 RELATED SECTIONS

- A. Section 033000 – Cast-In-Place Concrete
- B. Section 321123 – Aggregate Base Course

##### 1.03 REFERENCES

American Society of Testing and Materials (ASTM):

- A. C 33, Specification for Concrete Aggregates.
- B. C 136, Method for Sieve Analysis for Fine and Coarse Aggregate.
- C. C 140, Sampling and Testing Concrete Masonry Units.
- D. C 144, Standard Specification for Aggregate for Masonry Mortar.
- E. C 936, Specification for Solid Interlocking Concrete Paving Units.
- F. C 979, Specification for Pigments for Integrally Colored Concrete.
- G. D 698, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 5.5-lb (2.49 kg) Rammer and 12 in. (305 mm) drop.
- H. D 1557, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 10-lb (4.54 kg) Rammer and 18 in. (457 mm) drop.
- I. D 2940, Graded Aggregate Material for Bases or Subbases for Highways or Airports.

##### 1.04 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in the manufacture of concrete interlocking pavers for a minimum of three (3) years.
- B. Contractor Warranty: Contractor shall provide a (3) year warranty on workmanship for the entire concrete unit paver system.
- C. Manufacturer Warrant: Company must supply a (3) year product warranty.
- D. Contractor & Manufacturer Warranty: The use of a deicer on the pavers shall not void either the manufacturer's or the contractor's warranty.
- E. Installation shall be by a contractor and crew with at least three (3) years of experience in placing interlocking concrete pavers on projects of similar nature or dollar cost.
- F. Installation Contractor shall conform to all local, state/provincial licensing and bonding requirements.

##### 1.05 SUBMITTALS

- A. Submit copies of product drawings and data in accordance with General Conditions.

- B. Submit full size sample sets of concrete paving units to indicate color and shape selections. Color will be selected by Landscape Architect/Owner from manufacturer's available colors.
- C. Submit sieve analysis for grading of bedding and joint sand.
- D. Submit test results from an independent testing laboratory for compliance of paving unit requirements to ASTM C 936.
- E. Indicate layout, pattern, and relationship of paving joints to fixtures and project formed details.
- F. Substitutions: Base bid shall not include substitutions. Substitution recommendations and associated cost savings can be submitted with bid as an alternate.
- G. Manufacturer's recommendations for winter maintenance. Provide product and application rates for snow and ice removal.

#### 1.06 MOCK-UPS

- A. Install a 7 ft. x 7 ft. (2 m x 2 m) paver area as described in Article 3.02. Contractor shall provide mock-up for each paver area. These area shall be the standard from which the work will be judged. Consideration shall be given with regard to differences in age of materials from time of mock-up erection to time of actual product delivery. Mock-ups shall not be part of the work.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver concrete pavers to the site in steel banded, plastic banded, or plastic wrapped cubes capable of transfer by fork lift or clamp lift. Unload pavers at job site in such a manner that no damage occurs to the product.
- B. Sand shall be covered with waterproof covering to prevent exposure to rainfall or removal by wind. The covering shall be secured in place.
- C. Coordinate delivery and paving schedule to minimize interference with normal use of buildings adjacent to paving.

#### 1.08 ENVIRONMENTAL CONDITIONS

- A. Do not install sand or pavers during heavy rain or snowfall.
- B. Do not install sand and pavers over frozen base materials.
- C. Do not install frozen sand.

### PART 2 PRODUCTS

#### 2.01 CONCRETE UNIT PAVERS

- A. Manufacturers
  - 1. Concrete pavers shall be supplied by Pavestone, Inc. , 9401 E. 96th Avenue Denver, CO 80640 303-287-3700, or Approved Equal.
  - 2. Pool pavers/coping shall be supplied by Tile Tech Pavers, sales@TileTechPavers.com, 213-380-5560 or Approved Equal.
- B. Product names/shape, color, overall dimensions, and thickness shall be:
  - 1. Primary Paver "Type A" - Vehicular rated: Holland Stone
    - a. Height: 80mm (3 1/8") thickness.
    - b. Size: 3 7/8" x 7 13/16"
    - c. Field Pattern: 45 degree Herring Bone

- d. Colors: Winter Blend
  - e. Finish: Parkway
  - f. Reference construction plans for pattern and layout
- 2. Primary Paver "Type A" - Pedestrian rated: Holland Stone
  - a. Height: 60mm (3 1/8") thickness.
  - b. Size: 2 3/8" x 7 13/16"
  - c. Field Pattern: 45 degree Herring Bone
  - d. Colors: Winter Blend
  - e. Finish: Parkway
  - f. Reference construction plans for pattern and layout
- 3. Secondary Paver Color: Holland Stone
  - a. Height: 60mm (3 1/8") thickness.
  - b. Size: 2 3/8" x 7 13/16"
  - c. Field Pattern: Running Bond
  - d. Colors: Palomino or other T.B.D.
  - e. Finish: Parkway
  - f. Reference construction plans for pattern and layout
- 4. Paver "Type B", Pool Paver: Cool-Roof or Granite-Tech Series T.B.D.
  - a. Height: 2" thickness.
  - b. Size: 12" x 24"
  - c. Field Pattern: Running Bond
  - d. Colors: T.B.D.
  - e. Reference construction plans for pattern and layout
- 5. Pool Paver: Pool Coping Series
  - a. Height: 3" thickness.
  - b. Size: 18" x 48"
  - c. Profile: Dropped Profile
  - d. Colors: T.B.D.
  - e. Reference construction plans for pattern and layout
- C. Pavers shall meet the following requirements set forth in ASTM C 936, Standard Specification for Interlocking Concrete Paving Units:
  - 1. Average compressive strength of 8,000 psi (55 MPa) with no individual unit under 7,200 psi (50 MPa).
  - 2. Average absorption of 5% with no unit greater than 7% when tested in accordance with ASTM C 140.
  - 3. Resistance to 50 freeze-thaw cycles when tested in accordance with ASTM C 67.
- D. Pigment in concrete pavers shall conform to ASTM C 979.
- E. Materials shall be manufactured in individual layers on production pallets.
- F. Materials shall be manufactured to produce a solid homogeneous matrix in the produced unit.

## 2.02 VISUAL INSPECTION

- A. All units shall be sound and free of defects that would interfere with the proper placing of units or impair the strength or permanence of the construction.

- B. Minor cracks incidental to the usual methods of manufacture, or chipping resulting from customary methods of handling in shipment and delivery, shall not be deemed grounds for rejection.

#### 2.03 SAMPLING AND TESTING

- A. Manufacturer shall provide a minimum of three (3) years testing backup data showing manufactured products that meet and exceed ASTM 936-82 when tested in compliance with ASTM C-140.

#### 2.04 BEDDING AND JOINT SAND

- A. Bedding and joint sand shall be clean, non-plastic, free from deleterious or foreign matter. The sand shall be natural or manufactured from crushed rock. Limestone screenings or stone dust shall not be used. When concrete pavers are subject to vehicular traffic, the sands shall be as hard as practically available.
- B. Grading of sand samples for the bedding course and joints shall be done according to ASTM C 136. The bedding sand and joint sand shall conform to the grading requirements of ASTM C 33 as shown in Table 1.

Table 1  
Grading Requirements for Bedding Sand

ASTM C 33

<u>Sieve Size</u>	<u>Percent Passing</u>
3/8 in. (9.5 mm)	100
No. 4 (4.75 mm)	95 to 100
No. 8 (2.36 mm)	85 to 100
No. 16 (1.18 mm)	50 to 85
No. 30 (600 µm)	25 to 60
No. 50 (300 µm)	10 to 30
No. 100 (150 µm)	2 to 10

#### 2.07 PAVER EDGE RESTRAINT

- A. StructurEdge, aluminum paver edging, by Permaloc, 800.356.9660 or approved equal. Refer to manufacturers instructions for installation.

#### 2.08 GEOTEXTILE FABRIC

- A. Mirafi 500X Interlocking Concrete Paver Stabilization Geotextile, by Mirafi, 888.795.0808 or approved equal.

#### 2.09 PAVER SEALER

- A. Natural Look Concrete Paver Sealer (iN) by Techniseal, 800.465.7352 or approved equal.

#### 2.10 PAVER DE-ICING CHEMICALS

- A. Recommended Manufactures include; Meltsnow.com, Kissner Group, Landscapers Choice, Green-ice, Enviromelt or approved equal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that all systems are operable and in working condition or prove operability in the future prior to installation of snowmelt paver section. Pressure test, video inspection, pull actual wiring, etc.- provide necessary testing to insure operable systems.
- B. Verify that subgrade preparation, compacted density and elevations conform to the specifications. Compaction of the soil subgrade to at least 95% Standard Proctor Density per ASTM D 698 is recommended. Stabilization of the subgrade and/or base material may be necessary with weak or saturated subgrade soils. Bobcat and surface tractors shall be used for compaction. Hand held equipment shall be used at entrance doors near underground piping. Coordinate with Owner for approval of equipment to be used. The Owner’s Representative should inspect subgrade preparation, elevations, and conduct density tests for conformance to specifications.
- D. Verify that aggregate base materials, thickness, compaction, surface tolerances, and elevations conform to the specifications. Verify that geotextile fabric has been installed in accordance with manufacturer’s recommendation and as indicated in the plans.
- E. Verify location, type, installation and elevations of edge restraints around the perimeter area to be paved.
- F. Verify that base is dry, uniform, even, and ready to support sand, pavers, and imposed loads.
- G. Beginning of bedding sand and paver installation means acceptance of base and edge restraints.

3.02 SAND BED INSTALLATION

- A. Spread the sand evenly over the base course and screed to a nominal 2 in. thickness. The screeded sand should not be disturbed. Place sufficient sand to stay ahead of the laid pavers. Do not use the bedding sand to fill depressions in the base surface.
- B. Install paver edge restraint as indicated on construction plans and according to manufacturer’s instructions.
- C. Ensure that pavers are free of foreign materials before installation.
- D. Lay the pavers in the pattern(s) as shown on the construction plans. Maintain straight pattern lines.
- E. Joints between the pavers on average shall be between 1/16 in. and 3/16 in. (2 mm to 5 mm) wide.
- F. Fill gaps at the edges of the paved area with cut pavers or edge units.
- G. Cut pavers to be placed along edge with a double blade paver splitter or masonry saw.
- H. Use a low amplitude, high frequency plate vibrator to vibrate the pavers into the sand. Use Table 3 below to select size of compaction equipment:

Table 3

<u>Paver Thickness</u>	<u>Minimum Centrifugal Compaction Force</u>
------------------------	---

60 mm	3000 lbs. (13 kN)
80 mm	5000 lbs. (22 kN)

- I. Vibrate the pavers, sweeping dry joint sand into the joints and vibrating until they are full. This will require at least two or three passes with the vibrator. Do not vibrate within 3 ft. (1 m) of the unrestrained edges of the paving units.
- J. All work to within 3 ft. (1 m) of the laying face must be left fully compacted with sand-filled joints at the completion of each day.
- K. Post compaction, spread and sweep dry joint sand into joints continuously until full. Repeat sweeping in both directions. Wet joint sand to completely fill paving unit joints if required.
- L. Sweep off excess sand when the job is complete.
- L. The final surface elevations shall not deviate more than 3/8 in. (10 mm) under a 10 ft. (3 m) long straightedge.
- M. The surface elevation of pavers shall be 1/8 in. to 1/4 in. (3 to 6 mm) above adjacent drainage inlets, concrete collars or channels.
- N. The surface elevation of pavers shall be flush with all adjacent concrete curb and gutter, concrete steps, concrete bands, and building entrances. Final elevations of all concrete pavers shall match existing elevations at all building faces, steps, and miscellaneous building or site materials to remain unless otherwise noted. The final elevations shall not deviate more than 1/4".
- O. The re-sanding as necessary of paver joints shall be accomplished by contractor for a period of 90 days after completion of work.
- P. The paver surface shall have positive drainage and shall be slope away from building and site walls as indicated on the drawings and field directed by the Owner's Representative.

### 3.03 FIELD QUALITY CONTROL AND COMPLETION

- A. After removal of excess sand and mortar, check final elevations for conformance to the drawings.
- B. Contractor shall provide owner with 25 (twenty-five) additional concrete unit pavers in each style, size, and color to match installation. Additional pavers shall be provided to Owner in accordance with 1.07.

END OF SECTION

**SECTION 32 14 13.13**

**CONCRETE UNIT PAVERS FOR ROOF PLAZA DECKS**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. Section Includes
  - 1. Concrete paver units.
  - 2. Bedding and joint materials.
  - 3. Geotextiles.
  - 4. Cleaning and Sealing
- B. Related Sections
  - 1. Section 071413 – Hot Fluid-Applied Rubberized Asphalt Waterproofing
  - 2. Section 321313 – Concrete Paving

**1.02 REFERENCES**

- A. American Society of Testing and Materials (ASTM):
  - 1. C 33, Specification for Concrete Aggregates.
  - 2. C 136, Method for Sieve Analysis for Fine and Coarse Aggregate.
  - 3. C 140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
  - 4. C 144, Standard Specification for Aggregate for Masonry Mortar.
  - 5. C 936, Specification for Solid Interlocking Concrete Paving Units.
  - 6. C 979, Standard Specification for Pigments for Integrally Colored Concrete.
  - 7. C 1645, Standard Test Method for Freeze-thaw and De-icing Salt Durability of Solid Concrete Interlocking Paving Units.
  - 8. D 448, Standard Classification of Sizes of Aggregate for Road and Bridge Construction.
- B. Interlocking Concrete Pavement Institute (ICPI)
  - 1. ICPI Tech Spec Technical Bulletins

**1.03 SUBMITTALS**

- A. In accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
- B. Manufacturer's drawings and details: Indicate perimeter conditions, relationship to adjoining materials and assemblies, expansion and control joints, concrete paver layout, patterns, color arrangement, installation and setting details.
- C. Sieve analysis per ASTM C 136 for grading of bedding and joint materials.
- D. Concrete pavers:
  - 1. Four representative full-size samples of each paver type, thickness, color, finish that indicate the range of color variation and texture expected in the finished installation. Colors selected by Landscape Architect from manufacturer's available colors.
  - 2. Accepted samples become the standard of acceptance for the work.
  - 3. Test results from an independent testing laboratory for compliance of paving unit requirements to ASTM C 936.
  - 4. Manufacturer's certification of concrete pavers by ICPI as having met applicable ASTM standards.
  - 5. Manufacturer's catalog product data, installation instructions, and material safety data sheets for the safe handling of the specified materials and products.
- E. Paver Installation Subcontractor:
  - 1. A copy of Subcontractor's current certificate from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program.
  - 2. Job references from projects of a similar size and complexity. Provide Owner/Client/General Contractor names, postal address, phone, fax, and email address.

1.04 QUALITY ASSURANCE

- A. Paving Subcontractor Qualifications:
  - 1. Utilize an installer having successfully completed concrete paver installation similar in design, material, and extent indicated on this project.
  - 2. Utilize an installer holding a current certificate from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program.
- B. Mock-Ups:
  - 1. Install a 7 ft x 7 ft (2 x 2 m) paver area.
  - 2. Use this area to determine surcharge of the bedding material layer, joint sizes, lines, laying patterns, colors, and texture of the job.
  - 3. This area will be used as the standard by which the work will be judged.
  - 4. Subject to acceptance by owner, mock-up may be retained as part of finished work.
  - 5. If mock-up is not retained, remove and properly dispose of mock-up.

1.05 DELIVERY, STORAGE & HANDLING

- A. General: Comply with Division 1 Product Requirement Section.
- B. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers packaging with identification labels intact.
  - 1. Coordinate delivery and paving schedule to minimize interference with normal use of buildings adjacent to paving.
  - 2. Deliver concrete pavers to the site in steel banded, plastic banded or plastic wrapped packaging capable of transfer by fork lift or clamp lift.
  - 3. Unload pavers at job site in such a manner that no damage occurs to the product.
- D. Storage and Protection: Store materials protected such that they are kept free from mud, dirt, and other foreign materials. Store concrete paver cleaners and sealers per manufacturer's instructions.
  - 1. Cover bedding sand and joint sand with waterproof covering if needed to prevent exposure to rainfall or removal by wind. Secure the covering in place.

1.06 PROJECT/SITE CONDITIONS

- A. Environmental Requirements:
  - 1. Do not install aggregate bedding materials or pavers during heavy rain or snowfall.
  - 2. Do not install frozen sand or saturated aggregate bedding materials.
  - 3. Do not install concrete pavers on frozen or saturated aggregate bedding materials.

1.07 MAINTENANCE

- A. Extra Materials: Provide a total of 25 (twenty-five) additional concrete unit pavers in each style, size, and color to match installation for use by owner for maintenance and repair.
- B. Pavers shall be from the same production run as installed materials.

PART 2 - PRODUCTS

2.01 CONCRETE PAVERS

- A. Manufacturer: Reference 321413 - Concrete Unit Pavers
- B. Interlocking Concrete Paver Units, including the following:  
Product names/shape, color, overall dimensions, and thickness shall be:
  - 1. Reference 321413 - Concrete Unit Pavers



## 2.02 BEDDING AND JOINT MATERIALS

- A. Provide bedding and joint sand as follows:
1. Washed, clean, non-plastic, free from deleterious or foreign matter, symmetrically shaped, natural or manufactured from crushed rock.
  2. Do not use limestone screenings or stone dust.
  3. Sieve according to ASTM C 136.
  4. Bedding Material Requirements: Conform to the grading requirements as shown in Table 1.

Table 1 Grading Requirements for Bedding Materials	
No. 89 (per ASTM D 448)	
Sieve Size	Percent Passing
3/8 in. (9.5 mm)	90 to 100
No. 4 (4.75 mm)	20 to 55
No. 8 (2.36 mm)	5 to 30
No. 16 (1.18 mm)	0 to 10
No. 50 (0.300 mm)	0 to 5

- A. Joint Sand Material Requirements: Conform to the grading requirements of modified ASTM C 33 bedding material as indicated in Table 2 below.

Table 2 Grading Requirements for Joint Sand ASTM C 33	
Sieve Size	Percent Passing
3/8 in.(9.5 mm)	100
No. 4 (4.75 mm)	95 to 100
No. 8 (2.36 mm)	85 to 100
No. 16 (1.18 mm)	50 to 85
No. 30 (0.600 mm)	25 to 60
No. 50 (0.300 mm)	10 to 30
No. 100 (0.150 mm)	2 to 10
No. 200 (0.075 mm)	0 to 1

## 2.04 ACCESSORIES

- A. Provide accessory materials as follows:
1. Geotextile Fabric:
    - a. Material Type and Description: Mirafi 500X Inerlocking Concrete Paver Stabilization Geotextile by Mirafi, 888.795.0808 or approved equal.
  2. Sealer
    - a. Material Type and Description: Natural Look Concrete Paver Sealer (iN) by Techniseal, 800.465.7352 or approved equal

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Acceptance of Site Verification of Conditions:
1. General Contractor shall inspect, accept and certify in writing to the paver installation subcontractor that roof conditions meet specifications for the following items prior to installation of interlocking concrete pavers.
    - a. Verify that geotextiles, if applicable, have been placed according to drawings and specifications.
    - b. Verify that roof deck materials, thickness, surface tolerances and elevations conform to specified requirements.

- c. Provide written test results for roof deck materials to the Owner, General Contractor and paver installation subcontractor.
- d. Verify location, type, and elevations of edge restraints, drains, drain holes, and inlets.
- 2. Do not proceed with installation of bedding sand and interlocking concrete pavers until roof conditions are corrected by the General Contractor or designated subcontractor.

### 3.02 PREPARATION

- A. Verify that all surfaces, membrane(s), protection board, insulation, and drains, are free from dirt, oil, grease or any deleterious substances and debris that may prevent installation, drainage, and stability of the paver installation.
- B. Verify that roof has a minimum of [2%] slope to drains. Verify roof deck is clean and dry, and certified by General Contractor as meeting material, installation and grade specifications.
- C. Verify that roof deck [and geotextile] is ready to support sand, [edge restraints,] and, pavers and imposed loads.
- D. Edge Restraint Preparation:
  - 1. Install edge restraints per the drawings and manufacturer's recommendations at the indicated elevations.

### 3.03 INSTALLATION

- A. Spread geotextile and turn up at sides of installation against parapets and protrusions in the roof. Overlap downslope a minimum of 12 in. (30 cm) [as indicated on the drawings].
- B. Apply geotextile over the surface of the washed no. 57 stone and turn up vertically against it to prevent migration of bedding sand. Allow an extra 12 in. (30 cm) length at perimeters to fold over and capture bedding sand layer at edges. Place under pavers at perimeter of installation.
- C. Spread the bedding materials evenly over the geotextile and screed to a nominal 1 in. (25 mm) thickness.
  - 1. Do not disturb screeded sand.
  - 2. Screeded area shall not substantially exceed that which is covered by pavers in one day.
  - 3. Do not use bedding sand to fill depressions in the deck surface.
- D. Lay pavers in pattern(s) shown on drawings. Place units hand tight without using hammers. Make horizontal adjustments to placement of laid pavers with rubber hammers and pry bars as required.
- E. Provide joints between pavers between 1/16 in. and 3/16 in. (2 and 5 mm) wide. No more than 5% of the joints shall exceed [1/4 in. (6 mm)] wide to achieve straight bond lines.
- F. Joint (bond) lines shall not deviate more than  $\pm 1/2$  in. ( $\pm 15$  mm) over 50 ft. (15 m) from string lines.
- G. Fill gaps at the edges of the paved area with cut pavers or edge units.
- H. Cut pavers to be placed along the edge with a double blade paver splitter or masonry saw.
- I. Adjust bond pattern at pavement edges such that cutting of edge pavers is minimized. All cut pavers exposed to vehicular tires shall be no smaller than one-third of a whole paver. Cut pavers at edges as indicated on the drawings.
- J. Keep skid steer and forklift equipment off newly laid pavers that have not received initial compaction and joint materials.
- K. Use a low-amplitude plate compactor capable of at least minimum of 4,000 lbf (18 kN) at a frequency of 75 to 100 Hz to vibrate the pavers into the bedding materials.
- L. Inspect the drainage under a compacted area to be sure it is not crushed from compaction,]
- M. Remove any cracked or damaged pavers and replace with new units.
- N. Simultaneously spread, sweep and compact dry joint sand into joints continuously until full. This will require at least 4 to 6 passes with a plate compactor. Do not compact within 6 ft (2 m) of unrestrained edges of paving units.
- O. All work within 6 ft. (2 m) of the laying face must shall be left fully compacted with sand-filled joints at the end of each day or compacted upon acceptance of the work.
- P. Cover the laying face or any incomplete areas with plastic sheets overnight if not closed with cut and compacted pavers with joint materials to prevent exposed bedding sand from becoming

saturated from rainfall.

- Q. Remove excess sand from surface when installation is complete.
- R. Surface shall be broom clean after removal of excess joint sand.

3.04 FIELD QUALITY CONTROL

- A. The final surface tolerance from grade elevations shall not deviate more than  $\pm 3/8$  in. ( $\pm 10$  mm) under a 10 ft (3 m) straightedge.
- B. Check final surface elevations for conformance to drawings.
- C. The surface elevation of pavers shall be 1/8 in. to 1/4 in. (3 to 6 mm) above adjacent drainage inlets, concrete collars or channels.
- D. Lippage: No greater than 1/8 in. (3 mm) difference in height between adjacent pavers.

3.05 CLEANING & SEALING

- A. Clean & Seal concrete pavers in accordance with the manufacturer's written recommendations.

3.06 PROTECTION

- A. After work in this section is complete, the General Contractor shall be responsible for protecting work from damage due to subsequent construction activity on the site.

END OF SECTION

## **SECTION 328000**

### **IRRIGATION SYSTEM**

#### **PART 1 - GENERAL**

**1.01 WORK INCLUDED** - Work of this Section generally includes provisions for the installation of an underground landscape irrigation system including the following:

- A. Static pressure verification and coordination of irrigation system installation with landscape material installation.
- B. Trenching, stockpiling excavation materials, refilling and compacting trenches.
- C. Complete irrigation system including but not limited to piping, backflow preventer assemblies, valves, fittings, heads, controllers and wiring, and final adjustments to insure complete coverage.
- D. Water connections.
- E. Replacement of unsatisfactory materials.
- F. Clean-up, Consultant Reviews, and Project Acceptance.
- G. Tests.

#### **1.02 RELATED SECTIONS**

- A. Examine all sections related to project work.

#### **1.03 REFERENCES**

- A. Perform Work in accordance with requirements of Conditions of the Contract and Division 01 - General requirements as well as provisions of all applicable laws, codes, ordinances, rules, and regulations.
- B. Conform to requirements of reference information listed below except where more stringent requirements are shown or specified in Contract Documents.
  - 1. American Society for Testing and Materials (ASTM) - Specifications and Test Methods specifically referenced in this Section.
  - 2. Underwriters Laboratories (UL) - UL Wires and Cables.

#### **1.04 QUALITY ASSURANCE**

- A. Installer Qualifications - Installer shall have had considerable experience and demonstrate ability in the installation of irrigation system(s) of specific type(s) in a neat orderly, and responsible manner in accordance with recognized standards of workmanship. To demonstrate ability and experience necessary for this Project, and financial stability, submit if requested by Consultant, prior to contract award the following:
  - 1. List of 3 projects completed in the last 2 years of similar complexity to this Project. Description of projects shall include:

- a. Name of project.
- b. Location.
- c. Owner.
- d. Brief description of work and project budget.

**B. Special Requirements:**

- 1. Work involving substantial plumbing for installation of copper piping, backflow preventer(s), and related work shall be executed by licensed and bonded plumber(s). Secure a permit at least 48 hours prior to start of installation.
- 2. Tolerances - Specified depths of mains and laterals and pitch of pipes are minimums. Settlement of trenches is cause for removal of finish grade treatment, refilling, compaction, and repair of finish grade treatment.
- 3. Coordination with Other Contractors - Protect, maintain, and coordinate Work with Work under other Section.
- 4. Damage To Other Improvements - Contractor shall replace or repair damage to grading, soil preparation, seeding, sodding, or planting done under other Sections during Work associated with installation of irrigation system at no additional cost to Owner.

**C. Pre-Construction Conference - Contractor shall schedule and conduct a conference to review in detail quality control and construction requirements for equipment, materials, and systems used to perform the Work. Conference shall be scheduled not less than 10 days prior to commencement of Work. All parties required to be in attendance shall be notified no later than 7 days prior to date of conference. Contractor shall notify qualified representatives of each party concerned with that portion of Work to attend conference, including but not limited to Architect, Consultant, Contractor's Superintendent, and Installer.**

- 1. Minutes of conference shall be recorded and distributed by Contractor to all parties in attendance within five days of conference.

**1.05 SUBMITTALS - Prepare and make submittals in accordance with conditions of the Contract.**

**A. Materials List - Submit six copies of a complete materials list indicating manufacturer, model number, and description of all materials and equipment to be used. Show appropriate dimensions and adequate detail to accurately portray intent of construction.**

**B. Record Drawings (As-Built):**

- 1. At onset of irrigation installation secure Autocadd files of original irrigation design from Owner. At the end of every day, revise as-built prints for work accomplished that day in red ink. As-built field prints shall be brought up-to-date at the close of the working day every Friday by a qualified draftsman. A print of record plan(s) shall be available at Project Site. Indicate zoning changes on weekly as-built drawings. Indicate non-pressure piping changes on as-built. Upon completion of Project, but prior to scheduling of substantial acceptance walk-through, submit for review a final set of as-built mylars and an Autocadd disk copy. Dimensions, from two permanent points of reference (building corners, sidewalk, road intersections or permanent structures), location of following items:
  - a. Connection to existing water lines.
  - b. Routing of sprinkler pressure lines (dimension maximum 100 feet along routing).
  - c. Sprinkler control valves.
  - d. Quick coupling valves.
  - e. Manual drains and stop and waste valves.
  - f. Drip line blow-out stubs.
  - g. Control wire routing if not with pressure mainline.
  - h. Gate valves.
  - i. Control wire and communication cable splices

- j. Water meters
  - k. Locations of all sleeving including size, quantity and depth of sleeve
  - l. Flow sensors
  - m. Pressure regulating valves
- 2. Owner's Representative will not certify any pay request submitted by the Contractor if the as-built drawings are not current, and processing of pay request will not occur until as-builts are up-dated.
- C. Operation Instructions - Submit 3 written operating instructions including winterization procedures and start-up, with cut sheets of products, and coordinate controller/watering operation instruction with Owner maintenance personnel.
  - 1. Controller Charts:
    - a. Do not prepare charts until Consultant has reviewed record (as-built) drawings.
    - b. Provide one controller chart for each automatic controller installed.
      - 1) Chart may be reproduction of record drawing, if scale permits fitting of controller door. If photo reduction prints are required, keep reduction to maximum size possible to retain full legibility.
      - 2) Chart shall be blueline print of actual "as-built" system, showing area covered by that controller.
    - c. Identify area of coverage of each remote control valve, using a distinctly different pastel color drawing over entire area of coverage.
    - d. Following review of charts by Consultant, they shall be hermetically sealed between two layers of 20-mm thick plastic sheet
    - e. Charts shall be completed and reviewed prior to final review of irrigation system.

**1.06 DELIVERY, STORAGE, AND HANDLING** - Deliver, unload, store, and handle materials, packaging, bundling, products in dry, weatherproof, condition in manner to prevent damage, breakage, deterioration, intrusion, ignition, and vandalism. Deliver in original unopened packaging containers prominently displaying manufacturer's name, volume, quantity, contents, instructions, and conformance to local, state, and federal law. Remove and replace cracked, broken, or contaminated items or elements prematurely exposed to moisture, inclement weather, snow, ice, temperature extremes, fire, or jobsite damage.

- A. Handling of PVC Pipe - Exercise care in handling, loading and storing, of PVC pipe. All PVC pipe shall be transported in a vehicle that allows length of pipe to lie flat so as not to subject it to undue bending or concentrated external loads. All sections of pipe that have been dented or damaged shall be discarded, and if installed, shall be replaced with new piping.

**1.07 JOBSITE CONDITIONS:**

- A. Protection of Property:
  - 1. Preserve and protect all trees, plants, monuments, structures, and paved areas from damage due to Work of this Section. In the event damage does occur, all damage to inanimate items shall be completely repaired or replaced to satisfaction of Owner, and all injury to living plants shall be repaired by Owner. All costs of such repairs shall be charged to and paid by Contractor.
  - 2. Protect buildings, walks, walls, and other property from damage. Flare and barricade open ditches. Damage caused to asphalt, concrete, or other building material surfaces shall be repaired or replaced at no cost to Owner. Restore disturbed areas to original condition.
- B. Existing Trees:
  - 1. All trenching or other Work under limb spread of any and all evergreens or low branching deciduous material shall be done by hand or by other methods so as to prevent damage to

limbs or branches.

2. Where it is necessary to excavate adjacent to existing trees use all possible care to avoid injury to trees and tree roots. Excavation, in areas where 2 inch and larger roots occur, shall be done by hand. Roots 2 inches or larger in diameter, except directly in the path of pipe of conduit, shall be tunneled under and shall be heavily wrapped with burlap to prevent scarring or excessive drying. Where a trenching machine is operated close to trees having roots smaller than 2 inches in diameter, wall of trench adjacent to tree shall be hand trimmed, making clean cuts through roots. Trenches adjacent to trees shall be closed within 24 hours, and when this is not possible, side of trench adjacent to tree shall be kept shaded with moistened burlap or canvas.

C. Protection and Repair of Underground Lines:

1. Request proper utility company to stake exact location (including depth) of all underground electric, gas, or telephone lines. Take whatever precautions are necessary to protect these underground lines from damage. If damage does occur, Utility Owner shall repair all damage. Contractor shall pay all costs of such repairs unless other arrangements have been made.
2. Request Owner, in writing, to locate all private utilities (i.e., electrical service to outside lighting) before proceeding with excavation. If, after such request and necessary staking, private utilities that were not staked are encountered and damaged by Installer, Owner shall repair them at no cost to Installer. If Contractor damages staked or located utilities, they shall be repaired by Utility Owner at Contractor's expense unless other arrangements have been made.

- D. Replacement of Paving and Curbs - Where trenches and lines cross existing roadways, paths, curbing, etc., damage to these shall be kept to a minimum and shall be restored to original condition.

**1.08 WARRANTY/GUARANTY:** - Manufacturer shall warrant materials against defects for a period of one year from date of Substantial Completion. Installer(s) shall guaranty workmanship for similar period.

- A. Settling of backfilled trenches that may occur during guaranty period shall be repaired at no expense to Owner, including complete restoration of damaged property.
- B. Expenses due to vandalism before substantial completion shall be borne by Contractor.
- C. Owner will maintain turf and planting areas during warranty period, so as not to hamper proper operation of irrigation system.

**1.09 MAINTENANCE:**

- A. Furnish the following maintenance items to Owner prior to final Acceptance:
  1. Two Sets of special tools required for removing, disassembling, and adjusting each type of sprinkler head and valve supplied on this Project.
  2. One eight foot valve key for operation of stop and waste valve.
  2. Two six foot valve keys for operation of gate valves.
  3. Two keys for each automatic controller.
  4. Two quick coupler keys and two matching hose swivels for each type of quick coupling valve installed.
  5. Two aluminum drain valve keys of sufficient length for operation of drain valves.
- B. Winterization - include cost in bid for winterizing complete system at conclusion of sprinkling season (in which system received final acceptance) within 3 days notification by the Owner. System shall be voided of water using compressed air or similar method reviewed by Consultant. Reopen, operate, and adjust system malfunctions accordingly during April of following season within 3 days of

notification by Owner.

**1.10 EXTRA STOCK** - In addition to installed system furnish the following items to Owner:

- A. 10 Pop-up spray heads with nozzles of each type used.
- B. 4 Rotor heads of each type used.
- C. 30 Drip emitters of each type used.
- D. 2 Single Station Decoders

**PART 2 - PRODUCTS**

**2.01 MATERIALS:**

A. General Piping:

- 1. Pressure Supply Line (from point of connection through backflow prevention unit) - Type "k" Hard Copper (3/4" – 2 1/2").
- 2. Pressure Supply Lines (downstream of backflow prevention units) - Class 200 PVC BE (1" - 2 1/2").
- 3. Non-pressure Lines - 100 PSI NSF Polyethylene.
- 4. PVC Sleeving - Class 160 PVC.
- 5. Drip Tubing - Toro Dura-Pol EHD 1645 3/4" with .050 inch wall thickness.
- 6. Emitter Tubing - As recommended by emitter manufacturer.

B. Copper Pipe and Fittings:

- 1. Copper Pipe - Type K, hard tempered.
- 2. Fittings - Wrought copper, solder joint type.
- 3. Joints - Soldered with solder, 45% silver, 15% copper, 16% zinc, and 24% cadmium and solidus at 1125~F and liquids at 1145~F.

C. Brass Pipe and Fittings:

- 1. Brass Pipe - 85% red brass, ANSI Schedule 40 screwed pipe.
- 2. Fittings - Medium brass, screwed 125-pound class.

D. Plastic Pipe and Fittings:

- 1. Identification Markings:
  - a. Identify all pipe with following indelible markings:
    - 1) Manufacturer's name.
    - 2) Nominal pipe size.
    - 3) Schedule of class.
    - 4) Pressure rating.
    - 5) NSF (National Sanitation Foundation) seal of approval.
    - 6) Date of extrusion.
- 2. Solvent Weld Pipe - Manufactured from virgin polyvinyl chloride (PVC) compound in accordance with ASTM D2241 and ASTM D1784; cell classification 12454-B, Type 1, Grade 1.
  - a. Fittings - Standard Wright, Schedule 40, injection molder PVC; complying with ASTM D1784 and D2466, cell classification 12454-B.



- 1) Threads - Injection molded type (where required).
- 2) Tees and ells - Side gated.
- b. Threaded Nipples - ASTM D2464, Schedule 80 with molded threads.
- c. Teflon Tape – All PVC male threaded fittings and nipples, excluding marlex fittings, shall receive wrapping of Teflon tape applied to threaded surfaces per pipe manufacturer's recommendations.
- d. Joint Cement and Primer - Type as recommended by manufacturer of pipe and fittings.
3. Gasketed End Pipe - Manufactured from virgin Polyvinyl Chloride compound in accordance with ASTM D2241 and ASTM D1784; cell classification 1254-B, Type 1, Grade 1.
  - a. Fittings and Services Tees (3" and larger) - Ductile iron, grade 70-55-05 in accordance with ASTM A-536. Fittings shall have deep bell push-on joints with gaskets meeting ASTM F-477.
  - b. Gaskets - Factory installed in pipe and fittings, having a metal or plastic support within gasket or a plastic retainer ring for gasket.
  - c. Lubricant - As recommended by manufacturer of pipe fittings.
4. Flexible Plastic Pipe - Manufactured from virgin polyethylene in accordance with ASTM D2239, with a hydrostatic design stress of 630 psi and designated as PE 2306.
  - a. Fittings – Insert type manufactured in accordance with ASTM D2609; PVC Type 1 cell classification 12454-B.
  - b. Clamps - All stainless steel worm gear screw clamps. Use 2 clamps per joint on 1-1/2 inch and 2 inch fittings.

F. Drip and Sub-Surface Irrigation Systems:

1. Drip Tubing - Manufactured of flexible vinyl chloride compound conforming to ASTM D1248, Type 1, Class C, Category 4, P14 and ASTM D3350 for PE 122111C.
2. Fittings - Type and diameter recommended by tubing manufacturer.
3. Drip Valve Assembly - Type and size shown on Drawings.
  - a. Wye Strainer - Plastic construction with 150 mesh nylon screen and 1/2 inch blowout assembly.
  - b. Control Valve - 2 way, solenoid pilot operated type made of synthetic, non-corrosive material; diaphragm activated and slow closing. Include freely pivoted seat seal; retained (mounted) without attachment to diaphragm.
  - c. Pressure Reducing Valve - Plastic construction as detailed.
  - d. Single station decoder
4. Emitters - Single port, pressure compensating, press on type.
5. Sub-Surface tubing - Size and type shown on Drawings; installed as detailed.

G. Gate Valves:

1. Gate Valves for 3/4 inch through 2-1/2 Inch Pipe - Brass construction; solid wedge, IPS threads, and non-rising stem with wheel operating handle.

H. Quick Coupling Valves - Brass two-piece body designed for working pressure of 150 PSI; operable with quick coupler. Equip quick coupler with locking rubber cover.

I. Valve Boxes:

1. Gate Valves, Quick Coupling Valves, Drain Valves, Drip Line Blow-out Stubs, and Wire Splice or Stub Box - Carson Brooks #910-10, box as detailed.
2. 1 inch through 2 inch Control Valves, Master Valves, Pressure Regulating Valves and Communication Cable Splice box - Carson Brooks #1419-12 box as detailed.
3. Drip Valve Assemblies and Flow Sensors - Carson Brooks #1220-12 box as detailed.

J. Electrical Control Wiring:

1. Low Voltage:
  - a. Electrical Control Wire - UFUL approved No. 14/14 (2-wire Paige #170116RB or as per manufactures requirements) direct burial copper wire to operate system as designed.
  - b. If multiple controllers are utilized, refer to wire routing plan for individual wire runs.
  - c. Control Wire connections and splices shall be made with 3M DBR-6 direct bury splice.
  - d. Loop five (5) feet minimum of 2-wire cable into all valve boxes.
  - e. If multiple controllers are utilized, each controller shall have it's own 2-wire cable run, controllers can not be connected with same 2-wire run.
2. High Voltage - Type required by local codes and ordinances, of proper size to accommodate needs of equipment serviced.

J. Automatic Controller (2-Wire) - Size and type shown on Drawings; mounted as detailed.

1. Single Station Decoders (2-Wire) - Size and type shown on Drawings; mounted as detailed.
  - a. Install decoders and wire per manufacture recommendations and requirements.
  - b. Grounding for all decoders and 2-wire cable, to be per manufactures recommendations and requirements. Minimum one grounding assembly per every 500' of wire and/or every 10<sup>th</sup> decoder and at all ends of the wire runs.

L. Electric Control Valves - Size and type shown on Drawings having manual flow adjustment and manual bleed nut, single station decoder.

M. Sprinkler Heads - As indicated on Drawings. Fabricated riser units in accordance with details on Drawings - with fittings and nipples of equal diameter as riser inlet in sprinkler body.

N. Backflow Preventer - Size and type indicated on Drawings; Brass or iron construction with 150 psi working pressure.

## PART 3 - EXECUTION

### 3.01 SITE CONDITIONS, LANDSCAPE PLAN REVIEW AND COORDINATION

- A. Contractor will be held responsible for coordination between landscape and irrigation system installation. Landscape material locations shown on the Landscape Plan shall take precedence over the irrigation system equipment locations. If irrigation equipment is installed in conflict with the landscape material locations shown on the Landscape Plan, the Contractor will be required to relocate the irrigation equipment, as necessary, at Contractor's expense.
- B. Contractor is responsible to notify Consultant of any field conditions that vary from the conditions shown on the Irrigation Construction Documents. If Contractor fails to notify Consultant of these conditions, Contractor will be held responsible for all costs associated with system adjustments required due to the change in field conditions.

### 3.02 STATIC PRESSURE VERIFICATION - Contractor shall field verify the static pressure at the project site, prior to commencing work or ordering irrigation materials, and submit findings, in writing, to Consultant. If Contractor fails to verify static water pressure prior to commencing work or ordering irrigation materials, Contractor shall assume responsibility for all costs required to make system operational and the costs required to replace any damaged landscape material. Damage shall include all required material costs, design costs and

plant replacement costs.

**3.03 INSPECTION:** - Examine areas and conditions under which Work of this Section is to be performed. Do not proceed with Work until unsatisfactory conditions have been corrected.

- A. Grading operations, with the exception of final grading, shall be completed and approved by Owner before staking or installation of any irrigation system begins.
- B. Underground Utilities shall be installed prior to installation of irrigation system. If irrigation installation takes place prior to utility installation, Contractor shall notify Owner of this condition in writing prior to commencement of irrigation installation.

**3.04 PREPARATION:**

- A. Staking shall Occur as Follows:
  - 1. Mark, with powdered lime, routing of pressure supply line and flag heads for first few zones. Contact Consultant 48 hours in advance and request review of staking. Proposed locations of all trees shall be field staked by Contractor and approved by Owner/Landscape Architect prior to Consultant review of irrigation staking. Consultant will advise installer as to the amount of staking to be prepared. Consultant will review staking and direct changes if required. Review does not relieve installer from coverage problems due to improper placement of heads after staking.
  - 2. Contractor shall contact Consultant if field spacing varies by +/- 10% of the spacing shown on the irrigation plans. If Contractor fails to notify Consultant of variances exceeding 10%, Contractor assumes full responsibility for the costs associated with any required system modifications deemed necessary by the Consultant or Owner.
  - 3. If Project has significant topography, freeform planting beds, or other amenities, which could require alteration of irrigation equipment layout as deemed necessary by Consultant, do not install irrigation equipment in these areas until Consultant has reviewed equipment staking.
- B. Install sleeving under asphalt paving and concrete walks, prior to concreting and paving operations, to accommodate piping and wiring. Compact backfill around sleeves to 95% Modified Proctor Density within 2% of optimum moisture content in accordance with STM D1557.
- C. Trenching - Trench excavation shall follow, as much as possible, layout shown on Drawing. Dig trenches straight and support pipe continuously on bottom of trench. Trench bottom shall be clean and smooth with all rock and organic debris removed.
  - 1. Clearances:
    - a. Piping 3 Inches and Larger - Make trenches of sufficient width (14 inches minimum) to properly assemble and position pipe in trench. Minimum clearance of piping 3 inches or larger shall be 5 inches horizontally on both sides of the trench.
    - b. Piping Smaller than 3 Inches - Trenches shall have a minimum width of 7 inches.
    - c. Line Clearance - Provide not less than 6 inches of clearance between each line and not less than 12 inches of clearance between lines of other trades.
  - 2. Pipe and Wire Depth:
    - a. Pressure Supply Piping - 24 inches from top of pipe.
    - b. PVC Sleeving - To match depth of sleeved material.
    - c. Non-pressure Piping (rotor) - 18 inches from top of pipe.
    - d. Non-pressure Piping (pop-up) - 12 inches from top of pipe.
    - e. Control Wiring/Communication Cable - Side of pressure main or at 18 inch depth if installed in a separate trench with no mainline piping..
    - f. Drip Tubing - 12 inches from top of pipe.
    - g. Emitter Tubing (Micro-tubing) - 8 inches from top of pipe.
  - 3. Boring will be permitted only where pipe must pass under obstruction(s) which cannot be

removed. In backfilling bore, final density of backfill shall match that of surrounding soil. It is acceptable to use sleeves of suitable diameter installed first by jacking or boring, and pipe laid through sleeves. Observe same precautions as though pipe were installed in open trench.

4. Vibratory Plow - Non-pressure piping may be installed through use of vibratory plow method if consultant determines soil conditions are satisfactory for this method of installation. Vibratory plowing does not relieve installer of minimum pipe depths.

**3.05 INSTALLATION** - Locate other equipment as near as possible to locations designated. Consultant shall review deviations prior to installation.

- A. PVC Piping - Snake pipe in trench as much as possible to allow for expansion and contraction. Do not install pipe when air temperature is below 40 degrees F. Place manual drain valves at low points and dead ends of pressure supply piping to insure complete drainage of system. When pipe installation is not in progress, or at end of each day, close pipe ends with tight plug or cap. Perform Work in accordance with good practices prevailing in piping trades.

1. Solvent Weld PVC Pipe - Lay pipe and make all plastic to plastic joints in accordance with manufacturer's recommendations.
2. Flexible Plastic (Polyethylene) Pipe - Lay pipe and assemble fittings following manufacturer's recommendations.

B. Drip Tubing:

1. Make all fitting connections as per manufacturers recommendations.
2. Use only manufacturer provided or recommended hole punch when making penetrations in drip tubing for insert fittings. Use of any other hole punch shall be cause for immediate removal and replacement of all installed drip tubing.
3. Install drip line blow-out stubs at all dead ends of drip tubing.

C. Control Wiring:

1. Low Voltage Wiring:  
The wire paths shall be twisted pair, solid-core, color-coded red/blue pairs with each conductor in a polyethylene jacket suitable for direct burial. The two-wire paths shall be UFUL approved No. 14/14 (2-wire Paige #170116RB or 12 AWG (2mm) conductors for extended range (over 10,000 ft./3km, up to 15,000 ft./4.5km), or as per manufactures requirements). The two-wire paths may be spliced, or "teed", permitting extensions of the path in multiple directions. In general, the distance from the controller to the end of any one end of a "tee" or wire run shall not exceed the maximum for the gauge of wire, even if the total of all wire exceeds that number. For example, a path comprised of No.14/14 (rated for 10,000ft./3km) could extend 5000 ft./1.5km to a "tee" splice, and each arm of the tee could extend an additional 5000 ft./1.5km. The total wire connected would equal 15,000 ft./4.5km, but the distance from the controller, to the end of each run, would be 10,000ft./3km or less, meeting the specification. All wire splices must be made in a valve box with DBR-6 or equal direct-burial waterproof connectors.
2. High Voltage Wiring for Automatic Controller:
  - a. Provide 120 volt power connection to automatic controller.
  - b. All electric work shall conform to local codes, ordinances, and authorities having jurisdiction. All high voltage electrical work shall be performed by licensed electrician.

D. Automatic Controller:

1. Install controller in accordance with manufacturer's instructions as detailed and where shown on Drawings.

2. Connect remote control valves to controller in numerical sequence as shown on Drawings.
  3. Owner shall approve final location of controller prior to installation.
  4. Each controller shall be a dedicated separate ground wire and grounding rod as detailed. Earth grounding shall be connected via a factory supplied copper ground lug inside the controller, for connection to earth ground hardware via 6 AWG(4mm dia.) copper wire (see ASIC Earth Grounding Guideline 100-2002 for details of earth grounding irrigation control systems available online at [www.asic.org](http://www.asic.org)). Ground wire shall be extended underground, at right angles to any communications wiring, to approved direct burial earth grounding hardware at least 6 ft./2m from the controller location. Earth Ground shall be have an impedance of 10 Ohms or less, or shall meet the standards of the Earth Grounding Guideline cited above
  5. All above ground conduit shall be rigid galvanized with appropriate fittings. All below ground conduit shall be schedule 40 PVC.
- D. Electric Control Valves - Install cross-handle four inches below finished grade where shown on Drawings as detailed. When grouped together, allow minimum of 12 inches between valve box sides. Install each remote control valve in a separate valve box. Install valve box flush with grade or when present flush with surfacing material (rock mulch). When parallel to roadway, sidewalk or other permanent element or structure, control valve and box to be installed perpendicular to element or structure, spaced equally.
1. All connections in the two-wire paths (outside the controller enclosure) shall be made with 3M DBR-6 waterproof, strain-relieving direct burial connectors, or exact equals. Decoder output to solenoid connections shall be made with 3M DBY waterproof, strain-relieving connectors, or exact equals. No substitution of wire or wire connector specifications is permissible. All connections, tees, and splices shall be positioned in valve boxes for future location and service.
  2. The installer shall provide adequate earth ground (not to exceed 10 Ohms, or in compliance with practices as defined in American Society of Irrigation Consultants Earth Grounding Guideline 100-2002, available at [www.asic.org](http://www.asic.org)) and connect it to one of the decoder ground leads every 1000 ft.(330m), or every 12th decoder module, whichever is shorter. Minimum ground hardware shall be a 4" x 36" (100 x 915mm) copper plate with at least 10AWG/2.5mm dia. copper wire. In high lightning areas, grounding may be increased to every 500 ft./150m or 10 decoders. Ground connections from decoder ground lead to grounding hardware shall be made by joining the 12AWG (2mm dia.) decoder ground wire with a 10AWG (2.5mm dia.) solid copper lead in an approved wire nut of appropriate size, inserted in a DBR-6 waterproof direct burial connector, or with an approved wire clamp. Ground hardware shall extend at right angles from the two-wire red/blue path, and ground hardware shall be located at least 6ft./2m away from the two-wire path.
- F. Quick Coupling Valves - Install quick couplers on swing-joint assemblies as indicated on construction details; plumb and flush to grade. Angled nipple relative to pressure supply line shall be no more than 45 degrees and no less than 10 degrees.
- G. Drip and Sub-Surface Valve Assemblies - Install valve assembly as detailed
- H. Drip Emitters - Stake all surface emitters as detailed and staked with acceptable tubing stakes.
- I. Drain Valves - Install one manual drain valve on pressure supply line directly downstream of backflow preventer as detailed. Provide a three cubic foot drainage sump for drain valve as detailed.
- J. Valve Boxes:
1. Install one valve box for each type of valve installed as detailed. Valve box extensions are not acceptable except for master valves and flow sensors. Install gravel sump after compaction of all trenches. Place final portion of gravel inside valve box after valve box is backfilled and compacted.
  2. Brand controller letter and station number on lid of each valve box. Letter and number size shall be no smaller than 1 inch and no greater in size than 1 1/2 inches. Depth of branding

shall be no more than 1/8 inch into valve box lid.

- K. Gate Valves - Install where shown on Drawings as detailed.
- L. Sprinkler Heads - Install sprinkler heads where designated on Drawings or where staked. Set to finish as detailed. Spacing of heads shall not exceed the maximum indicated on Drawing unless re-staked as directed by Consultant. In no case shall the spacing exceed maximum recommended by manufacturer. Install heads on swing joints or riser assemblies as detailed. Adjust part circle heads for proper coverage. Adjust heads to correct height after sod is installed. Plant placement shall not interfere with intended sprinkler head coverage, piping, or other equipment. Consultant may request nozzle changes or adjustments without additional cost to the Owner.
- M. Backflow Preventer - Install as detailed at location designated on Drawings.
- N. Backfilling - Do not begin backfilling operations until required system tests have been completed. Backfill shall not be done in freezing weather except with review by Consultant. Leave trenches slightly mounded to allow for settlement after backfilling is completed. Trenches shall be finish graded prior to walk-through of system by Consultant.
  - 1. Materials - Excavated material is generally considered satisfactory for backfill purposes. Backfill material shall be free of rubbish, vegetable matter, frozen materials, and stones larger than 1 inch in maximum dimension. Do not mix subsoil with topsoil. Material not suitable for backfill shall be hauled away. Contractor shall be responsible for providing suitable backfill if excavated material is unacceptable or not sufficient to meet backfill, compaction, and final grade requirements.
  - 2. Do not leave trenches open for a period of more than 48 hours. Open excavations shall be protected in accordance with OSHA regulations.
  - 3. Compact backfill to 90% maximum density, determined in accordance with ASTM D155-7 utilizing the following methods:
    - a. Mechanical tamping.
    - b. Puddling or ponding. Puddling or ponding and/or jetting is prohibited within 20'-0" of building or foundation walls.
- O. Piping Under Paving:
  - 1. Provide for a minimum cover of 18 inches between the top of the pipe and the bottom of the aggregate base for all pressure and non-pressure piping installed under asphaltic concrete or concrete paving.
  - 2. Piping located under areas where asphalt or concrete paving will be installed shall be bedded with sand (a layer 6" below pipe and 6" above pipe).
  - 3. Compact backfill material in 6" lifts at 90% maximum density determined in accordance with ASTM D155-7 using manual or mechanical tamping devices.
  - 4. Set in place, cap, and pressure test all piping under paving, in presence of Owner prior to backfilling and paving operations.
  - 5. Piping under existing walks or concrete pavement shall be done by jacking, boring, or hydraulic driving, but where cutting or breaking of walks and/or concrete is necessary, it shall be done and replaced at not cost to Owner. Obtain permission to cut or break walks and/or concrete from Owner.
- P. Water Supply and Point of Connection - Water supply shall be extended as shown from water supply lines.

### **3.06 FIELD QUALITY CONTROL:**

- A. Flushing - After piping, risers, and valves are in place and connected, but prior to installation of sprinkler heads, quick coupler assemblies, and hose valves, thoroughly flush piping system under full

head of water pressure from dead end fittings. Maintain flushing for 5 minutes through furthestmost valves. Cap risers after flushing.

B. Pressure Testing - Conduct test in presence of Consultant. Arrange for presence of Consultant 48 hours in advance of testing. Supply force pump and all other test equipment. Compressed air shall not be used for pressure testing system.

1. After backfilling, and installation of all control valves, fill pressure supply line with water, and pressurize to 40 PSI over the designated static pressure or 120 PSI, whichever is greater, for a period of 2 hours.
2. Leakage, Pressure Loss - Test is acceptable if no loss of pressure is evident during the test period.
3. Leaks - Detect and repair leaks.
4. Retest system until test pressure can be maintained for duration of test.
5. Before final acceptance, pressure supply line shall remain under pressure for a period of 48 hours.
6. Pressure test shall be scheduled and passed prior to scheduling of Substantial Completion Walk-through.

C. Walk-Through for Substantial Completion:

1. Arrange for Consultant's presence 48 hours in advance of walk-through.
2. Entire system shall be completely installed and operational prior to scheduling of walk-through.
3. Operate each zone in its entirety for Consultant at time of walk-through and additionally, open all valve boxes if directed.
4. Generate a list of items to be corrected prior to Final Completion.
5. Furnish all materials and perform all work required to correct all inadequacies of coverage due to deviations from Contract Documents.
6. During walk-through, expose all drip emitters under operations for observation by Consultant to demonstrate that they are performing and installed as designed, prior to placing of all mulch material. Schedule separate walk-through if necessary.
7. Supply Consultant with prints of irrigation as-builts prior to scheduling substantial completion walk-through.

D. Walk-Through for Final Completion:

1. Arrange for Consultant's presence 48 hours in advance of walk-through.
2. Show evidence to Consultant that Owner has received all accessories, charts, record drawings, and equipment as required before Final Completion walk-through is scheduled.
3. Operate each zone, in its entirety for Consultant at time of walk-through to insure correction of all incomplete items.
4. Items deemed not acceptable by Consultant shall be reworked to complete satisfaction of Consultant.
5. If after request to Consultant for walk-through for Final Completion of irrigation system, Consultant finds items during walk-through which have not been properly adjusted, reworked, or replaced as indicated on list of incomplete items from previous walk-through, Contractor shall be charged for all subsequent walk-throughs. Funds will be withheld from final payment and/or retainage to Contractor, in amount equal to additional time and expenses required by Consultant to conduct and document further walk-throughs as deemed necessary to insure compliance with Contract Documents.

**3.07 ADJUSTING** - Upon completion of installation, fine-tune entire system by adjusting patterns and break-up pins, and setting pressure reducing valves at proper and similar pressure to provide optimum and efficient coverage. Flush and adjust all sprinkler heads for optimum performance and to prevent overspray onto walks, roadways, and buildings as much as possible. Heads of same type shall be operating at same pressure +/- 10%.

- A. If it is determined that irrigation adjustments will provide proper coverage, and improved water distribution as determined by Consultant, contractor shall make such adjustments prior to Final Acceptance, as directed, at no additional cost to Owner. Adjustments may also include changes in nozzle sizes, degrees of arc, and control valve throttling.
  - B. All sprinkler heads shall be set perpendicular to finish grade unless otherwise noted on Construction Plans or directed by Consultant.
  - C. Areas which do not conform to designated operation requirements due to unauthorized changes or poor installation practices shall be immediately corrected at no additional cost to the Owner.
- 3.08 CLEANING** - Maintain continuous cleaning operation throughout duration of work. Dispose of, off-site at no additional cost to Owner, all trash or debris generated by installation of irrigation system.

**END OF SECTION**



## **SECTION 329113**

### **SOIL PREPARATION**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. **RELATED DOCUMENTS:** The General Contract Conditions, Drawings and other Division - 1 Specification sections apply to Work of this section.
- B. **DESCRIPTION:** The work of this section consists of ripping, fertilizing, soil conditioning and fine grading of topsoil in preparation for seeding, sodding or planting operations.
- C. **RELATED SECTIONS:**
  - 1. Earthwork - Section 310000
  - 2. Planting- Section 329300

##### **1.2 SUBMITTALS:**

- A. **Quality Control Submittals:**
  - 1. **Existing Soil Testing:** Contractor shall be responsible for providing and paying for three (3) soil tests from three (3) locations (to be determined in-field by Owner's Representative and Contractor) prior to any soil preparation work is to begin. Test results shall be provided to Owner's Representative as per Section 01 40 00. Costs to be calculated into seeding and soil preparation costs.
  - 2. **Certificates:** State, federal and other inspection certificates shall accompany invoice for materials showing source or origin. Submit to Owner's Representative prior to acceptance of material.
  - 3. **Material Analysis:** Provide soil conditioner analysis performed no more than 3months prior to delivery to site. Submit 0.5 cubic foot sample of soil conditioner at least 14 days prior to delivery to the site.

##### **1.3 DELIVERY, STORAGE AND HANDLING:**

- A. **Fertilizer:** Deliver inorganic or chemical fertilizer to site in original unopened containers bearing manufacturer's guaranteed chemical analysis, name, trade name, trademark and conformance to state law, bearing name and warranty or producer. If fertilizers are delivered in bulk, supplier shall provide the same certification as above.
- B. Notify the Owner's Representative of delivery schedule in advance so material can be inspected upon arrival at project site. Immediately remove unacceptable material from project site.

##### **1.4 PROJECT/SITE CONDITIONS:**

- A. **General:** Do not perform work when climate and existing site conditions will not provide satisfactory results.

- B. Vehicular accessibility on site shall be as directed by the Owner's Representative. Repair damage to prepared ground and surface caused by vehicular movement during work under this section to original condition at no additional cost to the Owner.

## PART 2 - PRODUCTS

### 2.1 SOIL MATERIALS:

#### A. Soil Conditioner:

1. Composted material meeting the following requirements – shall be adjusted accordingly dependent upon Contractor's soil test results (at no additional cost):
  - a. Organic matter: 25% minimum
  - b. Salt content: 4.0 mmhos/cm maximum
  - c. pH: 8.5 maximum
  - d. Carbon to nitrogen ratio of 10:1 to 25:1
  - e. No live noxious weed seeds or plants shall be present
2. Mountain peat, aspen humus, gypsum, manure and sand will not be accepted.

### 2.2 OTHER MATERIALS:

- A. Fertilizer: Diamonium phosphate (18-46-0). Shall be adjusted accordingly dependant upon Contractor's soil test results (at no additional cost).
- B. Post Emergent Herbicide: Roundup (Glyphosate) as manufactured by Monsanto Company or approved equal.
- C. Sand: Washed local sand with no deletrious materials.

## PART 3 - EXECUTION

### 3.1 EXAMINATION:

- A. General: Verify that existing site conditions are as specified and satisfactory to perform the work in this section. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the installer. Starting installation constitutes acceptance of site conditions.
  1. Grades: Inspect to verify rough grading is within +/- 0.1 foot of grades indicated and specified.
  2. Damaged Earth: Inspect to verify that earth rendered unfit to receive planting due to concrete, water, mortar, limewater or any other contaminant dumped on it has been removed and replaced with clean earth from a source approved by the Owner's Representative.
- B. Unsatisfactory Conditions: Report in writing to General Contractor with copy to Owner's Representative.
- C. Acceptance: Beginning of installation means acceptance of existing conditions by installer.

### 3.2 PREPARATION

#### A. Protection

1. Locate sewer, water, irrigation, gas, electric, phone and other pipelines or conduits and equipment prior to commencing work.
2. Be responsible for proper repair to landscape, utilities, walls, pavements and other site improvements damaged by operations under this section.

#### B. Weed Control: Remove annual weeds by tilling. Remove perennial weeds by applying herbicide 1 week before soil preparation and as needed, but no sooner than 3 months before beginning work.

#### C. Surface Grade: Remove weeds, debris, clods and rocks larger than ½". Dispose of accumulated debris at direction of Owner's Representative.

#### D. Runoff: Take measures and furnish equipment and labor necessary to control the flow, drainage, and accumulation of water. Insure that all water will run off the grades.

#### E. Erosion Control: Take measures and furnish equipment and labor necessary to control and prevent soil erosion, blowing soil and accumulation of wind-deposited material on the site throughout duration of work.

### 3.3 INSTALLATION

#### A. Soil Preparation in Sod and Turfgrass Areas:

1. Evenly distribute soil conditioner and first application of fertilizer at the following rates (rates shall be finalized after existing soil tests are complete):
  - a. Soil conditioner at the rate of 4 to 6 cubic yards per 1,000 square feet.
  - b. 18-46-0 fertilizer at the rate of 4 to 7 lbs. per 1,000 square feet.
2. After applying soil conditioner and fertilizer, thoroughly till area to depth of 6" minimum by plowing, harrowing, or disking until soil is well pulverized and thoroughly mixed.
3. Lime or additional fertilizer may be required to be added – determinate on the Contractor's soil test results on the existing soil. This will be at no additional cost to the Contract.

#### B. Fine Grading in all Landscape Areas:

1. Do fine grading for all areas prior to seeding or planting.
2. For ground surface areas surrounding buildings to be landscaped, maintain required positive drainage away from buildings.
3. Establish finish grades to within 0.1 foot of grades indicated. Allow 1-1/2 inch for thickness of sod.
4. Finished grades of shrub, ground cover beds and planter pots shall be 3" below top of adjacent pavement, or cap, for thickness of mulch, unless otherwise specified on drawings.
5. Noxious weeds or parts thereof shall not be present in the surface grade prior to seeding.
6. Prior to acceptance of grades, hand rake to smooth, even surface, free of debris, clods, rocks and vegetable matter greater than 0.5 inch.

3.4 NOTIFICATION AND INSPECTION

- A. Inspection: Provide notice to Owner's Representative requesting inspection at least seven (7) days prior to anticipated date of completion.
- B. Deficiencies: Owner's Representative will specify deficiencies to Contractor who shall make satisfactory adjustments and shall again notify Owner's Representative for final inspection.

3.5 CLEANING

- A. General: Remove debris and excess materials from site. Clean out drainage inlet structures. Clean paved and finished surfaces soiled as a result of work under this Section, in accordance with direction given by Owner's Representative.

3.6 PROTECTION

- A. General: Provide and install barriers as required and as directed by Owner's Representative to protect completed areas against damage from pedestrian and vehicular traffic until acceptance by Owner. Contractor is not responsible for malicious destruction caused by others.

END OF SECTION

## **SECTION 329119**

### **TOPSOIL**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

###### **A. RELATED DOCUMENTS**

1. The General Contract Conditions, Drawings and other Division - 1 Specification sections apply to Work of this section.

###### **B. DESCRIPTION**

1. The work of this section consists of furnishing, stockpiling and placing topsoil on a previously prepared subgrade.

###### **C. RELATED WORK**

1. Soil Preparation - Section 329113
2. Sodding – Section 329223
3. Planting- Section 329300

##### **1.2 QUALITY ASSUARANCE**

- A. Contractor shall submit soil analysis report for on-site topsoil from the State University Agricultural Extension Service or other approved soil testing laboratory. Report shall cover soil textural classification (percentages of sand, silt, and clay), pH and include additive recommendations. Testing will be at the expense of the Contractor. Contractor to amend topsoil per test recommendations with approval of Owner's Representative.

##### **1.3 DELIVERY, STORAGE AND HANDLING**

- A. Do not deliver or place topsoil in frozen, wet, or muddy condition.

#### **PART 2 - PRODUCTS**

##### **2.1 ON-SITE TOPSOIL**

- A. On-site Topsoil shall consist of loose friable loam free of subsoil, trash, stumps, roots, rocks, heavy clay or hard clods greater than 1" in size, toxic substances, brush, weed seeds and reproductive vegetative plant parts (such as Knapweed, Purple Loosestrife, and Canadian Thistle) and other material which would be deleterious to its use on the project. Strip from top 6" of existing topsoil where organic material is visible and as directed by the Project Manager. Verify depth and size of topsoil stockpile with Project Manager.

2.2 IMPORTED TOPSOIL

- A. All topsoil shall be a loam or sandy loam. At least 10 days prior to topsoil delivery, notify Owner's Representative of the source(s) from which topsoil is to be furnished. Topsoil shall be furnished by the Contractor and shall be a natural, friable soil representative of productive soils in the vicinity. It shall be obtained from the top 6" of well drained areas
- B. Fertile, friable, loamy soil, reasonably free from subsoil, refuse, roots, heavy or stiff clay, stones larger than 1 inch, coarse sand, noxious seeds, sticks, brush, litter, and other deleterious substances; suitable for the germination of seeds and the support of vegetative growth. The pH value shall be between 7.0 and 8.0 and the total salts maximum content shall be 3 MMHOS/CM
- C. Soil Texture: Sand, 30 to 50 percent; silt, 30 to 50 percent; clay, 5 to 30 percent.
- D. Additives: As determined by soil fertility tests.
- E. % Organic Content: 2.9% minimum.

PART 3 - EXECUTION

3.1 STOCKPILING

- A. Stockpile topsoil within boundaries of staging areas within Limits of Construction as shown on drawings or as directed by the Project Manager. Topsoil stockpiles shall be separate from other soil and materials piles and protected with silt fence on the down-gradient side of the stockpile. Contractor shall construct storage piles to freely drain surface water. Seed or cover storage piles to prevent erosion.

3.2 PLACING TOPSOIL

- A. Scarify compacted subgrade to a 6-inch depth to bond topsoil to subsoil. Place topsoil to a minimum depth of 4-inches after settlement. Topsoil shall be free from weeds, sod, clods and stones larger than 1-inch, toxic substances, litter or other deleterious material. Spread evenly and grade to elevations and slopes shown. Hand rake areas inaccessible to machine grading.
- B. Utilize salvaged topsoil as the top layer to the extent available.

END OF SECTION

## **SECTION 329223**

### **SODDING**

#### **PART 1 - GENERAL**

##### **1.01 RELATED DOCUMENTS**

- A. The General Contract Conditions, Drawings and other Division - 1 Specification sections apply to Work of this section.

##### **1.02 DESCRIPTION**

- A. The work of this section consists of furnishing and installing bluegrass sod and maintenance of the sodded areas until Final Acceptance.

##### **1.03 RELATED SECTIONS**

- A. Section 3280 00 – Irrigation System
- B. Section 329113 - Soil Preparation
- C. Section 329300 – Plant Material

##### **1.04 SUBMITTALS**

- A. Quality Control Submittals:
  - 1. Certificates: State, Federal and other inspection certificates shall accompany the invoice for materials showing source or origin. Submit to Owner's Representative prior to acceptance of material.
  - 2. At least 10 working days before anticipated date of sod delivery, submit list of varieties contained in sod for approval by Owner's Representative.
- B. Contract Closeout Submittals:
  - 1. Warranty: At completion of work, furnish written warranty to Owner based upon requirements as specified.

##### **1.05 QUALITY ASSURANCE**

- A. Source Quality Control:
  - 1. Sod Materials: Subject to inspection and acceptance. Owner's Representative reserves the right to reject at any time or place prior to acceptance, any work and sod which in the Owner's Representative's opinion fails to meet these specification requirements.
  - 2. Inspection: Primarily for quality; however, other requirements are not waived even though visual inspection results in acceptance. Notify Owner's Representative of intended sod farm prior to cutting for inspection. Inspection at growth site shall not preclude the right of rejection at project site.
  - 3. Promptly remove rejected sod from site.
  - 4. Owner's Representative will make inspection periodically during sodding, at completion and at end of warranty period.
- B. Sod Standards:

1. General: Healthy, thick turf having undergone a program of regular fertilization, mowing and weed control; free of objectionable weeds; uniform in green color, leaf texture and density; healthy, vigorous root system; inspected and found free of disease, nematodes, pests and pest larvae by the entomologist of the State Department of Agriculture.
2. Each piece of Sod: Sandy-loam soil base that will not break, crumble or tear during sod installation.
3. Thickness: Minimum 3/4" thick, excluding top growth and thatch.
4. Thatch: Not to exceed 1/2" uncompressed.
5. Size: Cut in strips 18" wide no more than 24 hours prior to delivery.

#### 1.06 DELIVERY, STORAGE AND HANDLING

- A. Sod: Deliver on pallets properly loaded on vehicles and with root system protected from exposure to sun, wind, and heat in accordance with standard practice and labeled with botanical and common name of each grass species in accordance with Federal Seed Act. Sod that has been damaged by poor handling or improper storage is subject to rejection by the Owner's Representative.
  1. Protect from dehydration, contamination, freezing and heating at all times. Keep stored sod moist and under shade or covered with moistened burlap.
  2. Do not drop sod rolls from carts, trucks or pallets.
  3. Do not deliver more sod than can be installed within 48 hours.
  4. Do not stack sod more than 2 feet deep.
- B. Fertilizer: Deliver inorganic or chemical fertilizer to site in original unopened container bearing manufacturer's guaranteed chemical analysis, name, trade name, trademark, warranty and conformance to state law.
  1. Material shall be inspected upon arrival at job site.
  2. Immediately remove unacceptable material from job site.

#### 1.07 PROJECT/SITE CONDITIONS

- A. Existing Conditions:
  1. Import and place any fill material required to adjust the fine grade to meet drainage requirements or to match hard surface finish grades.
  2. Vehicular accessibility on site shall be as directed by Owner's Representative. Repair damage to prepared grounds and surfaces caused by vehicular movement during work under this section to original condition at no additional cost to Owner.
- B. Environmental Requirement:
  1. Install sod between June 1 and September 15 unless otherwise directed by Owner's Representative.
  2. Do not install sod on saturated or frozen soil.
  3. Schedule work for periods of favorable weather. Sod placement on days which, in the opinion of the Owner's Representative, are too hot, dry or windy for optimal installation may be prohibited.
  4. Remove and replace sod which has to be re-lifted to correct underlying work.

#### 1.08 PROJECT COMPLETION

- A. Substantial Completion:
  1. The Owner's Representative will inspect all work for Substantial Completion upon written request of the Contractor. The request shall be received at least ten calendar days before the anticipated date of inspection.



2. Acceptance of material by the Owner's Representative will be for general conformance to specified requirements, and shall not relieve the Contractor of responsibility for full conformance to the Contract Documents.
3. Upon completion and reinspection of all repairs or renewals necessary in the judgment of the Owner's Representative, the Owner's Representative will recommend that the Work of this Section be provisionally accepted.

B. Final Acceptance:

1. At the end of the Maintenance Period, the Owner's Representative will, upon written notice of end of Maintenance Period, inspect the work for Final Acceptance. Request shall be received at least ten calendar days before the anticipated date for Final Inspection.
2. Upon completion and reinspection of full repairs or replacements necessary in the judgement of the Owner's Representative at that time, the Owner's Representative will recommend that Final Acceptance of the Work of this Section be given.
3. Sod areas will be accepted when in compliance with all the following conditions:
  - a) Roots are thoroughly knit to the soil
  - b) Absence of visible joints
  - c) All areas show a uniform stand of specified grass in healthy condition
  - d) At least 30 days have elapsed since the completion of Work under this Section.

C. Quality Guarantee:

1. Sod shall be uniform in color, leaf texture, leaf and root density, and free from weeds, diseases, and other visible imperfections at time of Final Acceptance.
2. Guarantee does not cover damage as a result of deicing compounds, fertilizers, pesticides, or other applications not supervised by the Contractor or as a result of acts of God or vandalism.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Sod: Colorado-grown Kentucky Bluegrass/Fescue blend having a healthy, vigorous root system. Blend shall contain a minimum of 3 improved varieties of Bluegrass and 1 drought-tolerant variety of Tall Fescue and shall be grown in sand based soils.
- B. Water: Free of substances harmful to plant growth. Be responsible for furnishing water from underground sprinkler system, quick couplers or other source.
- C. Fertilizer: Inorganic mixture with following chemical composition: 20-5-10 with 50% sulfur coated urea (no iron).

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. General - Verify that existing site conditions are as specified and indicated before beginning work under this section.
  1. Layout: Sod shall be placed along all edges of hardscape and at all irrigation heads within turfgrass seed limits. Sod strips at hardscape edges shall be a minimum of 1'-0" wide. Verify layout of sodded areas as indicated prior to starting operations.
  2. Grades: Verify that grades are within 0.04 ft. of grades indicated and specified.

- B. Unsatisfactory Conditions: Report in writing to General Contractor with copy to Owner's Representative.
- C. Beginning of installation means acceptance of existing conditions by this Contractor.

### 3.02 PREPARATION

- A. Protection:
  - 1. Be responsible for proper repair to landscape, utilities, walls, pavements, and other site features damaged by operations under this section.
  - 2. Identify prepared sod areas requiring protection and erect barriers for proper protection and traffic control.
- B. The Contractor shall prepare the soil of all areas to be sodded in accordance with the requirements of Section 02920 - Soil Preparation.
- C. Sodded Areas: Remove weeds, debris and rocks larger than ½" which may hinder sodding. Dispose of accumulated debris at direction of Owner's Representative.
- D. Repair: Re-establish grade and specified conditions to damaged sod areas prior to placing sod.
- E. Adjustment: Adjust irrigation heads to proper watering height according to depth of sod material but lower than compacted blade height to enable lawn mowers to cut grass freely without damage to the sprinkler system.
- F. Fine Grading: Perform as required to maintain positive drainage, prevent ponding and direct run-off into catch basins, drainage structures, etc., and as required to provide smooth well-contoured surface prior to proceeding. Tolerance:  $\pm 0.04$  foot.

### 3.03 SODDING

- A. Sodding:
  - 1. Soil on which sod is laid: Slightly moist.
  - 2. Lay with longest dimension parallel to contours and in continuous rows.
  - 3. Tightly butt ends and sides of sod together. Stagger and compact vertical joints between sod strips by rolling so sod will be incorporated with the ground surface, insuring tight joints between adjacent pieces. Ensure that sod is neither stretched nor overlapped.
  - 4. Exposed joints due to shrinkage will require replacement of sod in affected areas.
- B. Topsoil: Add along exposed edges to match adjacent grade. Feather topsoil out approximately 1 ft. from edge of sod. Broom screened topsoil over entire sodded area to fill voids but do not smother sod.
- C. Rolling: When soil and sod are moist, roll sod lightly as soon as possible after it is laid. Roller shall weigh 100 to 160 lb per foot of roller. Delay rolling until just before the second watering.
- D. Drainage: Assure that finished areas of sod are such that positive drainage of storm and irrigation water will occur and ponding of water will be minimized.
- E. Watering: Thoroughly water sod immediately after laying to a depth sufficient that the underside of the new sod strips and soil below the sod are thoroughly wet.

### 3.04 FERTILIZING

- A. Fertilizer Applications: Distribute 20-5-10 fertilizer uniformly at the rate of 1 lb. actual nitrogen per 1,000 s.f. or 5 lbs of material per 1000 s.f. 30 days after sodding and every 30 days thereafter until final acceptance of project by Owner's Representative.

3.05 REPAIR OF EXISTING SOD AREAS DISTURBED BY RENOVATION

- A. Repair existing sod areas disturbed by renovation work (utilities, paving, etc) as indicated, in accordance with specifications of this section.

3.06 CLEANING

- A. Cleaning: Remove pallets, unused sod, and other debris from site. Clean paved and finished surfaces soiled as a result of work under this Section in accordance with directions given by Owner's Representative. Clean out drainage inlet structures.

3.07 PROTECTION

- A. General: Provide and install barriers as required and as directed by Owner's Representative to protect sodded areas against damage from pedestrian and vehicular traffic until Final Acceptance. Contractor is not responsible for malicious destruction of sodding caused by others.

**END OF SECTION**

**SECTION 329300**

**PLANT MATERIAL**

**PART 1 - GENERAL**

**1.1 SUMMARY**

**A. RELATED DOCUMENTS**

- A. The General Contract Conditions, Drawings and other Division 1 Specification Sections apply to Work of this Section.

**B. DESCRIPTION**

- A. The work of this section consists of providing, installing, and maintaining live woody plant material.

**C. RELATED SECTIONS:**

- A. Irrigation System - Section 328000
- B. Soil Preparation - Section 329113
- C. Topsoil – Section 329119.13

**1.2 SUBMITTALS**

- A. Delivery tickets for all bulk materials with Owner's Representative's approval or acknowledgment that materials were received in satisfactory condition.
- B. Product certificates signed by manufacturers certifying that their products comply with specified requirements.
  - A. Manufacturer's certified analysis for standard products, where applicable.
  - B. Analysis for other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- C. Samples: 1 cubic foot of mulch for each mulch type required for the project, in labeled plastic bags, boxes, or buckets.
- D. Contractor to provide representative photographs, or physical samples of all trees over 1" caliper to Landscape Architect for approval. Photographs must have a person or measuring stick to establish relative size. When approved, photographed or tagged will be maintained as representative samples for final installed plant materials.
- E. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and address of Landscape Architects and Owners, and other information specified.
- F. Material test reports from qualified independent testing agency, indicating and interpreting test results relative to compliance of the following materials with requirements indicated.

- G. Analysis of existing surface soil for plant growth.
- H. Planting schedule indicating anticipated dates and locations for each type of planting.
- I. Three (3) sets of maintenance instructions recommending procedures to be established by the Owner for maintenance of landscaping during an entire year. Submit before expiration of required maintenance period.
- J. Three (3) copies of a written warranty stating all items included in the warranty, conditions of the warranty, and beginning and ending of warranty period(s).

### 1.3 QUALITY ASSURANCE

- A. **Installer Qualifications:** Engage an experienced Installer who has completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment.
- B. **Installer's Field Supervision:** Require Installer to maintain an experienced full-time supervisor on the Project site during times that landscaping is in progress.
- C. **Testing Agency Qualifications:** To qualify for acceptance, an independent testing agency must demonstrate to Owner's Representative's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.
- D. Provide quality, size, genus, species, and variety of trees indicated, complying with applicable requirements of ANSI Z60.1 "American Standard for Nursery Stock", and all applicable state and local rules and regulations.
- E. **Inspection:** Owner's Representative may inspect plants either at place of growth or at site before planting, for compliance with requirements for name, variety, size, and quality.
  - A. The Owner's Representative reserves the right to reject at any time or place prior to final acceptance all plant materials, which in the Owner's Representative's opinion fail to meet specifications. Inspection of materials is primarily for quality, size, and variety, but other requirements are not waived even though visual inspection results in approval. Plants are to be inspected where available; however, inspection at the places of supply shall not preclude the right of rejection at the site or at a later time prior to final acceptance. Rejected material shall be removed from the site within 24 hours.
  - B. The Contractor shall schedule inspection of the plants, at either the supplier or on-site, to be completed in one visit. Any further inspection required due to plants being unavailable or rejected as not meeting specifications shall be charged to the Contractor at the current hourly rate for the Owner's personnel performing the inspection.
  - C. The Contractor shall pay all expenses for the Owner's Representative to visit the source for plants including airfare, taxi, hotels and meals.
- F. **Soil Analysis:** The Contractor shall furnish a soil analysis made by a qualified independent soil-testing agency stating percentages of organic matter, inorganic matter (silt, clay, and sand), deleterious material, pH, and mineral and plant-nutrient content of topsoil.
  - A. Report suitability of topsoil for growth of applicable planting material. State recommended quantities of nitrogen, phosphorus, and potash nutrients and any limestone, aluminum sulfate, or other soil amendments to be added to produce a satisfactory topsoil.

- B. Provide testing from 4 locations per direction of Owner's Representative.
  - C. The Contractor shall perform soil tests 30 days prior to mobilizing for landscape construction.
  - D. Soil testing shall be provided by Colorado Analytical Laboratory, 240 S. Main Street, Brighton, CO 80601, (303) 659-2313, or other approved testing facility. Soil shall be tested for soluble salts and nutrient levels. Testing facility shall provide interpretation of results and recommendation for soil amendments for each type of planting.
  - E. Deficient nutrients shall be corrected with the addition of appropriate fertilizer and amendment materials. The Contractor shall submit a Change Order Request for all additional materials that are recommended but are not included in this Specification.
- G. Measurements: Measure trees according to ANSI Z60.1 with branches and trunks in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches (150 mm) above ground for trees up to 4-inch (100-mm) caliper size, and 12 inches (300 mm) above ground for larger sizes. Measure main body of tree for height and spread; do not measure branches or roots tip-to-tip.
- H. Pre-installation Conference: Contractor shall attend pre-installation conference at location specified by Owner's Representative.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery and while stored at site. The Owner's Representative reserves the right to inspect containers before or after installation to verify compliance with Specifications.
- B. Trees: Deliver nursery stocked or freshly dug trees. Do not prune before delivery, except as approved by Owner's Representative. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees in such a manner as to destroy natural shape. Provide protective covering during delivery. Plant materials delivered without protective covering may be rejected. Do not drop trees during delivery. Label at least one tree of each variety with a securely attached waterproof tag bearing a legible plant name. Remove all tags and flagging as directed by Owner's Representative.
- C. Handle balled and burlapped stock by the root ball only.
- D. Deliver trees after preparations for planting have been completed and install immediately. If planting is delayed more than 6 hours after delivery, set planting materials in shade, protect from weather and mechanical damage, and keep roots moist.
  - A. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
  - B. Do not remove container-grown stock from containers before time of planting.
  - C. Water root systems of trees stored on site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

#### 1.5 PROJECT CONDITIONS

- A. Utilities: Determine location of above grade and underground utilities and perform work in a manner that will avoid damage. Hand excavate, as required. Maintain grade stakes until their removal is mutually agreed upon by parties concerned. Contractor shall be responsible for utility locating, repair of utilities damaged by Contractor, and establishment of grade controls.

- B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Owner's Representative before planting.
- C. Protection: Erect and maintain barricades, warning signs and lights, and provide guards as necessary or required to protect all persons on the site.

#### 1.6 COORDINATION AND SCHEDULING

- A. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.
- B. Plant trees after final grades have been accepted

#### 1.7 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Warrant trees and shrubs for a period of one year after date of Final Acceptance, against defects including death and unsatisfactory growth. Warranty shall not cover defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, abnormal weather conditions unusual for warranty period, or incidents that are beyond Contractor's control.
- C. Replace planting materials that are excessively pruned, more than 20 percent dead, or in an unhealthy or declining condition immediately upon notice from the Owner's Representative.
- D. All plants shall be true to name and meet all conditions of these specifications. Any plant that is not true to name as indicated by form, leaf, flower, or fruiting characteristics shall be replaced at the Contractor's expense.
- E. Inadequate or improper maintenance by the Owner shall not be cause for replacement, provided the Contractor shall have submitted a letter or report to the Owner on improper or inadequate maintenance practices and recommended remedial actions.
- F. The warranty shall not be enforced should any plant die due to vandalism after Final Acceptance.

#### 1.8 TREE MAINTENANCE DURING CONSTRUCTION PERIOD:

- A. Maintain trees by pruning, cultivating, watering, winter watering, weeding, restoring planting saucers, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray as required to keep trees free of insects and disease. Restore or replace damaged tree wrappings. Trees shall be maintained until Final Acceptance of the entire project.

## PART 2 - PRODUCTS

### 2.1 PLANT MATERIALS

- A. General: Furnish nursery-grown trees and shrubs conforming to ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully-branched, healthy, vigorous stock free of disease, insects, eggs, larvae, girdling, and defects such as sun scald, injuries, abrasions, and disfigurement. Trees of a larger size may be used if acceptable to Owner's Representative with a proportionate increase in size of roots and balls.
- B. Label at least 1 plant of each variety and caliper with a securely attached waterproof tag bearing legible designation of botanical and common name.
- C. All plants shall be the species designated on the Drawings. No substitutions will be accepted without the prior written approval of the Owner's Representative. Contractor must provide proof of non-availability.

### 2.2 TREES

- A. Shade Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, conforming to ANSI Z60.1 for type of trees required.
  - A. Branching Height: 1/3 to 1/2 of tree height.
- B. Provide balled and burlapped trees. Container-grown trees will be acceptable in lieu of balled and burlapped trees subject to meeting ANSI Z60.1 limitations for container stock.
- C. All deciduous trees of one species used in formal rows or groupings shall exhibit cultural uniformity, i.e. "matched" in height, crown width and shape, height to first branch, and trunk taper. For this reason it is desired that these trees be produced by a single grower.

### 2.3 SHRUBS

- A. Provide plants well established and rooted in removable containers with not less than the minimum number and length of branches required by ANSI Z60.1 for the pot size indicated.

### 2.4 MULCH

- A. Organic Mulch: Organic mulch, free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of chipped bark and/or wood material not larger than three inches (3") in length/dimension. Submit 1.0 CF sample for approval.
- B. Rock Mulch: 2-4" 'Speckled White' available from Pioneer Sand Co. (719.599.8100) or approved equal.

### 2.5 TOPSOIL

- A. Shall be soil stockpiled on site or excavated from plant pit. Refer to Section 32 91 19.13



2.6 WATER

- A. Water will be available from on-site quick couplers during the irrigation season (generally May through September). Contractor shall supply water when system is not charged.
- B. Water shall not contain any substances injurious to plant growth.

2.7 MISCELLANEOUS MATERIALS

- A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's instructions.
- B. Pre-Emergent Herbicide: Treflan as manufactured by Elanco Company, or an approved substitution.
- C. Trunk-Wrap Tape: Two layers of crinkled paper cemented together with bituminous material, 4 inches (102 mm) wide minimum, with stretch factor of 33 percent.
- D. Herbicides and Pesticides: EPA registered and approved, of type recommended by manufacturer.
- E. Tree Stakes: 8' tall shaved juniper stakes 2" in diameter.
- F. PVC Pipe: ½" diameter and 3' long (approx. – field measure)
- G. Tree Ties: Grommited nylon straps, 1 ½" wide.
- H. Staking Wire: Fourteen (14) or sixteen (16) gauge or larger galvanized steel.
- I. Evergreen Tree Guying Anchor: #4 deformed steel rebar or larger or steel T-bars 30 inches long.
- J. Deadman Type: Locust, catalpa, cedar or redwood, with minimum length of 24 in. and sufficient diameter to hold eyebolt securely. Provide each deadman with on (1) ¾ in. x 4 in. galvanized eyebolt, centered and secured on its side.
- K. Optional Anchor Types: Screw-type galvanized steel ground anchor, or Universal ground anchors, as manufactured by Laconia Malleable Iron Company, Laconia, NH.

- 2.8 STEEL EDGER – Steel edger shall be commercial type steel edging. 3/16" x 4" height x 16' length with tapered steel stakes supplied by the manufacturer (Ryerson, or approved substitute.) Submit a 1 foot long sample to Landscape Architect for approval prior to installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive landscaping for compliance with requirements and for conditions affecting performance of work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Cooperate with any other contractors and trades which may be working in and adjacent to the landscape work areas. Examine drawings which show the development of the entire site and become familiar with the scope of all work required.

### 3.2 FINISH AND FINE GRADING

- A. Tillable Soil: Mechanically rip or disk subsoil in all areas to be planted to minimum depth of 6 inches prior to placing top soil and soil amendments.
- B. Positive Surface Drainage: Finish and fine grade the project area to establish an even and well matched gradient over the entire surface. Provide positive surface drainage, with no depressions, settling, or irregularities in the finished grade.
- C. Transitional Areas: At any transitional point or line where one plane intersect another, such as from a sloping area or berm to a level area, a smooth and gentle transition shall be made. There shall be no abrupt changes in grade unless specifically noted otherwise. Match the grades of new work with existing areas outside the project area.
- D. Finish Grade Tolerance: The finish grade elevation shall not vary above or below the proposed grade more than 0.05 foot.

### 3.3 PREPARATION

- A. Lay out individual tree locations and areas for multiple plantings. Stake locations, outline areas, and secure Owner's Representative's acceptance before the start of planting work. Make adjustments as directed at no additional cost to the Owner.

### 3.4 WEED CONTROL

- A. In areas that have been regraded and/or have existing weed growth, weed control measures appropriate to the amount of growth and/or species shall be provided. Submit weed control plan to Owner's Representative for approval.
- B. Clear and grub, apply pre-emergent herbicide, and/or apply post emergent herbicide as necessary to eliminate weeds. Do not proceed with landscape work until weed growth has been controlled.

### 3.5 TOPSOIL PLACEMENT

- A. Place topsoil to a depth of 4" in shrub beds and planters

### 3.6 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits
  - A. Excavate with vertical sides and with bottom of excavation slightly raised at center to assist drainage. Roughen sides of planting pit.
    - a. Balled and Burlapped Trees: Excavate approximately 2 times as wide as ball diameter. The depth of the plant pit shall be 2 inches less than the depth of the ball in well drained soils and 4 inches less than the ball depth in poorly drained soils.
    - b. Container-Grown Trees and Shrubs: Excavate approximately 2 times as wide as container diameter. The depth of all plant pits shall be 1 inch less than depth of container.
    - c. Where drain tile is shown or required under planted areas, excavate to top of porous backfill over tile.

B. Obstructions

- A. Notify Owner's Representative if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavation.

C. Drainage

- A. Notify Owner's Representative if subsoil conditions show evidence of water seepage or retention in tree or shrub pits.
- B. Fill the pit with water and allow it to completely drain before planting occurs.
- C. If water does not drain out of pit within 24 hours, notify Owner's Representative.

3.7 PLANTING TREES AND SHRUBS

A. Balled and Burlapped Stock:

- A. Set balled and burlapped stock plumb and in center of pit with top of ball raised above adjacent finish grades as indicated.
- B. Remove burlap from tops of balls and partially from sides, but do not remove from under balls. Remove wire baskets entirely. Remove pallets, if any, before setting. Do not use planting stock if ball is cracked or broken before or during planting operation.
- C. Place backfill around ball in layers, tamping to settle backfill and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing and tamping final layer of backfill. Create 48" diameter saucer around tree and fill with 4" specified mulch.

B. Container Grown Stock:

- A. Carefully remove containers so as not to damage root balls.
- B. Lightly scratch sides of exposed root ball to loosen surface roots.
- C. Set plants plumb and in center of pit or trench with top of ball raised above adjacent finish grades as indicated.
- D. Place backfill around ball in layers, tamping to settle backfill and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing and tamping final layer of backfill.

C. Wrap trees with trunk-wrap tape

- A. Start at base of trunk and spiral cover trunk to height of first branches. Overlap wrap, exposing half the width, and securely attach without causing girdling. Do not use staples. Inspect tree trunks for injury, improper pruning, and insect infestation and take corrective measures required before wrapping.
- B. No tree shall be wrapped after May 21 nor before November 1.
- C. All deciduous trees shall be wrapped by November 15. Remove tree wrap by May 15.
- D. Contractor shall be responsible for wrapping and unwrapping trees during the warranty period.

3.8 PRUNING OF PLANTS

- A. Prune, thin, remove injured or dead branches, and shape plants as directed by Owner's Representative.

3.9 MULCHING

- A. Mulch backfilled surfaces of pits, planted areas, non-irrigated zones, and other areas indicated.
- B. Pre-Emergent Herbicide
  - A. Apply pre-emergent herbicide to all shrub bed areas at the rate recommended by the manufacturer. Do not apply to annual, perennial, or ground cover areas.
- C. Mulch in shrub bed areas: Apply 4" (100 mm) thick layer of mulch and finish level with adjacent finish grades. Do not place mulch against trunks or stems.
- D. Mulch tree rings in turf and native grass areas with 4 inch depth specified mulch. Mulch ring to be 48" diameter.

3.10 INSTALLATION OF MISCELLANEOUS MATERIALS

- A. Apply antidesiccant using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage.
  - A. When deciduous trees or shrubs are moved in full-leaf, spray with antidesiccant at nursery before moving and again 2 weeks after planting.

3.11 CLEANUP AND PROTECTION

- A. During landscaping, keep pavements clean and work area in an orderly condition.
- B. Protect landscaping from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.
- C. At the time of the final inspection of the work, clean all paved areas by sweeping and washing. Remove construction equipment, excess materials, debris or rubbish from the site.

3.12 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal
  - A. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of it off the Owner's property.

END OF SECTION

## SECTION 334416

### TRENCH GRATES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. The General Contract Conditions, Drawings, and Division - 1 Specification sections, apply to Work of this section.

##### 1.02 DESCRIPTION

- A. The work in this section consists of furnishing and installing iron trench grates.

##### 1.03 RELATED SECTIONS

- A. Section 033000 - Cast-In-Place Concrete
- B. Section 312000 – Earthwork
- C. Section 321413 – Concrete Unit Pavers

##### 1.04 QUALITY ASSURANCE

- A. Material and craftsmanship for trench grates shall conform to recognized association standards.
- B. Contractor to submit color samples, technical data, and installation methods prior to any ordering, manufacturing, and installing of these items.
- C. Contractor to field locate each item and associated paving prior to any installation and/or construction and shall have Owner's Representative's review.

##### 1.05 SUBMITTALS

- A. Manufacturer's Product Data: Copies of manufacturer's product data and installation instructions shall be submitted in accordance with Section 01300 Submittals. Product data shall include vehicular rating per specifications.
- B. Shop Drawings: Shop drawings shall be submitted for installation for trench grates and assembly prior to fabrication.

##### 1.06 DELIVERY, STORAGE AND HANDLING

- A. All trench grates and slot drains described herein shall be delivered from the manufacturer as designated and accepted and stored by the Contractor until time of installation.
- B. Protect all materials from damage, deterioration or loss of any kind while in storage and during construction.
- C. Ensure that materials have not been damaged during shipping. No damaged materials shall be accepted. If materials have been damaged beyond repair, they must be replaced with new materials of the same type and kind at no additional cost to the Owner. Damaged materials which have been repaired will be accepted only if the damaged part or parts can be replaced with a completely new manufacturer-supplied part or parts of the same type and kind.

1.07 PROJECT CONDITIONS

- A. Do not begin furnishings work before completion of final grading or surfacing.
- B. Review installation procedures and coordinate installation work with other work affected.
- C. Protect adjacent work from damage, soiling, or staining during installation.
- D. Protect underground snowmelt system, irrigation, and other utilities from damage during installation.

PART 2 - PRODUCTS

2.01 TRENCH GRATE & FRAME

- A. Trench Grate & Frame shall be installed per manufacturer's details and specifications. Trench Grate shall be provided by ACO Polymer Products, [www.acousa.com](http://www.acousa.com), mountain region 520.421.9968  
  
Pedestrian Type: ACO Klassikdrain K100 Galvanized steel edge rail channel system  
Width: 4"  
Grate: 410D/412D Galvanized Perforated Steel Grate (ADA compliant)
- B. Owner's Representative shall provide the contractor with a diagram of the Type Locations prior to the contractor ordering the trench grates. Trench Grate shall meet the following specifications:
  - a. Pedestrian Type: Class A load (2,000 lbs live load / 3,372 lbs per foot)

2.03 CONCRETE

- A. Reference Section 033000 - Cast-In-Place Concrete

2.04 STORM SEWER CONNECTIONS

- A. Contractor shall provide connection to storm sewer as indicated on the construction plans. Connection type is at Contractor's discretion. Contractor shall provide shop drawing of connection for approval by Owner's Representative prior to construction.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Owner's Representative shall supply the contractor with a diagram of the Type Locations prior to contractor ordering the trench grates.
- B. Contractor shall field verify site conditions with Owner's Representative prior to construction. Contractor shall confirm trench grate placement locations and storm sewer connections.
- C. Contractor shall prepare and compact subgrade in accordance with 02200
- D. Contractor shall place and compact aggregate base course in accordance with 02200 and 02232.

3.02 TRENCH GRATE AND FRAME FABRICATION

- A. Contractor shall field verify trench grate and frame layout prior to fabrication. Contractor shall be responsible for final trench grate and frame measurements for fabrication and installation including all custom radius installations. Resolution of any fabrication errors or inconsistencies shall be the responsibility of the Contractor once ordered at no additional cost to the Owner.

3.03 INSTALLATION

- A. Contractor shall install concrete surround, concrete trench, frame, grate, and assembly in accordance with the manufacturer's instructions and in accordance with the construction plans and specifications.
- B. Contractor shall connect trench drain to storm sewer system.

3.04 CLEANING

- A. Perform cleaning during installation of work and upon completion of the work. Remove from site all excess materials, debris and equipment. Repair damage resulting from installation.
- B. Prior to completion of project, clean trench grates assemblies as needed, to remove any excess concrete, dust, and dirt.

END OF SECTION

**APPENDIX A**  
**GEOTECHNICAL INVESTIGATION**



**Geotechnical Investigation and  
Pavement Design**

**Burgess Creek  
Diversion Structure and Plaza  
Steamboat Springs, Colorado**

**Project No. 29-133  
October 8, 2009**

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## **PURPOSE AND SCOPE**

This report presents the results of our geotechnical investigation and pavement design for the Burgess Creek Diversion Structure and Plaza project located at the base of Steamboat Mountain in Steamboat Springs, Colorado (Figure 1). The project includes a new diversion structure, a structural fill area with retaining walls, bridges, paving and a granite boulder with stone outcrops. The purpose of this study was to evaluate geotechnical characteristics of the on-site soils and pavement subgrade to provide geotechnical recommendations for the diversion structure, grading, retaining walls, bridges, pavement, the granite boulder landscape feature and other geotechnical related issues at the subject site.

The site investigation consisted of geologic reconnaissance and exploratory test hole drilling to investigate subsurface conditions. Test hole drilling was observed by a representative of Yeh and Associates. Samples obtained during the field exploration were examined by the project personnel and representative samples were subjected to laboratory testing to determine the engineering characteristics of materials encountered. This report summarizes our field investigation, the results of our analysis, and our conclusions and recommendations based on the proposed construction, site reconnaissance, subsurface investigation, and results of the laboratory testing.

## **PROPOSED CONSTRUCTION**

We understand that this project involves the demolition and reconstruction of an existing diversion structure immediately east of the Slopeslide Grill, placement of fill (of up to 17 feet) with associated retaining walls immediately south of the Torian Plum parking garage, the construction of three bridges along the Promenade alignment between and adjacent to the Preview Lift and just south of the Gondola Lift, the placement of a granite boulder with associated stone outcrops near the Fire Terrace and the paving (concrete unit pavers) of the Promenade and associated areas. At the time of the investigation, locations for the diversion structure, fill area, bridges and the granite boulder were provided as well as the diversion structure footing elevation. All other information including retaining wall and bridge footing elevations, wall heights, alignment and subgrade elevations and the granite boulder planned grades were not available.

## **SITE CONDITIONS**

The site is located within a quarter mile east and southeast of the intersection of Mount Werner Circle and Ski Time Square Drive near the base of Steamboat Mountain in Steamboat Springs, Colorado. At the time of investigation, the existing diversion structure was being demolished in preparation of new construction. The existing top of the Torian Plum parking garage was about 17 feet higher than the existing “old tennis court area”. The proposed promenade area was situated between the Sheraton/Gondola Building and the Christie, Preview and Gondola Lifts. The site gently slopes down from the “old tennis court area” to Gondola Lift at a grade of less than 5 percent. The existing Promenade alignment is currently the ski service road and access for on-going construction. The site was covered with dirt, weeds, grass and gravel.

## **SUBSURFACE CONDITIONS**

Subsurface conditions were investigated by drilling six exploratory test holes. Wenk and Associates provided suggested test hole locations. A seventh test hole (for the most southern bridge) was not drilled because of access, existing utilities and fire access issues. Test hole locations are presented on Figure 2. Test hole TH-1 was drilled for the new diversion structure, test holes TH-2 and TH-3 for the structural fill /retaining wall area, test holes TH-4 and TH-5 for two bridges and test hole TH-6 for the granite boulder. All test holes were advanced using a CME 55 drill rig with 4-inch continuous flight auger to pre-determined depths or practical drill rig refusal. A modified California or standard split spoon sampler was used to record blow counts and obtain samples. Bulk samples were also obtained.

To perform a modified California penetration resistance test, a 2-inch inside diameter sampler was seated at the bottom of the test hole, then driven up to 12 inches with blows of an standard hammer weighing 140 pounds and falling a distance of 30 inches utilizing a “cats head” (ASTM D1586). The number of blows (Blow Count) required to drive the sampler 12 inches or a fraction thereof, constitutes the N-value. The N-value, when properly evaluated, is an index of the consistency or relative density of the material tested. The standard split spoon penetration resistance test is performed in the same manner, but utilizing a 1.5-inch sampler. The results are shown on the test hole logs in Figures 3 and 4.

Subsoils encountered in the test holes consisted of fill underlain by sand, clay and gravel. The fill consisted of silty, clayey sand, silt and clay. The sand fill occasionally consisted

of gravels and cobbles. The natural sand and gravel contained occasional silt, clay, and cobbles. The natural clays contained occasional gravel and cobbles as well. Practical drill rig refusal was encountered in test holes TH-3 and TH-4 at depths of 16.5 and 7.5 feet, respectively. Weathered Shale bedrock was encountered in test hole TH-5 at a depth of 19 feet only and not encountered in all other test holes to maximum depths explored. Seven sand fill samples tested had 25 to 39 percent fines (material passing the No. 200 sieve). Atterberg limit testing on these sand fill samples exhibited liquid limits of non-liquid to 28 percent and plastic indices of non-plastic to 11 percent. Three silt and clay fill samples tested had 53 to 72 percent fines, liquid limits of 33 to 35 percent and plastic indices of 1 to 20 percent. Three natural sand and gravel samples tested had 10 to 33 percent fines, liquid limits of 26 to 33 percent and plastic indices of 9 to 16 percent. Two natural clay samples tested had 71 and 77 percent fines, a liquid limit of 38 percent and a plastic index of 22 percent. Two sand fill samples exhibited no movement and low collapse (0.0 and -1.3 percent) when wetted under an applied load of 1,000 psf. One clay fill and one natural clay sample exhibited low swell (0.2 and 0.1 percent, respectively) when wetted under an applied load of 1,000 psf. The sand fill was loose to very dense and classified as an SM and SC, the silt fill was stiff and classified as an ML, the clay fill was stiff to very stiff and classified as a CL, the natural sand was loose to very dense and classified as a SM and SC, the natural clay was stiff to very stiff and classified as a CL and the natural gravel was very dense and classified as a GP-GC all according to the Unified Soil Classification System (USCS). Results of the laboratory testing are presented in Figures 5 through 7 and are summarized in the Summary of Laboratory Test Results.

Groundwater was encountered in test hole TH-1 at a depth of 7 feet. Delayed water level checks were unavailable. Subsoils were slightly moist to very moist. All test holes were backfilled and/or plugged off at the surface immediately after drilling. Variations in groundwater conditions may occur seasonally. The magnitude of the variation will be largely dependent upon the amount of spring snowmelt, duration and intensity of precipitation, local landscape irrigation practices, site grading changes, and the surface and subsurface drainage characteristics of the surrounding area. Perched water tables might be present, but were not encountered at the time of this investigation. Due to the shallow groundwater condition in the vicinity of test hole TH-1, temporary diversion and/or dewatering may be necessary for the excavation of the new diversion structure.

## **SITE DEVELOPMENT**

For the structural fill area, short, grade break retaining walls were provided and wall heights and footing levels can be determined or estimated from proposed topography. We believe foundation soils would consist of the new structural fill to be placed. It is our understanding that an MSE (mechanically stabilized earth) retaining wall is planned adjacent to the existing south wall of the Torian Plum parking garage. We believe this wall could be up to 17 feet in height and that foundation soils would consist of the existing sand fill. We understand that on-site fill material is to be used for site grading fill. MSE wall backfill would likely consist of granular soils. Onsite sand or gravel could be used for MSE wall construction. Prior to wall construction, proposed backfill materials should be approved by the designer.

We believe all of the materials encountered at this site may be excavated with conventional heavy equipment although with depth, the gravels near foundation depth in the vicinity of test hole TH-4 (upper bridge) become denser and larger and may require additional effort and means.

Areas to receive fill should be stripped of vegetation, organic soils and debris. Topsoil is not recommended for fill material. Fill should be placed in thin, loose lifts of 8 inches thick or less. For granular soils, we recommend the materials be moisture conditioned to within 2 percent of optimum moisture content and compacted to at least 95 percent of maximum standard Proctor dry density (ASTM D 698). For fill below a depth of 15 feet, we recommend the materials be moisture conditioned within 2 percent of optimum moisture content and compacted to at least 100 percent of maximum standard Proctor dry density (ASTM D 698). Placement and compaction of fill should be observed and tested by a representative of the geotechnical engineer.

For the boulder feature, we recommend a 2-foot over excavation and replacement with Class 2 or 6 material. A nonwoven geofabric separator (Mirafi 140N or equivalent) should be placed at the base of the over excavation prior to placement of the structural fill.

## **FOUNDATION RECOMMENDATIONS**

Based on the results of our subsurface investigation, we believe the bridges, fill wall and diversion structure may be supported on footing foundations placed on the onsite soils. The

boulder feature could be supported on 2 feet of Class 2 or 6 structural fill as discussed above. Based on the anticipated construction and subsurface conditions, we believe there would likely be a low risk of foundation movement. Foundation excavations should be observed by a representative of the geotechnical engineer prior to foundation construction. The following design and construction details should be observed for footing foundations placed on onsite or imported soils.

1. Loose, disturbed soils encountered at foundation level should be removed and recompact. Compaction recommendations are presented in the SITE DEVELOPMENT section.
2. Footing foundations can be designed for a maximum allowable soil pressure of 2,000 psf.
3. Resistance to sliding at the bottom of the footing can be calculated based on a coefficient of friction of 0.30. Passive pressure against the side of the footing can also be considered for the sliding resistance if it is properly compacted. Passive pressure can be estimated based on an equivalent fluid density of 300 pcf for a level backfill.
4. Footing foundations should be protected from freezing. We recommend the bottom of footings be constructed at least 3.5 feet below finished grade or as required by local municipal code.
5. All foundation excavations should be observed by a representative of the geotechnical engineer prior to placement of concrete.

## **RETAINING WALLS**

If retaining walls are able to rotate to mobilize shear strength of the retained soils, the walls can be designed for active earth pressure conditions. Wall rotation is typically on the order of 0.5 to 1 percent of the wall height. We recommend retaining walls be backfilled with imported, Class 1 structural fill. If Class 1 material is utilized, retaining walls could be designed using an “active” equivalent fluid pressure of 35 pcf. This equivalent fluid density assumes a horizontal backfill. If wall rotation cannot be tolerated, a higher equivalent fluid density should be used such as an “at rest” condition. For “at rest” conditions, we recommend using an equivalent fluid density of 45 pcf for Class 1 backfill. Passive pressure against the footing can be calculated using an equivalent fluid density of 350 pcf for on-site material backfill. These values assume the backfill materials are not saturated. Wall designs should consider the influence of surcharge loading such as traffic, construction equipment and/or sloping backfill.



Retaining walls should be constructed with a drainage system to drain away any excess water immediately behind the wall. The drainage system may consist of free-draining gravel and/or weep holes commonly used for the wall drainage.

## PAVEMENT DESIGN

A pavement section is a layered structure designed to disperse dynamic traffic loads to the subgrade. The performance of the pavement structure depends on the traffic loadings and physical properties of the subgrade materials. As described below, concrete and aggregate base course (ABC) thicknesses derived from our understanding of the project, vehicle loading, subgrade materials, laboratory testing and our experience with similar type projects.

### Subgrade Materials

Based on the results of our field exploration and laboratory testing, the pavement subgrade material generally consisted of sand fill, silt fill, clay fill and natural sand soils. These soils classified as SC, ML and CL in accordance with the Unified Soil Classification System (USCS).

### Traffic Loading

Based on conversations with Wenk and Associates, our understanding of traffic loading will likely be limited to occasional service vehicles. Most of the traffic loading will be generated from pedestrian foot traffic. The low traffic loading typically results in recommended minimum thickness requirements. Table 1 presents recommended minimum thicknesses based on proposed traffic loadings.

Table 1 –Recommended Concrete and ABC Thicknesses

Roadway Section	Recommended Concrete Thickness (inches)	Recommended ABC Thickness (inches)
Promenade Roadways (vehicle traffic)	6	6
Promenade Plaza (pedestrian traffic)	-	12

### Subgrade Preparation

Prior to placing aggregate base course and concrete, the entire subgrade area should be scarified to a depth of 12 inches and recompact to the specified relative compaction with a

moisture content in accordance with the CDOT Standard Specifications for Road and Bridge Construction. In locations where the in-place subgrade contains more than 40 percent minus No. 200 sieve material, a separator fabric conforming to CDOT Separator Geotextile Class B should be installed prior to placing the aggregate base course. Based on our investigation, a separator fabric may be necessary in the areas of test holes TH-4 and TH-5. Imported fill material should be compacted in thin lifts to within 2 percent of optimum moisture content in accordance AASHTO T 99 or T 180. As noted above, the ABC should have a minimum R-value of 77. For all layers, drainage needs to be addressed during construction to prevent ponding of water and provide for ease of construction. The pavement subgrade and each layer ABC should be proof rolled with a heavily loaded pneumatic-tire vehicle. Areas which deform more than 0.5 inch under heavy wheel loads should be removed, replaced if necessary and reworked to achieve a stable subgrade prior to paving. We recommend that proof rolling and compaction tests be performed under the direct supervision of a representative of the geotechnical engineer.

#### Drainage Considerations

The collection and diversion of surface drainage away from paved areas is critical to the satisfactory performance of the pavement. Proper drainage design should include prevention of ponding of water on or immediately adjacent to pavement areas. All landscape sprinkler heads and lines if any, adjacent to pavement areas should be frequently checked for leaks and maintained in good working order. Over-spray from sprinklers should be minimized. Concentrated runoff should be avoided in areas susceptible to erosion. Slopes and other stripped areas should be protected against erosion by re-vegetation or other methods.

#### **WATER SOLUBLE SULFATES**

Based laboratory test results, we anticipate a Class 0 exposure for concrete due to the presence of water-soluble sulfate. Based on ACI 201.2R-01, "Guide to Durable Concrete," concentrations between 0 and less than 0.1 percent represent Class 0 exposures (negligible). For cast-in-place structures such as curb and gutter and pavements placed on natural soils, ACI requires no special requirements for sulfate resistance. Structural fill and aggregate base course are assumed to have Class 0 exposure or no effect on concrete as well.

## **LIMITATIONS**

The analyses and recommendations presented in this report are based upon our data obtained from the borings at the indicated locations, field observations, laboratory testing, our understanding of the proposed construction and other information discussed in this report. It is possible that subsurface conditions may vary between or beyond the points explored. The nature and extent of such variations may not become evident until construction. If variations appear, we should be contacted immediately so we can review our report in light of the variations and provide supplemental recommendations as necessary. We should also review the report if the scope of the proposed construction, including the proposed loads, finished elevations or structure locations, change from those described in this report. The conclusions and recommendations contained in this report shall not be considered valid unless Yeh and Associates reviews the changes and either verifies or modifies the conclusions of this report in writing.

The scope of services for this project did not include, specifically or by implication, any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions or biological conditions. If the owner is concerned about the potential for such contamination, conditions or pollution, other studies should be undertaken.

The report was prepared in substantial accordance with the generally accepted standards of practice for geotechnical engineering as exist in the site area at the time of our investigation. No warranties, express or implied, are intended or made. The recommendations in this report are based on the assumption that Yeh and Associates will conduct an adequate program of construction testing and observation to evaluate compliance with our recommendations.

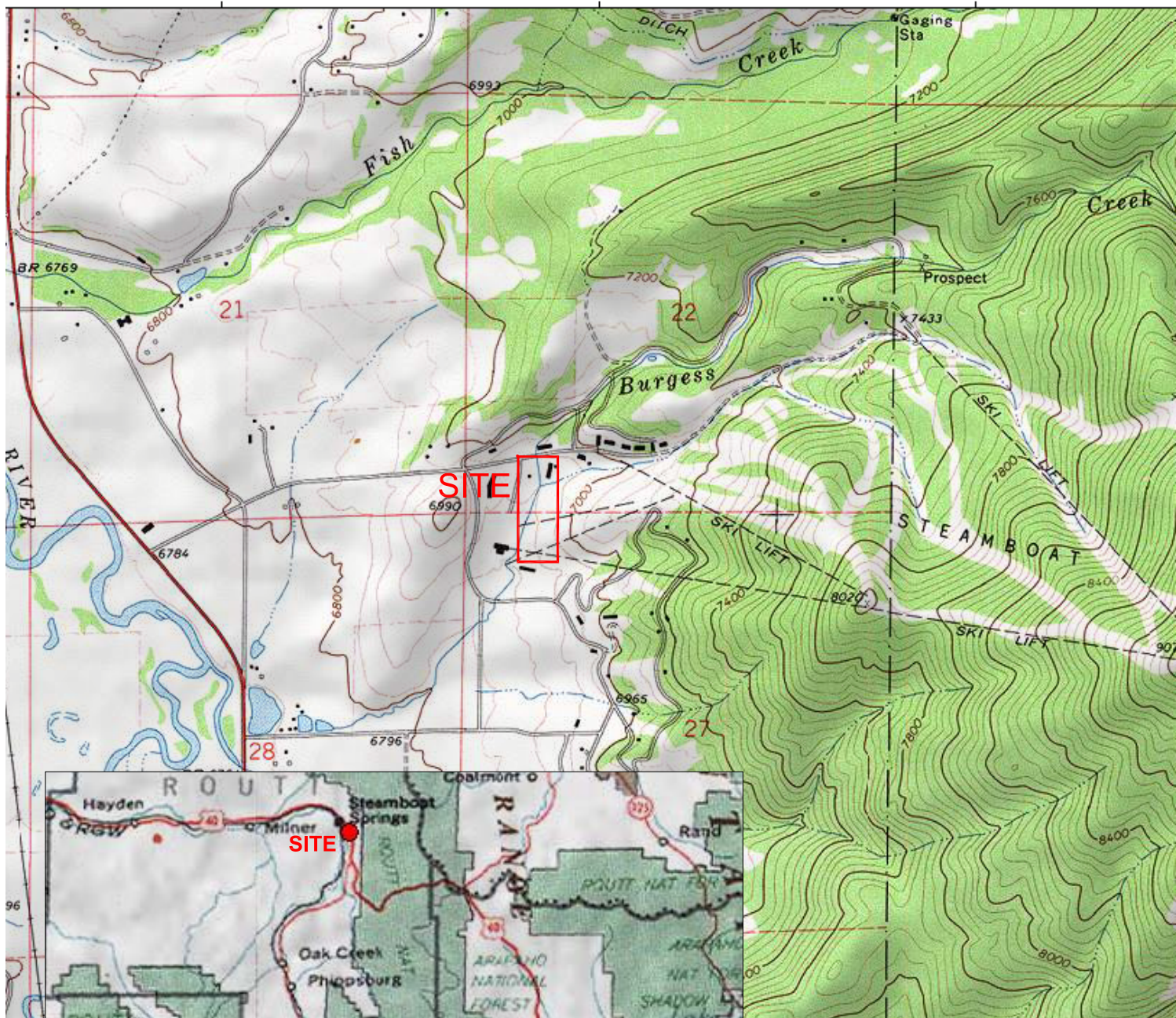
YEH AND ASSOCIATES, INC.

Reviewed by:

Keith E. Asay  
Staff Engineer

Richard D. Johnson, P.E.  
Senior Geotechnical Engineer





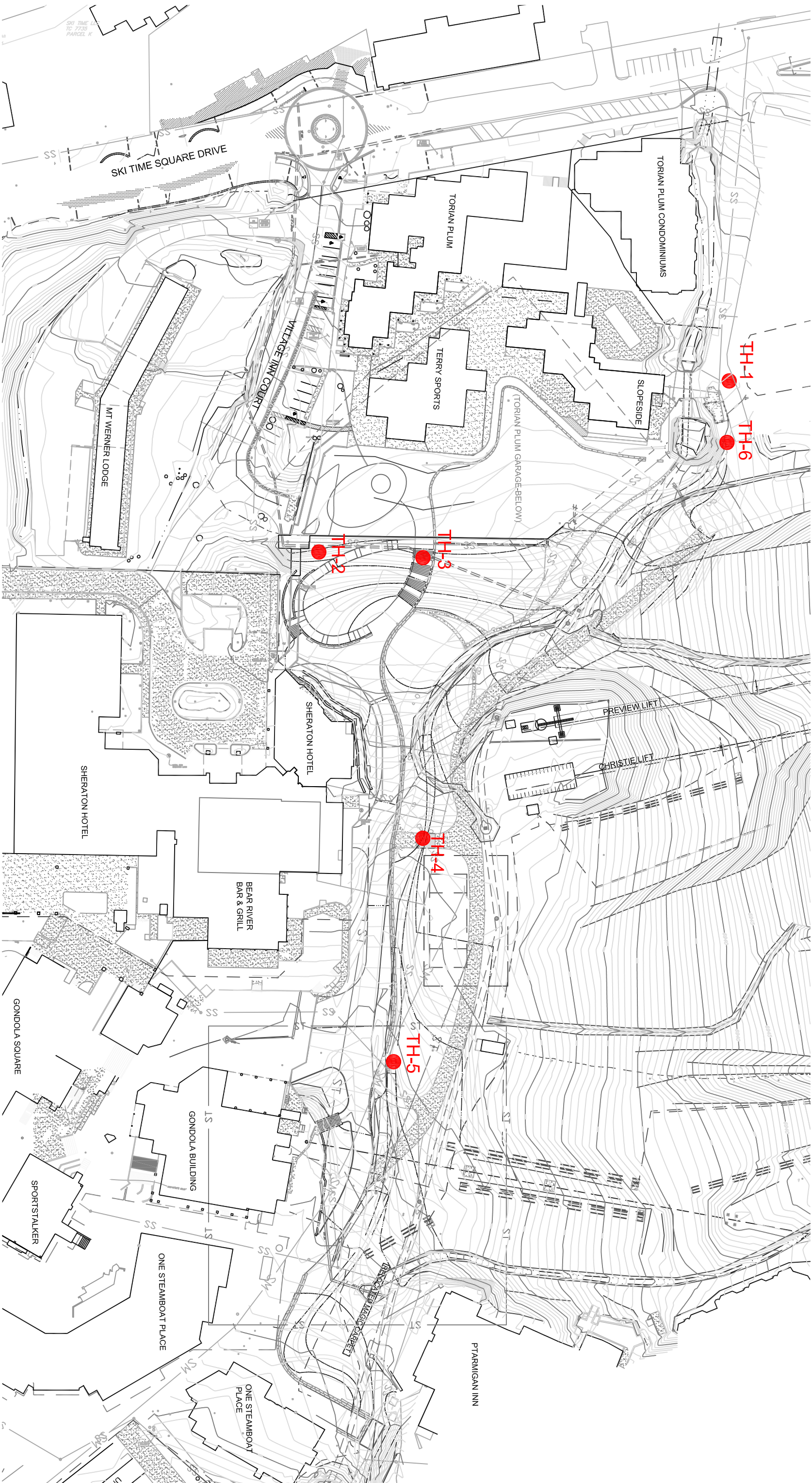
Topographic maps created with TOPO!® © National Geographic

Not to scale



**Approximate  
Site Location**

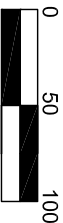




Base map provided by Wenk Associates, Inc., Denver, Colorado

LEGEND:

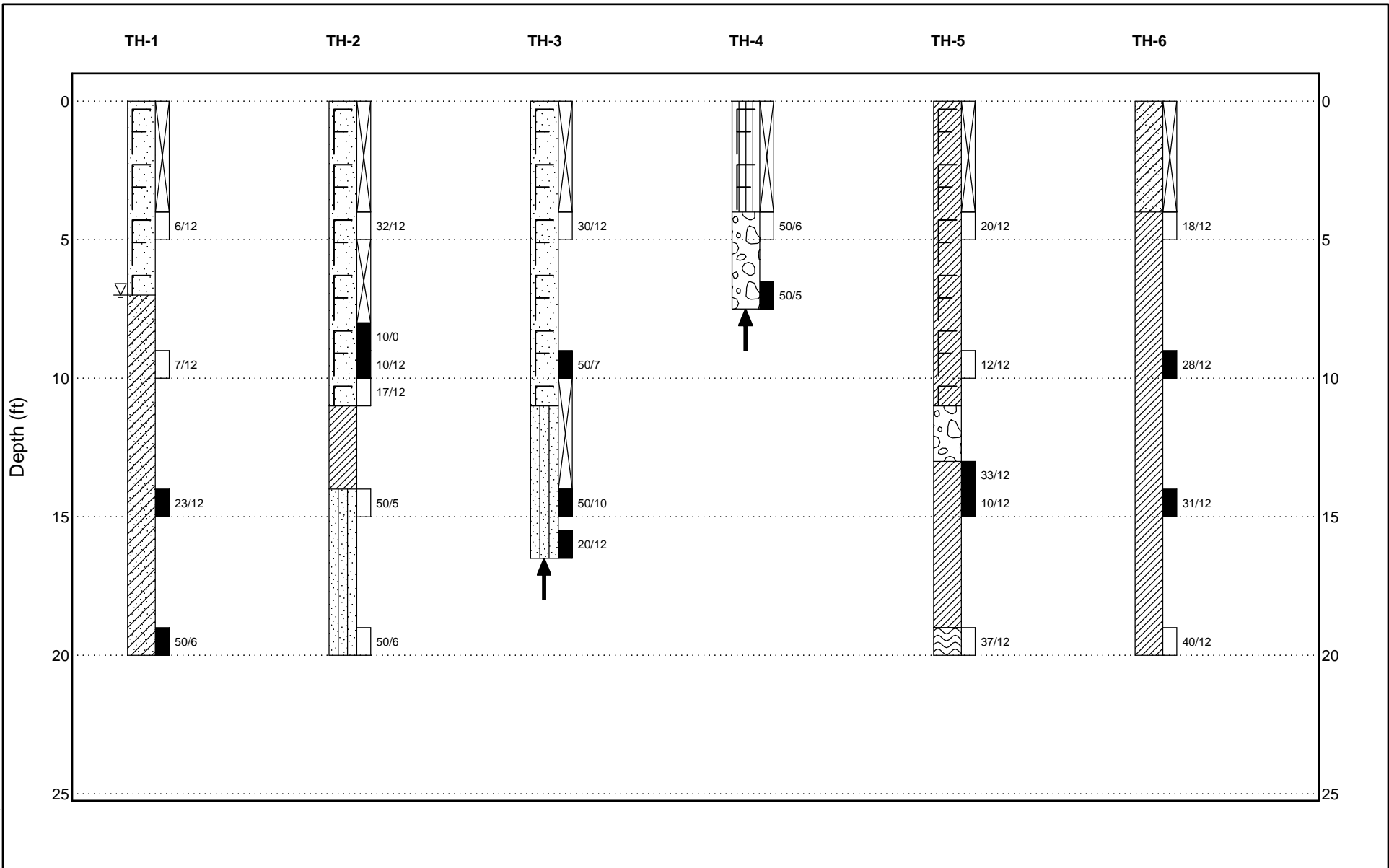
**TH-1** Indicates approximate location of exploratory test hole



SCALE: 1" = 100'

# Approximate Test Hole Locations

FENCES BY DEPTH - A SIZE 28-133, LOGS.GPJ RDJ.GDT 10/1/09



**YEH AND ASSOCIATES, INC.**  
 GEOTECHNICAL ENGINEERING CONSULTANTS

Burgess Creek Diversion Structure and Plaza

Project Number: 29-133

Figure 3

# Legend for Symbols Used on Test Hole Logs

## Sample Types



Modified California Sampler. The symbol 6/12 indicates that 6 blows from a 140 pound hammer falling 30 inches was used to drive 2-inch I.D. sampler 12 inches.



Split Spoon Sampler. The symbol 23/12 indicates that 23 blows from a 140 pound hammer falling 30 inches was used to drive 1.5-inch I.D. sampler 12 inches.



Bulk sample was obtained from auger cuttings at the depths indicated.

## Other Symbols



Indicates practical drill rig refusal.



Indicates depth to groundwater at time of drilling.

## Soil Lithology



Fill: Sand, silty, clayey, occasional gravel and cobble, loose to very dense, slightly moist to very moist, brown, dark brown, black (SM, SC).



Fill: Silt, sandy, occasional gravel, stiff, moist, dark brown (ML).



Fill: Clay, sandy, occasional gravel, stiff to very stiff, moist to very moist, brown, dark brown, gray (CL).



Sand, silty, occasional gravel and cobble, medium dense to very dense, slightly moist to moist, brown (SM).



Sand, clayey, occasional gravel and cobble, loose to very dense, slightly moist to wet, brown, dark brown, black (SC).



Clay, sandy, occasional gravel and cobble, stiff to very stiff, slightly moist to very moist, brown, gray (CL).



Gravel, poorly graded with clay, occasional cobble, very dense, slightly moist, brown (GP-GC).

## Bedrock Lithology



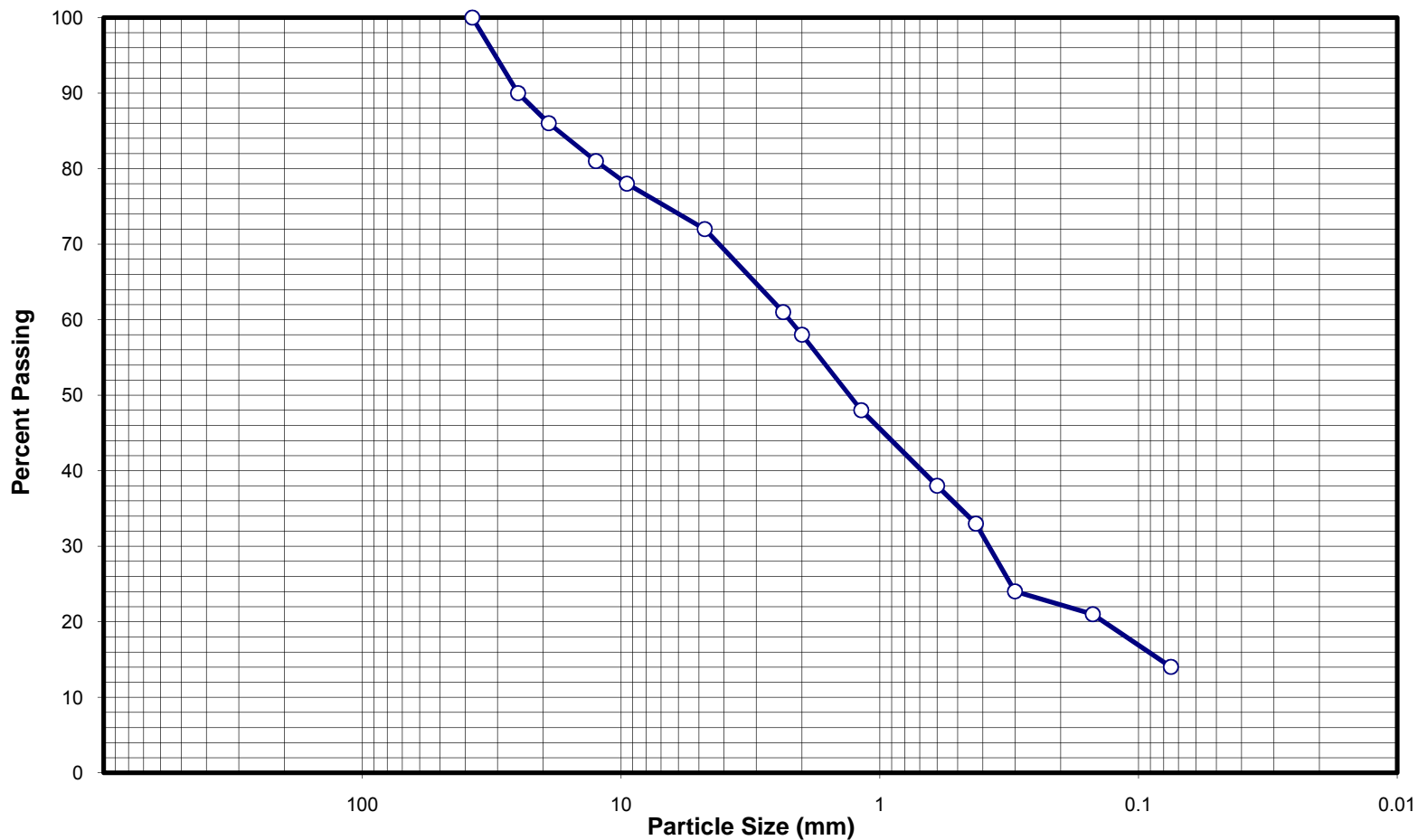
Weathered Shale, medium hard, slightly moist, gray.

### Notes:

1. Test holes were drilled on 8/19/2009 using 4-inch continuous flight auger.
2. Test hole descriptions are subject to explanations contained in this report.

Sieve Analysis		Hydrometer Analysis
Sieve Opening in Inches	U.S. Standard Sieves	Size of Particles in mm

12" 6" 3" 2" 1" 3/4" 1/2" 3/8" 4 8 10 16 30 40 50 100 200

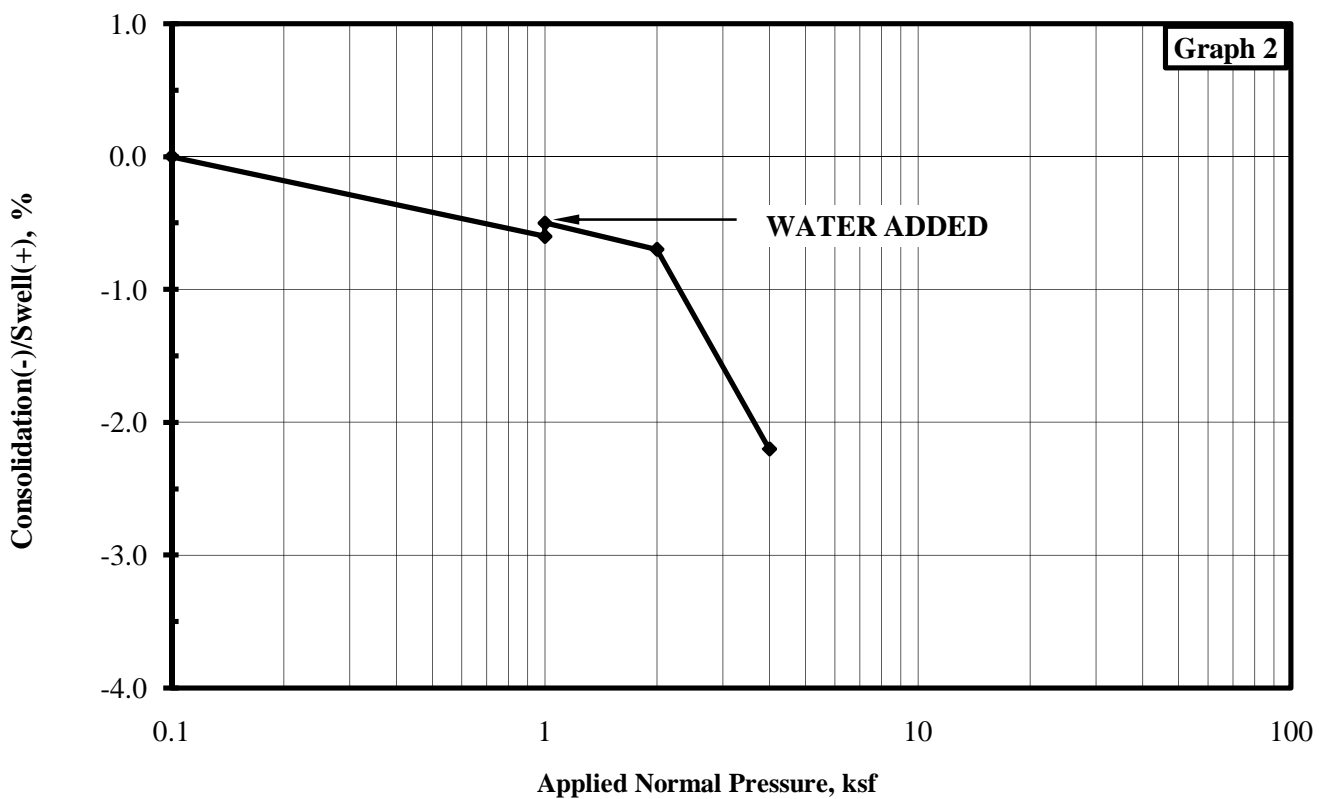


Sieve Size	% Passing
3"	-
2 1/2"	-
2"	-
1 1/2"	100
1"	90
3/4 "	86
1/2"	81
3/8"	78
#4	72
#10	58
#40	33
#200	14

Gravel (%)	28	LL	31	Project Name:	Burgess Creek Diversion Structure and Plaza		
Sand (%)	58	PL	22	Sample ID:	TH-1		
Fines (%)	14	PI	9	Sample Depth (ft.):	9		
Sample Description:				Sand, clayey (SC)			
</							







Graph Number	Boring Number	Depth (ft)	Natural Dry Density (pcf)	Moisture Content (%)	Swell(+) / Consolidation(-) (%)	Soil Description	SWELL / CONSOLIDATION GRAPH
1	TH-5	4	109	14.4	0.2	Fill: Clay, sandy (CL)	Drawn By: KEA
2	TH-6	4	105	9.7	0.1	Clay, sandy (CL)	Checked By: RDJ
Job No:	29-133	Project Name:		Burgess Creek Diversion Structure and Plaza			Figure 7
YEH & ASSOCIATES, INC.							



## Summary of Laboratory Test Results

Project No: 29-133

Project Name: Burgess Creek Diversion Structure and Plaza

Sample Location			Moisture Content (%)	Dry Density (pcf)	Grain Size Analysis			Atterberg Limits			Swell (+) / Consolidation (-) under 1000 psf (%)	Water Soluble Sulfate (%)	Soil Description
Test Hole	Depth (ft)	Sample Type			Gravel > #4 (%)	Sand (%)	Fines < #200 (%)	LL	PL	PI			
TH-1	0-4	Bulk	11.7				25	27	19	8			Fill: Sand, clayey (SC)
	4	CA	13.6	119									Fill: Sand, clayey (SC)
	9	CA	18.9		28	58	14	31	22	9			Sand, clayey (SC)
TH-2	0-4	Bulk	7.7				34	NL	NP	NP			Fill: Sand, silty (SM)
	5-9	Bulk	8.8				30	NL	NP	NP			Fill: Sand, silty (SM)
	10	CA	9.6	116			39				-1.3		Fill: Sand, silty (SM)
TH-3	0-4	Bulk	11.0				27	28	17	11			Fill: Sand, clayey (SC)
	4	CA	10.5	105			28				0.0		Fill: Sand, silty (SM)
	10-14	Bulk	9.7				25						Sand, silty (SM)
TH-4	0-4	Bulk	11.7				53	33	32	1		0.006	Fill: Silt, sandy (ML)
	4	CA	4.2				10	33	17	16			Gravel, poorly graded with clay (GP-GC)
TH-5	0-4	Bulk	18.8				72	35	25	20			Fill: Clay, sandy (CL)
	4	CA	14.4	109			71				0.2		Fill: Clay, sandy (CL)
	14	Bulk	22.8				77	38	16	22			Clay, sandy (CL)
TH-6	0-4	Bulk					33	26	14	12		0.001	Sand, clayey (SC)
	4	CA	9.7	105			71				0.1		Clay, sandy (CL)

CA-Indicates modified California sample

NL-Indicates non-liquid

NP-Indicates non-plastic