Technical Specifications

Kerr Admin South Parking Lot

Bid Set

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Project Engineer: Mark Reuland, PE

March 1, 2023 | KPFF Project #2000403

kpff

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TECHNICAL SPECIFICATIONS

Division 01 prepared by OSU, dated April 2023

[1] Prepared by KPFF, dated March 1, 2023

Division 05, 26, 31, 32, 33 prepared by KPFF, dated March 1, 2023

SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY OF WORK

A. The Work Contract consists of reconstruction of the existing Kerr South parking lot on the Oregon State University Campus, Corvallis, Oregon. The project also contains right-of-way improvements including construction of a new pedestrian crossing on 15th Street. The work generally consists of: demolition of existing asphalt and concrete, re-alignment of sanitary sewer utilities, new pathway lighting, irrigation system improvements, new landscaping, and replacement of parking lot asphalt, concrete ADA stalls, walk paths, and plaza.

In general, PIPC improvements include construction of a raised pedestrian crossing, new sidewalks, new driveway, asphalt restoration, storm drain improvements, tree removal, and street lighting.

B. Work can begin within ten (10) calendar days after signing of Contract on behalf of Oregon State University. The Contract may not be signed prior to approval of the Contractor's Certificate of Insurance by Construction Contract Administration (CCA), Oregon State University. Project has flexible construction period, between June 19 and September 22 of 2023, however it must reach final completion within a 75-day timeframe within those dates. The work must be scheduled and coordinated carefully, as the project area tends to be a more populated location on the OSU campus. Substantial Completion is expected to be within 60 days after start of active construction on site.

1.02 CONTRACTORS USE OF PREMISES

A. Contractor shall limit use of the Premises for work and storage to allow for:
   1. Owner occupancy, day and night.
   2. Public use, day and night.
   3. Security.
   4. Safe entry and exit for vehicles and pedestrians.
   5. Fire egress.

B. Coordinate all operations with the Owner's Authorized Representative during the construction period. A 96-hour notification is required prior to scheduled utility shutdowns or street closures, but more lead time is often required to schedule around other critical activities.

C. Limit Contractor's employee parking to locations designated at the Pre-construction Conference.

1.03 OWNER OCCUPANCY

A. The Owner will occupy the Premises during the entire period of construction for the conduct of normal operations. Cooperate with Owner's Authorized Representative in construction operations to minimize conflict and to facilitate the Owner's usage especially in the following areas:
   1. Restricted access and parking.
   2. Use of stairs.
   3. Storage space availability.

B. Conduct operations in such a way to ensure the least inconvenience to the general public, including:
   1. Limitations and easements.
   2. Emergency vehicle access.
   3. Building access to the public, day and night.

C. Temporary signage to indicate closures will be required to safely direct pedestrian and vehicular traffic around the site during construction.

1.04 ASBESTOS AND OTHER HAZARDOUS MATERIAL

A. The Owner has made a reasonable attempt to locate and identify asbestos or other hazardous material that may be encountered during the course of the Work.

B. If the Contractor observes or suspects the existence of asbestos, polychlorinated biphenyl (PCB) or other hazardous materials in the structure or components of the building, the Contractor shall immediately stop work and notify the Owner’s Authorized Representative.

C. The Owner will arrange for the removal of asbestos, polychlorinated biphenyl (PCB) or other hazardous materials as required by Facilities Services personnel or by separate contract.

D. Schedule ten (10) days of slack or "down" time for the removal of hazardous materials without penalty to Owner for the delay of the Contract.

1.05 LEAD BASED PAINT

A. The Owner may have tested existing paint in the project area and if levels are found the following conditions apply.

B. Contractor shall remove paint as specified for surface preparation and capture removed material for disposal.

C. Contractor shall follow OSHA guidelines involving exposure to workers.

D. Owner will provide containers for Contractor’s use at project site.

E. Contractor shall comply with the requirements of DEQ and EPA and shall submit a lead abatement plan.

F. Contractor shall separate lead contaminated material from effluent and water.

G. Owner will dispose of lead paint and effluent resulting from stripping operation.

H. Soil contaminated by stripping operations shall be replaced with topsoil.

END OF SECTION

SECTION 01 24 76

APPLICATIONS FOR PAYMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Work of this Section includes forms and procedures for progress payments.

B. Related work specified elsewhere.
   1. For the primary discussion of payments, refer to OSU General Conditions, Section E, as supplemented.
   2. In compliance with OSU General Conditions, Section K, no payments beyond 75% will be made by the Owner before draft Operation and Maintenance Manuals have been received for review by the Owner.

1.02 APPLICATION FORMS

A. For applications for payment, use sample Contract Payment Request (see below), contract payment request on company letterhead, or AIA Document G702, supported by AIA Document G703, Continuation Sheet, or similar document.

B. Prepare the Schedule of Values in such a manner that each major item of Work and each subcontracted item of Work is shown as a line item broken down in terms of material and labor costs on AIA Document G703, Application Certification of Payment, Continuation Sheet or similar format. The sample continuation sheet shall be the minimum Schedule of Values breakdown.

C. The Schedule of Values shall be submitted for review by the Owner prior to the first application for payment; and may be used when, and only when, accepted in writing by the Owner.

D. Contractor shall provide a schedule of values prior to the pre-construction kickoff meeting which shall include (at a minimum) the items below for internal cost tracking.

- PIPC Work within the right-of-way (All)
- Parking Lot Demolition (Asphalt)
- Concrete Demolition
- Asphalt Pavement in Parking Lot
- Concrete Pavement in Parking Lot (stalls and walkway)
- Lighting in Parking Lot
- Site Concrete (sidewalk, curb & gutter, plaza)
- Site Utility work
- Landscaping, Planting, Irrigation
- Lighting & Electrical (other than parking lot lighting system)

E. Payment request is to include the Contractor's Federal Tax Identification number and return address.

1.03 PAYMENTS

A. The Owner will make progress payments on account of the Contract once monthly for the scheduled duration of the project (i.e. three (3) payments on a three-month project), based on the value of work accomplished or materials on the job site, as stated in the Schedule of Values on the Application and Certificate Payment.

B. Complete and forward Application to the Owner on or about the 15th day of each month for work performed the previous month and include certified payroll statements as specified in the OSU General Conditions.

C. Submit one (1) copy of forms requesting payment to the Owner.

D. Payments will be made on protected materials on hand at the job site properly stored, protected, and insured.

E. Estimated quantities shall be subject to the Owner's review and judgment.

1.04 EARLY PURCHASE AND PAYMENT OF MATERIALS AND EQUIPMENT

A. Order materials and equipment requiring a long lead or waiting time early so as not to delay progress of the Work.

B. The Contractor will be reimbursed for early order materials or equipment upon receipt and verification of quality and quantity against submittals and shipping documents by the Owner's Authorized Representative.

C. Receipt shall be to the job site or stored at Owner's other premises in an orderly and safe manner, secured from normal weather damage.

D. Security remains the responsibility of the Contractor.

END OF SECTION

CONTRACT PAYMENT REQUEST

DATE: _____

TO: University Financial Services
Oregon State University
850 SW 35th St.
Corvallis, OR 97333
FacServContracts@oregonstate.edu

Payment Request No. _____Contract No. _____ Period from _____ to _____

Project: _____

Original Contract Amount ..... $_____

Change Orders (Net Amount)..... $_____

Contract Total to Date..... $_____

==========

Total Completed and Stored to Date ..... $_____

Less Retainage (5%), if applicable ..... $_____

Total Earned, Less Retainage (if applicable)..... $_____

Less Previous Payments..... $_____

Net Amount Due this Request..... $_____

The undersigned Contractor certifies that, to the best of his/her knowledge, information, and belief, the Work covered by this request has been completed in accordance with the Contract Documents, that all amounts have been paid for Work for which previous applications for Payment were issued and payments received from the Owner, and that the amount shown herein is now due.

Contractor:_____

By: _____Date: _____

Federal Tax ID Number:_____

Address:_____

_____

CONTINUATION SHEET

Project Name:

Application No.:

Date:

Period To:

WRN No.:

NOTES:

Amounts are stated to the nearest penny.
Use Column I on Contracts where variable retainage for line items may apply, or if retainage is required.

Change Orders are usually listed as the last items of the basic schedule.

A	B	C	D	E	F	G		H	I
Item No.	**Description of work**	**Scheduled Value**	**Work Completed**		**Materials Presently Stored (Not in D or E)**	**TOTAL Completed & Stored (D+E+F)**	**% Completed (G/C)**	**Balance to Finish (C-G)**	**Retainage**
			From Previous Applications	This Period					
TOTALS									

SECTION 01 25 00

PRODUCT SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General requirements for the Work in relation to substitutions and product options.

B. Submit to the Owner's property insurance carrier shop drawings, samples, and product data (such as manufacturer's standard schematic drawings and other literature) when required by individual Specifications sections.

C. Related Work Specified Elsewhere
   1. Invitation to Bid.
   2. OSU General Conditions.

1.02 REQUESTS FOR SUBSTITUTIONS

A. Requests for substitution of products in place of those specified shall be in accordance with Invitation to Bid, and as specified herein.

1.03 CONTRACTOR'S RESPONSIBILITIES

A. Investigate proposed products and determine that they are equal or superior in all respects to products specified.

B. Provide same guarantee for accepted substitutions as for products specified.

C. Coordinate installation of accepted substitutions into the Work, making such changes as may be required for the Work to be complete in all respects.

1.04 SUBSTITUTIONS DURING BIDDING

A. Submit one electronic copy of the following information with each request to the Owner:
   1. Substitution request form provided below.
   2. Comparison of proposed substitution with product, material or system specified.
   3. Complete data, substantiating compliance of proposed substitution with the Contract Documents.
   4. Test numbers and supporting reports, indicating compliance with referenced standards.
   5. Evidence that warranty requirements are acceptable.
   6. Details indicating specific deviations proposed for the substitution.
   7. Reference and applicable Specification sections.
   8. Applicable product samples.

B. All substitution requests shall be received in the Owner's office prior to the deadline for questions as identified in the Invitation to Bid. Requests received after this date

will not be considered.

1.05 SUBSTITUTIONS DURING CONSTRUCTION

A. Substitutions will normally not be considered after date of Contract except when required due to unforeseen circumstances.

B. Within a period of thirty (30) days after date of Contract, the Owner may, at its option, consider formal written requests for substitution of products in place of those specified, when submitted in accordance with the requirements stipulated herein.

C. One or more of the following conditions must be documented in any such request:
   1. Required for compliance with final interpretation of code or insurance requirements.
   2. Required due to unavailability of a specified product.
   3. Required because of the inability of the specified product to perform properly or to fit in the designated space.
   4. Substitution would be substantially in the best interest of the Owner in terms of cost, time, or other considerations.

1.06 SUBSTITUTIONS NOT PERMITTED

A. If implied on submittals without first requesting approval thereof.

B. If acceptance will require substantial revision of the Contract Documents.

END OF SECTION

SUBSTITUTION REQUEST FORM

TO: _____

PROJECT: _____

SPECIFIED ITEM:

_____	_____	_____	_____
Section	Page	Paragraph	Description

The undersigned requests consideration of the following:

PROPOSED SUBSTITUTION: _____

Attached data includes product description, specifications, drawings, photographs, performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes description of changes to Contract Documents which proposed substitution will require for its proper installation.

The undersigned states that the following paragraphs, unless modified on attachments, are correct:

1. The proposed substitution does not affect dimensions shown on Drawings.

2. The undersigned will pay for changes to the building design, including engineering design, detailing and construction costs caused by the requested substitution.

3. The proposed substitution will have no adverse effect on other trades, the construction schedule, or specified warranty requirements.

4. Maintenance and service parts will be locally available for the proposed substitution.

The undersigned further states that the function, appearance and quality of the Proposed Substitution are equivalent or superior to the Specified Item.

Submitted by:

Signature _____

Firm _____

Address _____

_____

Date _____

Telephone _____

Attachments:

For use by Design Consultant:

☐ Accepted ☐ Accepted as noted

☐Not Accepted ☐ Received too late

By _____

Date _____

Remarks _____

SECTION 01 31 19

PROJECT MEETINGS

PART 1 GENERAL

1.01 PRE-CONSTRUCTION MEETING

A. Architect/Engineer/Designer, Contractor and Owner will meet prior to start of the Work (within seven (7) days after notice to proceed) to discuss at least the following topics and any others of mutual interest.
   1. Schedule of Values
   2. Permit Status/tree protection/erosion control
   3. List of sub-contractors
   4. Job inspections.
   5. Early purchase of, and/or lead time requirements for material and equipment/prepurchase of equipment
   6. Monthly payment date/SOP for pay requests
   7. Portion of site to be occupied by construction.
   8. Parking/Staging areas
   9. Non-smoking campus requirements
   10. Maintenance of access and safety.
   11. Processing of field decisions and change orders
   12. Labor provisions/labor rates for subs
   13. Material submittals/deferred submittals
   14. Owner access during construction.
   15. Review of Contract Documents/review ADA requirements/cross-slopes
   16. Coordination procedures and separate contracts.
   17. Progress schedules.
   18. Critical Work sequencing.
   19. Safety and emergency procedures/24 hour contact numbers
   20. Security procedures.
   21. Hazardous materials.
   22. Progress meetings.
   23. Contract close-out.

B. Location of Meeting: Project site

1.02 PROGRESS MEETINGS

A. The Contractor will schedule and administer progress meetings and will:
   1. Prepare agendas.
   2. Schedule progress meetings, frequency, time and day to be determined during pre-construction meeting.
   3. Make physical arrangements for and preside at meetings.
   4. Record minutes and include decisions.

5. Distribute copies of minutes to participants within four (4) days after meetings.

B. Location of Meetings: Project site.

C. Attendance:
   1. The Owner or Owner's Authorized Representative.
   2. Contractor.
   3. Subcontractors affected by agenda.
   4. Project Architect/Engineer/as necessary.
   5. Owner will attend meeting to ascertain Work is expedited consistent with progress schedule and with Contract Documents.

D. Minimum Agenda:
   1. Review and approve minutes from previous meeting.
   2. Review Work progress since previous meeting.
   3. Discuss field observations, and problems.
   4. Review delivery schedules, construction schedule, and identify problems which impede planned progress.
   5. Review proposed changes.
   6. Material submittals.
   7. Note all new subcontractors performing Work at the job site.

END OF SECTION

SECTION 01 33 23

SHOP DRAWINGS, PRODUCT DATA, SAMPLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submit to the Owner shop drawings, samples, and product data (such as manufacturer's standard schematic drawings and other literature) when required by individual Specifications sections.

B. Related Work Specified Elsewhere
   1. OSU General Conditions.

1.02 SUBMITTAL SCHEDULING

A. For items requiring review by the Owner only, submittals shall be sent to the Owner at least 15 calendar days before the date each is required for fabrication or installation.

B. Submittals to be reviewed by Owner's consultants shall be sent to the Owner at least 20 calendar days before the date each is required for fabrication or installation.

C. Submittals to be reviewed by Owner's property insurance carrier shall be sent to Owner as directed in individual specification sections.

D. Submittals involving Substitution requests or other modifications requiring review by the Owner and/or the Owner's consultants shall be sent to the Owner at least 20 calendar days before the date each is required for fabrication or installation.

1.03 SUBMITTAL CONTENT AND FORMAT

A. General Requirements:
   1. Shop Drawings: Submit in electronic format and, if requested by Owner's Authorized Representative, submit one reproducible transparency and 1 print of each drawing.
   2. Product Data: Submit electronically, and if requested by Owner's Authorized Representative, up to 6 hard copies.
   3. Samples: Submit the number and type stated in each Specification Section. Submit a minimum of three sets of color samples where color selection is required.
   4. Submittals shall include:
      a. Date and revision dates return date requested.
      b. Project title and number.
      c. The names of the Contractor, subcontractor, supplier, and manufacturer.
      d. Identification of product or material, with Specification Section number.
      e. Relation to adjacent critical features of work or materials.
      f. Field dimensions, clearly identified as such.
      g. Applicable standards, such as ASTM number or Federal Specification.

h. Identification of deviations from Contract Documents, and for products accompanied by Substitution request as required by Section 01 25 00.
i. Contractor's stamp legibly signed, essentially as follows:
1) The undersigned, acting on behalf of the Contractor, certifies that this submittal has been reviewed and is approved; products have been verified as being as specified, field measurements and field construction criteria have been or will be coordinated, and the submittal is in compliance with Contract Documents.

5. Re-submission Requirements:
a. Revise initial drawings as required and resubmit as specified for initial submittal.
b. Indicate on drawings any changes which have been made other than those requested by the Owner or the owner's consultants.
6. The Owner may return without review any submittal not meeting the requirements listed above.

B. Shop Drawings:
1. Present data in a clear and thorough manner.
2. Details shall be identified by reference to sheet and detail, schedule or room numbers shown on Contract Documents.
3. Structural items shall be identified by location in the completed structure. Identify details by reference to contract sheet and detail numbers.
4. Minimum sheet Size: 8 ½ x 11".

C. Product Data:
1. Manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts, illustrations and other standard descriptive data:
a. Clearly mark each copy to identify pertinent product or models.
b. Show dimensions, weights, and clearances required.
c. Show performance data consisting of capabilities, ROM, KW, pressure drops, design characteristics and consumption; conforming as closely as possible to the test methods referenced in the Plans and Specifications.
d. Show wiring or piping diagrams and controls.
2. Manufacturer's standard schematic drawings and diagrams:
a. Modify to delete information which is not applicable.
b. Supplement standard information to provide information specifically applicable to the Work.

D. Samples:
1. Insure that samples are of sufficient size to indicate the general visual effect or color.
2. Where samples must show a range of color, texture, finish, graining, or other property, submit sets of pairs illustrating the full scope of this range.
3. One (1) sample or one (1) set of approved samples will be retained by the Owner;

final work will be measured against approved samples.

1.04 QUALITY ASSURANCE

A. Process submittals in ample time for review, as applicable, so as to not delay the Work. All submittals shall be received by the Owner within ten (10) days after pre-construction.

1.05 DEFINITIONS

A. The Owner will mark reviewed materials as follows:
   1. “No Exception Taken,” which means fabrication, manufacture and/or installation may proceed.
   2. “Make Revisions Noted,” which means fabrication, manufacture and/or installation may proceed with revisions as noted.
   3. “Revise and Resubmit,” which means that fabrication, manufacture and/or installation may not proceed.
   4. “Rejected,” which means do not proceed; make arrangements for the review of the proposed Work with the Owner as soon as possible.

1.06 PROCESSING

A. Review submittals, make necessary corrections, and become familiar with the content of the submittals.

B. Mark each item with Contractor’s stamp.

C. Accompany submittals with a transmittal letter bearing the project name, Contractor’s name, number of items, and other pertinent data.

D. Keep one copy of each reviewed submittal on the job site at all times.

E. Be responsible for obtaining and distributing prints of shop drawings to the various suppliers, and the Owner once review process has been completed. Make prints of reviewed shop drawings only from transparencies which carry the appropriate stamp and endorsement.

END OF SECTION

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ABBREVIATIONS AND SYMBOLS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Words which may be found elsewhere in the Project Manual and Drawings are abbreviated in accordance with the standards set forth in the following table:

A/C	air conditioning
AB	anchor bolt
AC	asphaltic concrete
ACT	acoustical tile
AD	area drain
ADD	addendum
ADD'L	additional
ADH	adhesive
AFF	above finish floor
AGG	aggregate
AL	aluminum
ALLOW	allowable
ALT	alternate
ANOD	anodized
AP	access panel
APPRX	approximate
ARCH	architect(ural)
ASPH	asphalt
AUTO	automatic
AVE	avenue
BD	board
BIT	bituminous
BLDG	building
BLKG	blocking
BM	bench mark, beam(s)
BOT	bottom
BRZ	bronze
BS	both side
CB	catch basin
CEM	cement
CF	cubic foot
CFOI	contractor furnished owner installed
CG	corner guard
CH	ceiling height
CI	cast iron
CJ	control joint
CKBD	chalkboard
CL	centerline
CLG	ceiling
CLR	clear(ance)
CM	construction manager
CMT	ceramic mosaic (tile)
CMU	concrete masonry unit
COL	column
COM	communications
CONC	concrete
CONN	connect(ion)
CONST	construction
CONT	continuous or continue
CONTR	contract(or)
CPT	carpet
CRS	course(s)
CS	countersink
CSMT	casement
CT	ceramic tile
CTR	center
CVG	clear vertical grain
CW	cold water
CWT	ceramic wall tile
CY	cubic yard

D	depth
DEMO	demolish, demolition
DEP	depressed
DF	drinking fountain
DIA	diameter
DIAG	diagonal
DIM	dimension
DISP	dispenser
DIV	division
DL	dead load
DMT	demountable
DN	down
DP	dampproofing
DR	door
DS	downspout
DT	drain tile
DTL	detail
DW	dumbwaiter
DWG	drawing(s)
DWR	drawer
EA	each
EB	expansion bolt
EF	each face
EJ	expansion joint
EL	elevation
ELEC	electric(al)
EMBED	embedment
EMER	emergency
ENCL	enclose(ure)
EP	electrical panel board
EQ	equal
EQUIP	equipment
EST	estimate
EVT	equiviscious temperature
EW	each way
EWC	electric water cooler
EX.EXIT	existing
EXH	exhaust
EXP	exposed
EXT	exterior
FA	fire alarm
FAF	fluid applied flooring
FARF	fluid applied resilient floor
FAS	fasten, fastener
FBD	fiberboard
FBT	finished blowing temperature
FD	floor drain, fire damper
FE	fire extinguisher
FEC	fire extinguisher cabinet
FF	factory finish
FGL	fiberglass
FHMS	flathead machine screw
FHWS	flathead wood screw
FIN	finish(ed)
FLCO	floor cleanout
FLR	floor(ing)
FLUR	fluorescent
FND	foundation
FOC	face of concrete
FOIC	furnished by owner/installed by contractor
FOIO	furnished by owner/installed by owner
FOM	face of masonry
FP	fireproofing, flash point
FPHB	freeze-proof hose bib
FR	fire resistive, fire rated
FRM	frame(d), (ing)
FS	full size
FSS	finished structural slab
FT	foot
FTG	footing
FTS	finished topping slab
GA	gage, gauge
GALV	galvanized
GB	grab bar or gypsum board
GC	general contractor
GI	galvanized iron
GL	glass, glazing
GLS	glass resin wall surfacing

GP	gypsum
HB	hose bib
HBD	hardboard
HC	hollow core
HD	heavy duty
HDR	header
HDW	hardware
HM	hollow metal
HOR	horizontal
HP	high point
HR	hour
HT	height
HTG	heating
HVAC	heating, ventilating, air conditioning
HWD	hardwood
HWH	hot water heater
ID	inside diameter, identification
IN	inch
INCIN	incinerator
INCL	include(d), ion)
INT	interior
INV	invert
JB	junction box
JC	janitor's closet
JT	joint
KD	kiln dried
KCP	Keene's cement plaster
KO	knockout
KP	kick plate
LAB	laboratory
LAM	laminate(d)
LAV	lavatory
LBS	pounds
LH	left hand
LL	live load
LONGIT	longitudinal
LP	low point
LW	lightweight
MAX	maximum
MB	machine bolt
M. MECH	mechanic(al)
MFR	manufacture(r)
MH	manhole
Min	minimum, minute
MISC	miscellaneous
MO	masonry opening
MO#	model number
MOD	modular
MPH	miles per hour
MS	machine screw
MTL	metal
MULL	mullion
MWP	membrane waterproofing
NAT	natural, natural finish
NIC	not in contract
NO	number
NOM	nominal
NTS	not to scale
OA	overall
OBS	obscure
OC	on center(s)
OD	outside diameter
OF	overflow
OFCI	owner furnished contractor installed
OFOI	owner furnished owner installed
OHMS	ovalhead machine screw
OHWS	ovalhead wood screw
OPG	opening
OPP	opposite
OZ	ounce(s)
P	paint(ed)

PB	push button
PCF	pounds per cubic foot
PCP	putting coat plaster
PERF	perforate(d)
PL	plate, property line
PLAM	plastic laminate
PLAS	plaster
PNL	panel
PP	push plate
PR	pair
PREP	prepare
PSF	pounds per square foot
PSI	pounds per square inch
PT	point, pressure treated
PTN	partition
PVC	polyvinyl chloride
PWD	plywood
QT	quarry tile
R	rise
RA	return air
RAD	radius
RCP	reflected ceiling plan
RD	roof drain
REF	reference
REFR	refrigerator
REINF	reinforce(ing)
REQ	required
RET'G	retaining
REV	revision(s), revised
RH	right had
RM	room
RO	rough opening
RSF	resilient sheet flooring
SC	solid core
SCHED	schedule
SEC	section
SF	square feet (foot)
SHT	sheet
SHTHG	sheathing
SIM	similar
SL	sleeve
SOG	slab on grade
SPEC	specification(s)
SQ	square
SS	storm sewer
S4S	finished 4 sides
SD	storm drain
ST	steel, street
ST ST	stainless steel
STD	standard
STR	structural
SUPP	supplement
SUPT	support
SUSP	suspended
SV	sheet vinyl
T	tread
TBM	top bench mark
T&G	tongue and groove
TB	towel bar
TC	top of curb
TEL	telephone
TEMP	tempered
THK	thickness
TKBD	tackboard
TO	top of
TP	top of paving
TRANS	transverse
TS	top of slab
TV	television
TW	top of wall
TYP	typical
UNO	unless noted otherwise
VAT	vinyl asbestos tile
VB	vapor barrier
VCT	Vinyl Composition Tile
VERT	vertical
VG	vertical grain
VIF	verify in field

VWC	vinyl wall covering	WP	waterproof(ing)
		WNS	wainscot
W	width, wide, water	WR	water resistant
W/	with	WS	waterstop
W/O	without	WW	window wall
WC	water closet	WWC	wood wall covering
WD	wood, wood finish	WWF	woven wire fabric

B. Words which may be found elsewhere in the Project Manual and Drawings are abbreviated in accordance with the standards set forth in the following table:

&	and
λ	angle
@	at
ι	diameter, round
"	inches
:	is, shall b
'	feet
ζ	perpendicular
/	per
%	percent
#	pound, number
X	by (as in 2 by 4)

END OF SECTION

SECTION 01 42 16

DEFINITIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Words which may be found elsewhere in the Contract Documents are defined in accordance with the standards set forth in the following table:

Approve:

Where used in conjunction with Architect's response to submittals, requests, applications, inquiries, reports and claims by Contractor, the meaning of term "approved" will be limited to the Architect's responsibilities and duties as specified in General and Supplementary Conditions. In no case will "approval" by Architect be interpreted as a release of Contract requirements.

As Detailed, As Shown:

Where “as detailed”, “as shown” or words of similar importance are used, it shall be understood that reference to the Drawings accompanying the Specifications is made unless otherwise stated.

As Directed, As Required, As Authorized, As Reviewed, As Accepted:

Where “as directed”, “as required”, “as authorized”, “as reviewed”, “as accepted” or words of similar importance are used, it shall be understood that the direction, requirement, permission, authorization, review, or acceptance of the Architect is intended, unless otherwise stated.

As Indicated:

Where “as indicated” is used it shall be understood that reference to Drawings and/or Specifications is made unless otherwise stated.

Directed, Requested, etc.:

Terms such as "directed," "requested," "authorized," "selected," will be understood as "directed by Architect," "requested by Architect," and similar phrases shall not be interpreted to extend Architect's responsibility into Contractor's responsibility for construction supervision.

Furnish:

Except as otherwise defined in greater detail the term "furnish" is used to mean supply and deliver to project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

Indicated:

The term "indicated" is a cross-reference to graphic representations, notes or schedules on drawings, to other paragraphs or schedules in the specifications and to similar means of recording requirements in Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated," it is for purpose of helping reader locate cross-reference and no limitation of location is intended except as specifically noted.

Install:

Except as otherwise defined in greater detail, the term "install" is used to describe operations at project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations, as applicable in each instance.

Installer:

The term "installer" is defined as the entity (person or firm) engaged by Contractor, or its subcontractor or sub-subcontractor for performance of a particular unit of Work at project site, including installation, erection, application and similar required operations. It is a general requirement that such entities (Installers) be expert in operations they are engaged to perform.

Provide:

Except as otherwise defined in greater detail, term "provide" means furnish and install, complete and ready for intended use, as applicable in each instance.

END OF SECTION

SECTION 01 42 19

REFERENCE STANDARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Quality Assurance.

B. Location of References.

C. Schedule of References.

1.02 QUALITY ASSURANCE

A. For products or quality of work specified by association, trade, or federal standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date of Contract Documents.

C. General Applicability of Standards: Except where Contract Documents include more stringent requirements, applicable standards of the construction industry have the same force and effect as if bound or copied directly into Contract Documents.

D. Such standards are made a part of the Contract Documents by reference.

E. Individual sections indicate which codes and standards the Contractor must keep at the project site, available for reference.

F. Referenced industry standards take precedence over standards which are not referenced but recognized in industry as applicable.

G. Non-referenced standards are not directly applicable to the Work, except as a general requirement of whether the Work complies with standards recognized in the construction industry.

1.03 LOCATION OF REFERENCES

A. Valley Library, Oregon State University.

1.04 SCHEDULE OF REFERENCED ASSOCIATIONS

AIA American Institute of Architects

	WWW.AIA.ORG
AISC	American Institute of Steel Construction WWW.AISC.ORG
AISI	American Iron and Steel Institute WWW.STEEL.ORG
ANSI	American National Standards Institute WWW.ANSI.ORG
APA	American Plywood Association WWW.APAWOOD.ORG
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers WWW.ASHRAE.ORG
ASTM	American Society for Testing and Materials WWW.ASTM.ORG
AWPA	American Wood Protection Association WWW.AWPA.COM
AWS	American Welding Society WWW.AWS.ORG
BIA	Masonry Institute of America WWW.MASONRYINSTITUTE.ORG
BOLI	Oregon Bureau of Labor and Industries WWW.BOLI.STATE.OR.US
CCB	Construction Contractors Board WWW.OREGON.GOV.CCB/
CDA	Copper Development Association WWW.COPPER.ORG
CISPI	Cast Iron Soil Pipe Institute WWW.CISPI.ORG
CSI	Construction Specification Institute WWW.CSINET.ORG
DEQ	Department of Environmental Quality (Oregon) WWW.OREGON.GOV/DEQ/

DHI	Door and Hardware Institute WWW.DHI.ORG
DOT	Department of Transportation WWW.DOT.GOV
EPA	U.S. Environmental Protection Agency WWW.EPA.GOV
FM	Factory Mutual System WWW.FMGLOBAL.COM
FS	Federal Specification General Services Administration Specifications and Consumer Information Distribution Section (WFSIS) WWW.GSA.GOV/PORTAL/CONTENT/103856
IBC	International Building Code WWW.ICCSAFE.ORG
ICBO	International Conference of Building Officials PUBLICECODES.CITATION.COM/ICOD/IBG/INDEX.HTM
IRS	Internal Revenue Service WWW.IRS.GOV
ISA	Instrumentation Systems and Automation Society WWW.ISA.ORG
NAAMM	National Association of Architectural Metal Manufacturers WWW.NAAMM.ORG
NBFU	National Board of Fire Underwriters WWW.NFPA.ORG
NEC	National Electric Code WWW.NECPLUS.ORG
NEMA	National Electrical Manufacturers' Association WWW.NEMA.ORG
NESC	National Electrical Safety Code WWW.IEEE.ORG
NFPA	National Fire Protection Association WWW.NFPA.ORG

NRCA	National Roofing Contractors' Association WWW.NRCA.NET
OAR	Oregon Administrative Rules ARCWEB.SOS.STATE.OR.US/404.HTML
OESP	State of Oregon Electrical Specialty Code http://www.bcd.oregon.gov/programs/online_codes.html
ORS	Oregon Revised Statutes LANDRU.LEG.STATE.OR.US/ORS/
OSHA	Occupational Safety and Health Administration WWW.OSHA.GOV
OSSC	Oregon Structural Specialty Code http://www.bcd.oregon.gov/programs/online_codes.html
PS	Product Standard STANDARDS.GOV/STANDARDS.CFM
SDI	Steel Door Institute WWW.STEELDOOR.ORG
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association WWW.SMACNA.ORG
SPRI	Single Ply Roofing Institute WWW.SPRI.ORG
SSPC	Steel Structures Painting Council WWW.SSPC.ORG
SWRI	Sealing, Waterproofing and Restoration Institute WWW.SWIRONLINE.ORG
UBC	Uniform Building Code (See ICBO)
UFC	Uniform Fire Code WWW.NFPA.ORG
UL	Underwriters' Laboratories, Inc. WWW.UL.COM
UMC	Uniform Mechanical Code WWW.UBC.COM

UPC	Uniform Plumbing Code WWW.UBC.COM
WHL	Warnock Hersey Laboratories WWW.INTEK.COM/MARKS/WH/
WCLIB	West Coast Lumber Inspection Bureau WWW.WCLIB.ORG
WWPA	Western Wood Products Association WWW.WWPA.ORG

END OF SECTION

SECTION 01 45 00

QUALITY CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Codes, regulations and permits.

B. Procedures for quality control.

1.02 OWNER RESPONSIBILITIES

A. Owner will employ and pay for services of an independent testing laboratory to perform inspection, sampling and testing as required by local building authority.

B. Owner's Authorized Representative will provide on-site observation during construction.

1.03 CODES, REGULATIONS AND PERMITS

A. All Work shall conform with the Oregon Structural Specialty Code (OSSC) based on the International Building Code (IBC), as amended by the State of Oregon Building Codes Division and the edition designated by the governing authority.

B. Contractor shall comply with all applicable state and local construction codes.

C. References to codes, Specifications and standards referred to in the Contract Documents shall mean, and are intended to be, the latest edition, amendment or revision of such reference standard in effect as of the date of these Contract Documents.

D. The Owner shall be responsible for all permits and City of Corvallis plan review fees; the Contractor shall be responsible for all licenses and associated fees required for the Project.

E. Contractor shall arrange and attend all required permit inspections and furnish evidence of approved City inspection reports per Section 01 77 00.

1.04 QUALITY OF WORK

A. It is the true and specific intent of these Specifications that quality of Work on all phases of the construction and embracing all the trade sections shall be of high quality performed by workers skilled in their trade and performing their Work only according to the standard of best practice of the trade.

B. All manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with manufacturer's directions unless otherwise specified.

C. If Work is required in a manner to make it impossible to produce first quality Work, or should discrepancies appear among Contract Documents, request interpretation from

Architect before proceeding with Work.

D. Failure to secure interpretation may cause rejection by Architect or owner of installation.

1.05 LAYOUT

A. Be responsible for properly laying out the Work and for lines and measurements for the Work.

B. Verify the figures shown on the drawings before laying out the Work and report errors or inaccuracies to the Architect before commencing Work.

C. Strict compliance with maximum slopes is required. Accessible parking spaces and adjacent access aisles with slope exceeding 2% in any direction, as determined by OSU, shall be removed and replaced by the contractor at their expense.

D. Strict compliance with maximum slopes is required. New sidewalks exceeding 1:20 slope or with cross slope exceeding 2%, as determined by OSU, shall be removed and replaced by the contractor at their expense. Ramps exceeding 1:16 slope or with cross slope exceeding 2%, as determined by OSU, shall be removed and replaced by the contractor at their expense.

1.06 SUPERVISION

A. The Contractor shall maintain effective supervision on the project at all times Work is being performed.

B. The superintendent shall be the same person throughout the project and shall attend the preconstruction conference.

1.07 INSPECTIONS AND TESTING

A. Contractor shall notify the Owner at least twenty-four (24) hours in advance of any required progress inspection or final inspection including final punch list inspection.

B. Cooperate with laboratory personnel, provide access to Work and furnish incidental equipment material and labor required for field testing and sample taking.

1.08 EVALUATION OF TESTS AND INSPECTIONS

A. Results of laboratory and/or field control tests and inspections shall be the principal basis upon which satisfactory completion of Work shall be judged.

B. If results of tests and inspections indicate Work is below requirements of Contract Documents, that portion of Work is subject to rejection.

1.09 ADJUSTMENTS

A. Remove and replace Work so rejected at Contractor’s expense including costs of subsequent tests and inspections until Work meets requirements of Contract Documents.

B. The Owner reserves the right to perform any testing as may be required to determine compliance with the Contract Documents.

C. Costs for such testing will be the Owner's responsibility unless testing indicates noncompliance. Cost for such testing indicating noncompliance shall be borne by the Contractor.

D. Noncomplying Work shall be corrected and testing will be repeated until the Work complies with the Contract Documents.

E. Contractor will pay costs for retesting noncomplying Work.

END OF SECTION

SECTION 01 51 00

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This Section specifies requirements for temporary services and facilities, including utilities, construction and support facilities, security and protection.

1.02 REQUIREMENTS OF REGULATORY AGENCIES

A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction.

B. Standards: Comply with NFPA Code 241, "Building Construction and Demolition Operations", ANSI-A10 Series standards for "Safety Requirements for Construction and Demolition".

C. Electrical Service: Comply with NEMA, NEC and UL standards and regulations for temporary electric service; install service in compliance with National Electric Code (NFPA 70).

D. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use; obtain required certifications and permits if required.

1.03 PROTECTION

A. Protect sidewalks, asphalt paving, concrete, trees, shrubs, and lawn areas at all times from damage resulting from construction activities.

B. Prevent materials from clogging catch basins and yard drains; leave drains clean and in proper working condition.

C. Protect Existing Irrigation Systems:
   1. In the event damage occurs to an underground irrigation system as a direct result of a Contractor's activities, the Contractor shall repair/replace or be assessed a charge at the discretion of the Owner.
   2. If repairs are to be made by the Contractor, the repairs will be inspected by the Owner’s Authorized Representative prior to backfilling.
   3. Any galvanized pipe that requires repair shall be repaired at a threaded coupling, not by use of a compression coupling.

D. Protect Existing Air Handling Systems:
   1. Contractor shall be responsible for protection of the cleanliness of the existing air handling system at all times. This protection shall include:
      a. During site work or building demolition, prefilters shall be provided and maintained on all building outside air intakes at all times throughout the construction duration.

b. During any interior work that may create dust in the interior space and adjacent corridor/hallways, air filters shall be provided and maintained on all affected air return and exhaust grilles. Where air flow in or out of the space is not required, all air duct openings shall be temporarily blanked off with plywood or sheet metal.
c. Prior to starting any work, the Contractor shall record and submit to the Owner's Authorized Representative, pressure readings across all existing air handler air filter banks before installation of new prefilters.
d. Upon completion of all Work affecting existing air handling systems, the Contractor shall remove all temporary filters, covers and associated parts and restore the system to its original operating condition unless otherwise stated elsewhere in the Contract Documents

E. Clean, repair, resurface, or restore existing surfaces to their original, or better, condition, or completely replace such surfaces to match existing, where damaged by construction operations.

F. Security is the responsibility of the Contractor.

G. Construction Debris:
1. Debris shall not be allowed to remain around the buildings during performance of Work, but shall be disposed of as rapidly as it accumulates.
2. On completion of Work, the buildings and grounds shall be left in a condition that is equal to or better than original condition.
3. In case of failure to do so, the Owner may remove rubbish and charge the cost to the Contractor.

H. The Contractor shall manage a safe job environment for both the safety of all the people around the Work site as well as the safety of the Owner's and general public's property.

I. The Contractor shall provide and maintain suitable barricades, shelters, lights, and danger signals during the progress of the Work; they shall meet the requirements of the local building code and OSHA.

1.04 DRAINAGE

A. Verify that all rain drains in the construction areas are in working order and notify the Owner's Authorized Representative in writing of any rain drains that are plugged, prior to the start of the Work.

B. Start of Work will be considered as acknowledgment that all drains are clear and in good working order.

C. All drains shall be left in a clean and proper working condition.

1.05 CONSTRUCTION PROJECT SAFETY FORM

A. Contractor shall submit to the Owner, prior to signing the Contract, the completed

"Construction Project Safety Form", which is provided with instructions at the end of this Section.

1.06 TEMPORARY UTILITIES

A. Temporary Utilities:
   1. Prepare a schedule indicating dates for implementation and termination of each temporary utility.
   2. At the earliest feasible time, when acceptable to the Owner, change over from use of temporary service to use of the permanent service.

B. Conditions of Use:
   1. Keep temporary services and facilities clean and neat in appearance.
   2. Operate in a safe and efficient manner.
   3. Take necessary fire prevention measures.
   4. Do not overload facilities or permit them to interfere with progress.
   5. Do not allow hazardous, dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.

C. Electrical Service:
   1. Service limited to 20 amp 120V circuits will be paid for by the Owner.
   2. Connection to the service shall be the responsibility of the Contractor, with the Owner's approval.
   3. Coordinate with the Owner's Authorized Representative.

D. Water Service:
   1. Service in reasonable quantities for the Project will be paid for by the Owner.
   2. Connection to the service shall be the responsibility of the Contractor, with the Owner's approval.
   3. Coordinate with the Owner's Authorized Representative.

1.07 TEMPORARY SUPPORT FACILITIES

A. Temporary Sanitary Facilities:
   1. Provide and maintain an adequate number of facilities for the use of all persons employed on the Work during construction.
   2. Provide enclosed, weatherproof facilities with heat as required.
   3. Use of new or existing Owner's facilities will not be permitted.

B. Temporary Heat and Ventilation:
   1. As necessary, provide temporary heat and ventilation required by construction activities, for curing or drying of completed installations or protection of installed construction from adverse effects of low temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition required and minimize consumption of energy.

C. Telephone Equipment: Provide telephone communications at project site.

D. Existing Services:
   1. Do not interrupt any existing service.
   2. Prior request and approval of the Owner's Representative will enable the Owner to shut down any utility required by the Work.
   3. Contractor shall not shut down utilities.

1.08 TEMPORARY BARRIERS AND ENCLOSURES

A. Provide barriers and fencing to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage.

B. Provide Commercial grade chain link fence construction.

C. Provide 6 foot high fence around construction site as directed by Owner's Authorized Representative; equip with vehicular and pedestrian gates with lock.

D. Exterior Closures: Provide temporary secured, weather-tight closures at exterior openings, to permit acceptable working conditions and protection of the Work.

E. Interior Closures:
   1. Provide temporary floor to ceiling partitions (not plastic sheeting) and ceilings as required to separate work areas from Owner occupied areas, to prevent penetration of dust and moisture into Owner occupied areas, to reduce construction noise, and to prevent damage to existing materials and equipment.
   2. Paint surfaces exposed to view from Owner occupied areas.

1.09 ODORS

A. Work that causes excessive odors shall be performed only after coordination with the Owner's Authorized Representative. Filtering of air intakes to units may be required to prevent odors and vapors from entering the buildings.

B. Contractor shall provide 7 days advance notice to the Owner's Authorized Representative in order for advance notice to be forwarded to building occupants. Work stoppage may occur if advance notification has not been coordinated or odors and vapors from the work are found to generate complaints from building occupants.

1.10 FIRE SAFETY

A. Ensure that required exit routes remain unobstructed while building is occupied.

B. Abide by all fire safety requirements for buildings under construction, alteration or demolition as required by Article 87, of the Uniform Fire Code as adopted by the State of Oregon.

C. An emergency telephone shall be provided on site. Cellular telephone equipment is acceptable.

D. Fire Suppression Equipment:

1. Install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10 "Standard for Portable Fire Extinguishers", and NFPA 241 "Standard for Safeguarding Construction, Alterations and Demolition Operations".
2. Maintain equipment in working condition with current inspection certificate attached to each.
3. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stairwell.
4. Store combustible materials in containers in fire-safe locations.
5. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways, and other access routes for fighting fires.
6.
6. Provide continual supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.
7. When possible, relocate hot work to a designated hot work area.
8. If the materials or equipment cannot be relocated to a designated hot work area, use the least hazardous form of hot work that will get the job done and prepare the area properly.
9. Manage mobile hot work using the formal hot work permit system. (mentioned in the next bullet point and also a directive in the OSU Hot Work Safety Program)
10. Make sure both fire protection and hot work equipment work properly.
11. Train all personnel involved in hot work operations and activities so that they have the understanding, knowledge, and skills necessary to safely perform their jobs.

1.11 CONSTRUCTION AIDS

A. Scaffolding: comply with applicable OSHA requirements.

B. Material Handling Equipment:
   1. Provide necessary cranes, hoists, towers, or other lifting devices.
   2. Use only experienced operators.
   3. Remove equipment as soon as possible after task is ended.
   4. Coordinate placement of such equipment with Owner’s Authorized Representative.
   5. Obtain required permits and meet requirement of governing authorities regarding applicable regulations.

C. Materials or debris shall not be allowed to free fall from building.

D. The use of chutes or conveyors must be approved by Owner.

1.12 TEMPORARY CONTROLS

A. Water Control:
   1. Maintain excavations free of water.
   2. Provide, operate, and maintain necessary pumping equipment.

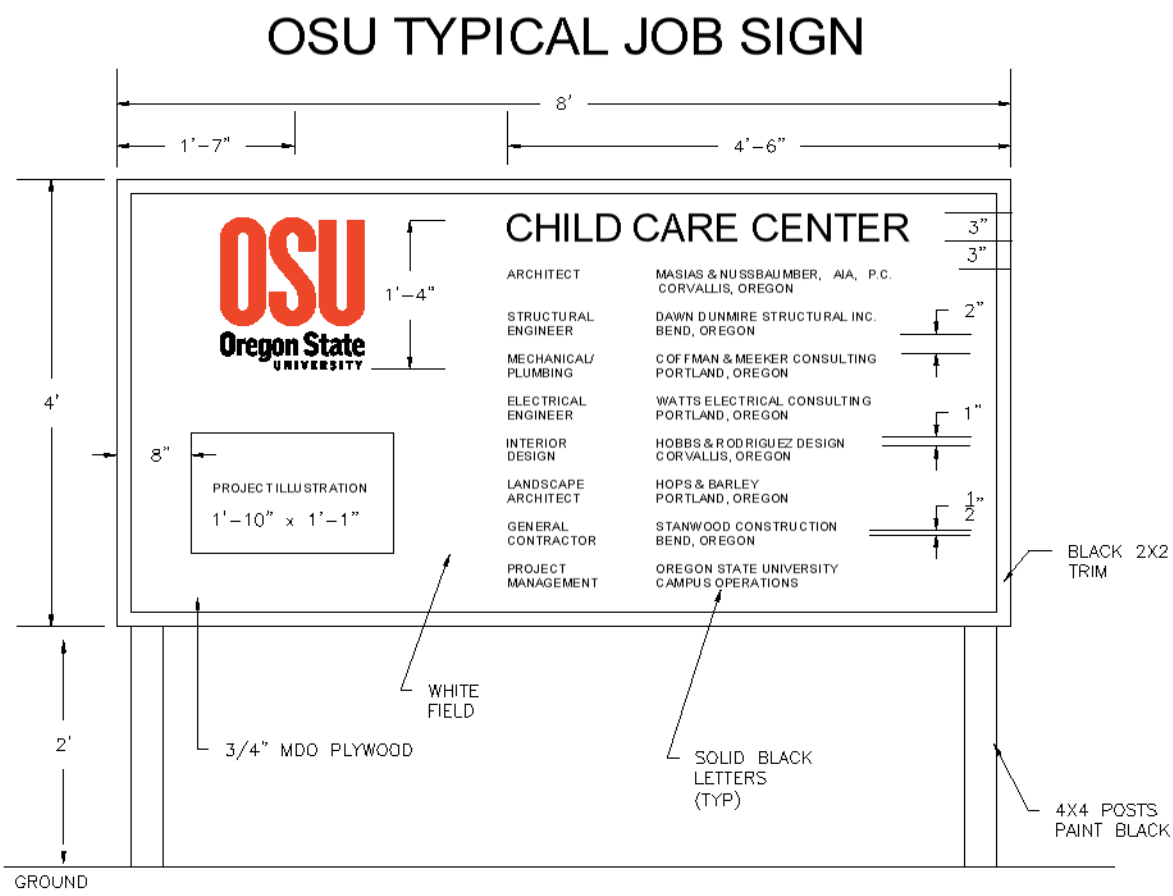
B. Protection:
   1. Protect installed Work and provide special protection where specified in individual specification sections.
   2. Prohibit traffic or storage upon waterproofed or roofed surfaces.

C. Security:
   1. Provide security and facilities to protect Work and existing facilities and Owner's operations from unauthorized entry, vandalism, or theft.
   2. Coordinate operations with Owner's Authorized Representative.

D. Temporary Traffic Control /Pedestrian Accessibility
   1. A continuous route for all pedestrians, including persons with disabilities and bicyclists, shall be maintained at all times. When existing pedestrian facilities are disrupted, closed, or relocated in a construction zone, temporary pedestrian facilities shall be provided.
   2. Temporary pedestrian facilities should be safe and accessible. There should be no curbs or abrupt changes in grade that could cause tripping or be a barrier to wheelchair use.
   3. Signage shall be provided directing people to the temporary accessible route. The signage shall include the International Symbol of Accessibility.
   4. Contractors shall not block temporary walkways with vehicles, equipment, construction materials, signs, trash, or other objects that might prohibit pedestrian passage.
   5. Construction equipment and equipment operation must be separated from any open walkways. At construction zones, pedestrian fences or other protective barriers shall be provided to prevent access into the construction zone.

1.13 PROJECT SIGNAGE

A. Contractor is permitted to post only one project identification sign based on the following example:



1.14 PREPARATION

A. Consult with Owner to review jobsite areas required for field offices, material storage and stockpiles, equipment storage, access to different locations, etc.

1.15 PERFORMANCE

A. Confine equipment, apparatus, and storage of material to work limits. The Owner will not be responsible for protection of materials and equipment from damage, pilfering, etc.

B. Install temporary facilities in such a manner that the installed work will not be damaged.

C. Do not use facilities of existing building unless authorized in writing by the Owner.

D. Effective September 1, 2012, OSU became a non-smoking campus and smoking is prohibited on all Campus property.

E. Keep facilities well maintained.

F. Relocate temporary facilities as required during job progress.

G. At Substantial Completion, clean and renovate permanent facilities that have been used during the construction period, including but not limited to:
   1. Replace air filters and clean inside of ductwork and housings.
   2. Replace significantly worn parts and parts that have been subject to unusual operating conditions.
   3. Replace lamps that are burned out or noticeably dimmed by substantial hours of use.

END OF SECTION

Oregon State University Construction and Maintenance Safety Requirements

EH&S, 100 Oak Creek Building, Corvallis, OR 97331-7405, (541) 737-2273,
FAX (541) 737-9090

Complete OSU Construction and Maintenance Safety Form - Send completed documents (including Site Safety Plan and all separate answer pages) to Construction Contract Administration along with the signed contract and bonds.

Project Isolation - All construction and remodeling activities regardless of size and/or scope must be fenced, barricaded, or otherwise protected to restrict entrance and to ensure the safety of those in the general area. See isolation requirements.

Site Safety Plan - A site safety plan will be required and will address:

- General Information
- Emergency Information
- Key Organization Personnel
- Hazard Evaluation/Facility Impact
- Emergency Procedures
- Work Zones
- Security Measures
- Fire Protection

A model plan is attached. This form can be used if another plan has not already been prepared. Contact OSU Environmental Health & Safety for more information 737-2505.

Isolation Requirements

General: All construction, maintenance, and remodeling activities, regardless of size or scope, must be fenced, barricaded, or otherwise isolated to restrict entrance and to ensure the safety of those in the general area.

Outdoor Activities: Outdoor projects require the following perimeter isolation:

- A six foot chain-link fence, with controlled access points, extending in all directions around the excavation or building site such that no area of the construction is accessible to pedestrians or unauthorized personnel or vehicles.
- Isolation area will include vehicle loading and unloading areas.
- At the University's option, other barricading plans may be accepted. These may apply to projects such as road resurfacing, parking lot striping, exterior building water proofing, deliveries, etc. Contact EH&S regarding other barricading plans.

Overnight: Any excavation across or adjacent to sidewalks or pathways which must be left open overnight, must be identified with working, blinking construction lights in addition to solid barricades

Indoor Activities: Indoor construction or maintenance projects which will create dust, potentially hazardous fumes or vapors, or offensive odors are subject to the following isolation:

- Areas where existing doors can provide isolation will be labeled "Construction Area--Authorized Personnel Only ".

- All other areas will be isolated by a solid barrier. The minimum barrier allowed is 4 mil poly sheeting sealed to prevent migration of dust.
- Mechanical ventilation may be required.
- A solid wall is required if building envelope is opened to the outside.

Contractor Responsibilities

- The contractor will provide all barricading, isolation, and fencing material. OSU will not provide any materials.
- The contractor will also provide all appropriate warning and detour signs when sidewalks, exits, or roads are closed.
- Contractor will provide all other construction area signs.

OSU Construction and Maintenance Safety Form

Send completed safety documents to Construction Contract Administration with contract and bonds.

Date: _____ Project: _____

Start Date: _____ Completion date: _____

Contractor: _____ Contact: _____

Work # _____ 24 hr #: _____

OSU Project Mgr: _____ Work / 24hr #'s: _____

Dept Contact: _____ OSU EH&S Contact: _____

Preconstruction meeting? **Y** **N** Date/Time/Location: _____

For the following items, prepare answers on a separate sheet for all items marked "Yes". Precede each answer with the appropriate item number. All boxes need to be checked

Y	N		For This Project	If YES, then:
		1	Will any confined spaces be accessed?	Describe location of entry Specify location of permit Notify EH&S prior to entry See SAF 209
		2	Will hot work be performed (welding, cutting, brazing, etc.)?	Provide min. 5# 2A10BC extinguisher within 10 ft If indoors - provide and describe ventilation See SAF 214
		3	Any products brought to campus?	Provide MSDS on site prior to first use; Make available to OSU on request
		4	Will lead paint be impacted?	Describe plan to limit contamination
		5	Will asbestos-containing-material be impacted?	Coordinate with OSU asbestos manager
		6	Will <u>any</u> materials (construction debris, soil, water, etc) be removed from campus?	Describe in detail identity and disposition of material (how, where)
		7	Any open trenches or holes?	Describe isolation procedures (see Page 1)
		8	Will a crane be used?	Describe crane safety plan (include plan to prevent loads above occupied areas)
		9	Is this project building a new facility, a major remodel?	Provide Site Safety plan Describe isolation procedures (see Page 1)
		10	Is this a minor remodeling project?	Provide, or fill out model Site Safety Plan form (see Page 3) Describe isolation procedures (see Page 1)
		11	Will air contamination be produced (e.g. dust, CO, solvent vapors, VOCs, odors)?	Describe project ventilation and isolation Indicate position of building air intake(s)
		12	Will there be noise > 85 dB?	Describe noise minimization plan
		13	Will this project use a scaffold or an external chute?	Describe isolation, dust control, installation
		14	Will this project involve a working surface >6' above a lower level	Describe fall protection
		15	Will any "blind" saw-cuts or penetrations be made in existing foundations, floors, ceilings and/or walls?	Describe plan for detecting and protecting power lines or other building utility lines.

<u>EH&S Review:</u> _____ <u>Date:</u> _____

Model Site Safety Plan

1. General Information

Contractor name_____

Address_____

City, State, Zip_____

Site Safety Officer_____ Project Dates_____

Project Name_____

2. Emergency Information

Emergency Response	911	OSU EH&S and OSU Facilities Services must be notified in the event of an emergency
Hazardous Materials Spill		
MSDS on-site location		
OSU EH&S	(541) 737-2273	
Facilities Services	(541) 737-2969	

3. Contractor Key Personnel

	Name	Phone	Emergency Contact
Company Owner			
Project Manager			
Job Supervisor			
Site Safety Officer			
Other Responsible Individual			
24 Hour Notification			

List of employees on site _____

_____

_____

4. Hazard Evaluation/ Facility Impact	
Physical	**Yes / No**
Heavy Equipment	
Noise	
Heat	
Elevation	
Radiation Materials	
Excavations	
Underground Utilities	
Confined Spaces	
Fire Prevention	
Electrical	

5. Emergencies
Services
Evacuation Route
First Aid Location
Hazardous Materials Spill Procedure

6. Work Zones

Material Storage_____

Parking locations_____

Individuals with OSU keys_____

Access issues_____

7. Security measures_____

_____

_____

8. Fire protection _____

SECTION 01 56 39 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies minimum requirements for protection of existing trees and shrubs from damage resulting from the Contractor's operations, and for maintenance of existing trees, shrubs, and other plant materials including lawn surfaces indicated to remain on the Project site.

B. The Contractor shall ensure all labor, equipment, and materials are provided for temporary tree, plant, and lawn protection during the work including, but not limited to:

1. Marking of clearing limits.
2. Protection signage and panelized chain link fencing.
3. Tree trunk boxing.
4. Tree and root pruning.
5. Maintenance of trees and landscaping.

1.2 DEFINITIONS

A. Certified Arborist: An approved arborist certified by the International Society of Arborists (ISA).

B. Tree Root Protection Zone (TRPZ): Measure the tree's diameter at breast height (DBH), in inches. DBH is calculated using the circumference of the tree trunk at 4.5 feet above grade.

1. Multiply the DBH by 1.5.
2. Example = 7" DBH x 1.5 = 10.5'.
3. The result expressed in feet shall be the minimum radius of the TRPZ.
4. For trees less than 8" in DBH, the TRPZ shall not be less than the diameter of the canopy drip line.
5. For shrubs scheduled to remain the protection shall be the drip line of the existing plant or plant grouping.

C. Dripline: The dripline of a tree is the area on the ground beneath the tree's canopy.

D. Landscape Requiring Protection and Maintenance: All existing on-site trees, plants, and lawn areas which are not identified for Contractor's lay down or parking use, including tree canopies and root zones extending within the Project site.

E. University Arborist: A certified arborist employed by or contracted by the university to inspect and oversee the daily construction activities to ensure the program developed by the project arborist is executed according to the tree protection plan

1.3 SUBMITTALS

A. Name and contact of Certified Arborist for approval.

B. Tree and Landscape Protection Plan: Prior to any site disturbance, the Contractor shall submit for Owner's approval a "Tree and Landscape Protection Plan" developed in consultation with a certified arborist for all trees, plants, and lawn indicated to remain.

1. The Tree and Landscape Protection Plan shall include:
   a. Proposed protection fence locations;
   b. The location of all on-site trees requiring protection
   c. Identification of the TRPZ for each tree requiring protection; and
   d. Temporary irrigation and fertilization schedule.

1.4 CONTRACTOR RESPONSIBILITY

A. The Contractor shall assume all landscape shall be protected, unless indicated to be removed in the Contract Documents, and shall be responsible for all damage and/or disturbance within the TRPZ of trees indicated to remain such as, cutting or skinning of roots, skinning or bruising of bark, compaction of root zones, and breaking of branches.

1. Damage and/or disturbance which, at the Owner's sole discretion, can be remedied by corrective maintenance shall be immediately repaired by the Contractor upon written notice by Owner.
   a. The Contractor shall employ a certified arborist to repair damage to trees.

2. Trees or shrubs which are injured or irreparably damaged shall, at the Owner's sole discretion, be replaced by the Contractor with new trees or shrubs of the same size and type. However, the Owner is not bound to have the trees or shrubs replaced in the same location and may request the Contractor provide the tree or shrub for installation by Owner.
   a. Trees which fail to fully foliate in the spring following Substantial Completion shall be presumed to have been injured or irreparably damaged due to construction.

B. Trees or shrubs which require removal and/or replacement due to damage by construction shall be removed to a depth of two (2) feet below grade and include the refilling and repair of the ground surface, with such costs to be borne by the Contractor.

C. Protection and maintenance shall include, but not be limited to, replacement of damaged protection fencing; aeration of compacted soils; control of temporary irrigation water runoff; pruning and treatment of damaged roots, limbs, and branches; and replacement of wood chips within tree protection areas.

D. Site damage and/or disturbance caused by the Contractor outside the Project site shall be repaired or replaced, and all costs shall be borne by the Contractor.

Repairs shall include, but are not limited to, pruning or removing damaged vegetation, replacement of damaged vegetation and/or lawn restoration, soil remediation to alleviate over-compaction, and temporary irrigation to establish new plantings.

1.5 COORDINATION

A. The project arborist will coordinate with other trades and contractors affecting or affected by work of this section to ensure that tree protection measures are understood prior to work commencing.

B. An on-site review of tree protection measures will be completed among the project arborist, Landscape Architect, contractor, OSU Project Manager, City of Corvallis, and FS Landscape Manager or designee prior to any site work or grading is started.

C. During this meeting the pre-construction evaluation of those trees identified to remain shall be completed.

D. The contractor is responsible for maintaining all tree protection measures during all construction phases of the project.

E. The project arborist and OSU Project Manager and FS Landscape Manager or designee shall be contacted immediately if any of the trees on site are damaged during the construction of the project. The project arborist in consultation with the OSU Project Manager and FS Landscape Manager or designee will assess the damage to any tree and provide corrective measures, which may include pruning; tree wound repair, or even removal.

F. Upon completion of the project the project arborist will contact the OSU Project Manager and review the post construction evaluation of the trees on the site.

G. No tree shall be removed from the site without the completion of a tree condition report and prior notification and approval of the OSU Project Manager.

H. Tree removal within the OSU National Historic District requires a Historic Tree Checklist to ensure that any trees being removed are not considered historic. An arborist report must accompany the Historic Tree Checklist.

1.6 SIGNAGE

A. A highly visible sign shall be posted on the chain link fence demarking the area as a tree root protection zone. The sign shall remain posted and unobstructed until the project is completed.

PART 2 - MATERIALS

2.1 PROTECTION FENCING

A. Protection fencing shall be six (6) feet high, 11 gauge-galvanized, 2-inch mesh chain link fencing with nominal 1-1/2± -inch diameter galvanized steel perimeter frame and posts or approved equal. Fencing may be panelized, with extended legs for insertion into pipe frame supports or precast concrete blocks which will allow for repositioning during the progress of the Work. Anchor clamps shall be placed within 8 inches of the top of all abutting panels to lock them in place.

B. The Contractor shall post weather-resistant 8 1/2" x 11” fluorescent green or yellow signage on protection fencing at twenty (20) foot intervals warning construction personnel to keep out of protective zones.

2.2 TREE TRUNK BOXING

A. Existing trees that are not protected with fencing and are designated to remain shall be protected by boxing constructed with 4 x 4-inch posts at corners with 2 x 4-inch horizontal top, middle, and bottom rails on each side. Box shall be approximately 8 x 8 feet in size centered on the tree trunk to a height of approximately six (6) feet. Top and middle rails shall be painted orange.

2.3 WOOD CHIPS

A. Wood chips shall be composted for a minimum of one (1) year prior to use.

PART 3 - EXECUTION

3.1 ASSESSMENT

A. Pre-Construction Tree Assessment: Prior any site work, grading, staging of equipment, materials or any other mobilization of the project, the project arborist shall complete a pre-construction assessment report that outlines the physical conditions of the trees identified to remain on the site. The project arborist shall review the report with the OSU Project Manager and the FS Landscape Manager or designee.

B. The OSU FS Landscape Manager or designee shall provide written notification to the project arborist that the report has been reviewed and is acceptable prior to the mobilization of the project.

C. The assessment report shall provide any specific tree protection measures required to ensure the health and vigor of the trees during the construction of the project.

D. The assessment report shall also include a value appraisal of the trees completed according to the most recent edition of the Council of Tree and Landscape Appraiser standards.

E. The value of the trees that are to remain will be provided to the contractor prior to the mobilization of the site to ensure the contractor is aware of the replacement cost of the trees as outline in the appraisal report.

F. Tree Protection Areas: Prior any site work, grading, staging of equipment, materials or any other mobilization of the project the contractor shall establish the tree root protection zones as specified in the tree protection plan and install the specified fencing.

G. This protection area shall be maintained by the contractor during all phases of construction and only removed upon demobilization of the site.

H. In consultation with the OSU Project Manager and OSU FS Landscape Manager or designee, the project arborist shall recommend corrective measures for any tree damaged during construction,

I. Prior to any removal of a damaged tree the project arborist will ensure a replacement cost is determined for the damaged tree.

J. The Project Arborist shall complete a post construction assessment of the trees to determine the condition of the trees. The report shall be submitted to the OSU Project Manager and OSU FS Landscape Manager or designee for review and approval.

K. The OSU FS Landscape Manager or designee shall provide written notification that the post construction report has been reviewed and accepted prior to the close out of the project.

3.2 PROTECTION

A. There shall be no alteration or disturbance of existing grade of any kind within the TRPZ.

B. No alteration of drainage flow into the TRPZ shall be permitted without the written authorization from the project arborist.

C. No storage of construction materials, equipment or supplies of any kind shall be permitted within the TRPZ.

D. No disposal of any liquids of any kind shall be permitted within the TRPZ.

E. No movement of vehicles, equipment, pedestrians, etc. shall be permitted within the TRPZ.

F. No excavation or trenching shall be permitted within the TRPZ.

G. No tunneling under the TRPZ without prior written authorization from the project arborist and landscape coordinator.

H. No roots extending beyond the TRPZ shall be pruned or cut without prior authorization from the project arborist.

I. No exceptions of the tree protection measures shall be provided without written approval from the OSU Project Manager and the OSU FS Landscape Manager or designee.

J. Comply with City of Corvallis requirements for tree protection.

3.3 PLANS

A. All site and landscape plans shall identify the trees that are to remain, the trees to be removed, the tree root protection zone, and protection fencing.

B. Plans should be reviewed by the City of Corvallis.

3.4 TREE DAMAGE AND REPAIR

A. Upon notification of a damaged tree, the Project Arborist shall inspect the tree and assess the damage. The arborist shall outline in writing the corrective measures necessary to repair the damage.

B. If a tree is to be removed as a result of construction related damage, then the cost of the removal and replacement and one year establishment care of the tree shall be the responsibility of the general contractor.

C. Tree Replacement

1. Up to 8” DBH: Same size as damaged tree, species selected by Landscape Architect after consulting with OSU Project Manager and OSU FS Landscape Manager or designee.
2. Over 8” DBH: Compensate OSU as determined by value appraisal completed by project arborist according to the most recent Council of Tree and Landscape Appraiser standards.

D. Replacement shrubs and groundcovers: Same size and quality as damaged shrub and groundcover, species selected by project Landscape Architect in consultation with the OSU Project Manager and OSU FS Landscape Manager.

3.5 CLEAN-UP

A. Any limbs, branches, leafy debris, or mulch accumulated on site as a result of the Work of this Section shall be removed and disposed of in a lawful manner

END OF SECTION 01 56 39

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Summary:
   1. Product options.
   2. Owner-furnished products.
   3. Product delivery, storage and handling.

1.02 PRODUCTS

A. Products:
   1. New material, machinery, components, equipment, fixtures, and systems forming the Work, but does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work.
   2. Products may also include existing materials or components specifically identified for reuse.

B. Use interchangeable components of the same manufacture for similar components.

C. Unless otherwise specified, all material and equipment shall be new; free from defects impairing strength, durability, and appearance; of current manufacture.

D. Items specified shall be considered minimum as to quality, function, capacity, and suitability for application intended.

E. Items incorporated into the Work shall conform to applicable specifications and standards designated, and shall be of size, make, type, and quality specified.

F. Design, fabricate, and assemble in accordance with current best engineering, industry, and shop practices.

G. Manufacture like parts of duplicate units to standard size and gauge to make them interchangeable.

H. Two or more items of the same kind shall be identical and made by the same manufacturer.

1.03 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

C. Products Specified by Naming One [or More] Manufacturer[s]: Products of manufacturer[s] named and meeting specifications, no options or substitutions

allowed.

D. Substitution Procedure: Under Section 01 25 00.

1.04 REUSE OF EXISTING PRODUCTS

A. Except as specifically indicated or specified, materials and equipment removed from existing construction shall not be used in the completed Work.

B. For material and equipment specifically indicated or specified to be reused in the Work:
   1. Use care in removal, handling, storage, and reinstallation to assure proper function in the completed Work.
   2. Arrange for transportation, storage, and handling of products which require off-site storage, restoration, or renovation.
   3. Remove and reinstall mechanical units, vents, guys, antennae, and electrical and grounding wires or conduits.

1.05 OWNER FURNISHED PRODUCTS

A. Designate delivery dates of Owner-furnished items in the construction schedule.

B. Receive, unload, store and handle Owner-furnished items at the site; protect from damage.

1.06 DELIVERY, STORAGE AND HANDLING

A. Transport, handle, store and protect products in accordance with manufacturer's instructions.

B. Arrange deliveries in accordance with construction schedules; coordinate to avoid conflict with Work and site conditions.

C. Deliver and store products in undamaged condition in manufacturer's original containers or packaging with identifying labels intact and legible.

D. Inspect shipments to assure compliance with Contract Documents and reviewed submittals, and that products are undamaged.

E. Prevent soiling or damage to products or packaging.

F. Interior Storage: Maintain required temperature and humidity ranges. Verify that Owner furnished storage meets product manufacturer's requirements.

G. Exterior Storage:
   1. Store materials above ground to prevent soiling and/or moisture infiltration.
   2. Cover materials with waterproof breathable sheet coverings; provide adequate ventilation.
   3. All storage locations to be approved in advance by the Owner.

H. Arrange storage to provide access for inspection.

I. Coordinate with Owner’s Authorized Representative all on-site storage activities.

J. Provide for security of stored products.

END OF SECTION

SECTION 01 73 29

CUTTING AND PATCHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Requirements and limitations for cutting and patching of Work.

1.02 RELATED SECTIONS

A. Section 01 25 00, Product Substitution Procedures.

B. Section 01 33 23, Shop Drawings, Product Data, Samples

1.03 SUBMITTALS

A. Submit written request in advance of cutting or alteration which affects:
   1. Structural integrity of any element of the Work.
   2. Efficiency, maintenance, or safety of any operational element.
   3. Visual qualities of sight exposed elements.
   4. Work of Owner or separate contractor.

B. Include in request:
   1. Identification of project.
   2. Location and description of affected work.
   3. Necessity for cutting or alteration.
   4. Description of proposed work, and products to be used.
   5. Alternatives to cutting and patching.
   6. Effect on work of Owner or separate contractor.
   7. Written permission of affected separate contractor.
   8. Date and time work will be executed.

PART 2 PRODUCTS

2.01 MATERIALS

A. Primary Products: Those required for original installation.

B. Product Substitution: For any proposed change in materials, submit request for substitution under provisions of Section 01 25 00.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect existing conditions prior to commencing Work, including elements subject to

damage or movement during cutting and patching.

B. After uncovering existing work, inspect conditions affecting performance of Work.

C. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

A. Provide temporary supports to ensure structural integrity of the Work.

B. Provide devices and methods to protect other portions of the Work from damage.

C. Provide protection from elements for areas which may be exposed by uncovering work.

3.03 CUTTING AND PATCHING

A. Execute cutting, fitting and patching to complete work.

B. Fit products together, to integrate with other work.

C. Remove and replace defective or non-conforming work.

D. Provide openings in the work for penetration of mechanical and electrical work.

3.04 PERFORMANCE

A. Execute work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.

B. Cut rigid materials using masonry saw or core drill. Pneumatic tools are not allowed without prior approval from Owner's Authorized Representative.

C. Restore work with new products in accordance with requirements of Contract Documents.

D. At penetrations of fire rated walls, partitions, ceiling or floor construction, completely seal voids with approved fire rated material, to full thickness of the penetrated element.

E. Refinishing:
   1. Refinish surfaces to match adjacent finish.
   2. For continuous surfaces, refinish to nearest intersection or natural break.
   3. For an assembly, refinish entire unit.

END OF SECTION

SECTION 01 74 00

CLEANING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Related requirements specified elsewhere, cleaning for specific products or work: Specification section for that work.

B. Maintain premises and public properties free from accumulations of waste, debris, and rubbish, caused by operations.

C. At completion of Work remove waste materials, rubbish, tools, equipment, machinery and surplus materials, and clean all sight-exposed surfaces; leave project clean and ready for occupancy.

1.02 QUALITY ASSURANCE

A. Standards: Maintain project in accord with applicable safety and insurance standards.

B. Hazard Control:
   1. Store volatile wastes in covered metal containers.
   2. Provide adequate ventilation during use of volatile or noxious substances.

1.03 MATERIALS

A. Use only cleaning materials recommended by manufacturer of surface to be cleaned.

B. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

1.04 DURING CONSTRUCTION:

A. Wet down dry materials and rubbish to lay dust and prevent blowing dust.

B. At reasonable intervals during progress of Work clean site and public properties, and dispose of waste materials, debris and rubbish.

C. Provide on-site containers for collection of waste materials, debris and rubbish.

D. Remove waste materials, debris and rubbish from site and legally dispose of at public or private dumping areas off Owner's property.

E. Vacuum clean interior building areas when ready to receive finish painting, and continue vacuum cleaning on an as-needed basis until project is ready for Substantial Completion or occupancy.

F. Handle materials in a controlled manner with as few handlings as possible; do not drop or throw materials from heights.

1.05 FINAL CLEANING

A. Employ experienced workers, or professional cleaners, for final cleaning.

B. In preparation for Substantial Completion or occupancy, conduct final inspection of sight-exposed interior and exterior surfaces, and of concealed spaces.

C. Remove grease, dust, dirt, stains, labels, and other foreign materials from exposed interior and exterior finished surfaces.

D. Remove putty, paint, labels, lubricants, etc., from windows, mirrors, and sash, and then polish, taking care not to scratch glass.

E. Vacuum carpeting (shampoo where required), removing debris and excess nap.

F. Repair, patch and touch up marred surfaces to specified finish, to match adjacent surfaces.

G. Replace air filters where units were operated during construction.

H. Maintain cleaning until project, or portion thereof, is occupied by Owner.

END OF SECTION

SECTION 01 77 00

CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 DESCRIPTION

A. The requirements specified in this section relate to all Contractors individually performing under these Contract Documents:
   1. Project Record Documents.
   2. Final review and payment.

B. Related work specified elsewhere:
   1. OSU General Conditions.
   2. Shop Drawings, Product Data and Samples, Section 01 33 23.

1.02 PROJECT RECORD DOCUMENTS

A. The Project Record Documents shall be organized to include the following information, as applicable:
   1. Table of Contents
   2. Project Team List
   3. Specifications (Including Addenda and Change Orders)
   4. Drawings
   5. Inspection Reports
   6. Signed Warranty(ies)
   7. Maintenance Instructions

B. Draft Project Record Documents shall be submitted for review upon 75% completion of the Work.

C. Project Record Documents shall be submitted electronically to the Owner. Hard copies will not be accepted.

D. The project team list shall include the name, address, and phone number of the Owner, Contractor, Inspector, Subcontractors, and the materials manufacturers.

E. Legibly mark each Specification section to indicate actual as-built condition indicating changes in the Work made by addenda or change order or actual materials used and actual manufacturer(s) used.

F. Maintain current and accurate as-built mark-ups during construction and make available to Owner's Authorized Representative upon request.

G. Legibly mark the drawings to indicate actual as-built conditions indicating changes in the Work made by addenda or change order or actual conditions which differ from the drawings.

H. Redraw or provide new drawings as required for a complete as-built set of drawings.

The Contractor shall maintain current and accurate as-built mark-ups during construction and make available to Owner's Authorized Representative.

I. Include inspection reports if applicable.

J. Include, in a single section, all copies of the Project's labor and material warranties clearly marked to identify the Owner's responsibilities under the terms of each warranty and the section of Work that each warranty covers. One set must be clearly marked as containing original documents.

K. In the case of an elevator installation, the Contractor's and manufacturer's warranty shall provide for the Owner's right to respond to emergency/car failure situations for the purpose of extricating individuals trapped in the elevator.

L. Include maintenance instructions complete with technical information and name, address, and phone number of the Contractor(s) and manufacturer(s) of each material and product.

1.03 FINAL REVIEW AND PAYMENT

A. Prior to completion, the Contractor shall inspect the Work and make a Punch-list noting all items that are incomplete and/or incorrect.

B. The Contractor shall notify all Subcontractors in writing of incomplete and/or incorrect items. Notify far enough in advance of the completion date that the Work can be completed on schedule. Said Work shall be immediately corrected.

C. Should conditions prevail which prohibit some elements of the Work from being accomplished, but the work-in-place will perform the primary function (i.e., painting cannot be completed due to high moisture content of masonry walls.) the Contractor shall record the reason with this Punch-list item requesting temporary delay in completion from the Owner in writing.

D. Notify the Owner in writing that all items are completed and ready for final review or else that the Work product is fully usable, but some listed deficiencies remain to be completed. Submit all record documents at this time.

E. The Owner will review all documents. When the documents include a Contractor's request for delay in completion, the Owner will review all Work which is certified as complete to the best knowledge of the Contractor. The Owner will also review the listed incomplete Work and assign a value to such uncompleted work.

F. The Contractor shall make the required corrections to the Work expeditiously. A letter will be addressed to the Contractor informing the Contractor of the project status.

G. When Contract closeout procedures are completed and all Punch-list deficiencies have been corrected, provide Owner with final corrected Project Record Documents based on Owner's preliminary review. Correct Project Record Documents shall be in electronic format.

H. Final Completion by the Owner will be documented and the Contractor will receive written notice of acceptance of the Work and notification that final payment may be billed and released.

I. All warranties shall commence and become effective beginning on the date of Substantial Completion.

END OF SECTION

SECTION 05 52 10 METAL RAILINGS - LANDSCAPE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Hot dipped galvanized bar and tube railings and handrails with painted finish.
2. Hot dipped galvanized fittings, fasteners and embedment items required for the installation, including embedded and surface-affixed mounting plates and anchors.

B. Furnish all materials, labor, equipment, tools, and transportation for the fabrication and installation of metal site railings.

1.2 REFERENCES

A. Comply with the provisions of the following unless otherwise required. Contractor responsibility to provide Work complying with contract requirements shall not be altered by statements made in reference standards and documents.

1. ASTM, International, (ASTM).
   a. ASTM A36 – Standard Specification for Carbon Structural Steel.
   b. ASTM A47 – Standard Specification for Ferritic Malleable Iron Castings.
   c. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   d. ASTM A108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
   e. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   f. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   g. ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic Cement Grout (Non-Shrink).
   h. ASTM D6386 – Standard Practice for Preparation of Zinc (Hot Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting.
   i. ASTM E488 –Standard Test Methods for Strength of Anchors in Concrete Elements.
   j. ASTM E894 – Standard Test Method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings.
   k. ASTM E935 –Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
   l. ASTM F1941 – Standard Specification for Electrodeposited Coatings on Threaded Fasteners (Unified Inch Screw Threads (UN/UNR)).

2. American Welding Society, (AWS).
   a. AWS D1.-1**,** Structural Welding Code –Steel.

1.3 PERFORMANCE REQUIREMENTS

A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Steel: 72 percent of minimum yield strength.

B. Structural Performance: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails:
   a. Uniform load of 50 lbf/ ft. applied in any direction.
   b. Concentrated load of 200 lbf applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 ACTION SUBMITTALS

A. Product Data for the following:

1. If not custom fabricated, manufacturer's product lines of railings assembled from standard components.
2. Non-shrink grout, anchoring cement and paint products.

B. Shop Drawings: Include appropriately scaled and dimensioned plans, elevations, sections, details, and attachments to other work.

1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Shop drawings shall accurately reflect any sloping conditions along pavements or walls and all mounting conditions.

C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.

D. Samples for Verification: For each type of exposed finish required.

1. Sections of each linear railing member, including handrails, top rails, and posts.
2. Fittings and brackets.
3. Welded connections.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For firms and persons specified in Quality Assurance article to demonstrate their capabilities and experience.

B. Welding certificates.

1. Submit 2 copies of weld inspection reports prior to covering or painting structural welds.
2. Welder Qualifications: Welder shall be certified by American Welding Society for steel welding.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing through one source from a single manufacturer or fabricator.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1 1, "Structural Welding Code Steel."

C. Personnel: Provide a list of at least three completed custom railing projects of similar scope with project names and addresses, names and addresses and contact information for architects and owners.

D. Contractor shall communicate with the fabricator that the railings are to be painted. Precautions are to be taken to avoid any processes that may interfere with the adhesion of the paint system.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver railings securely wrapped with a protective covering.

B. Store finished railings assemblies in a dry, well-ventilated, weather-tight place until they can be installed.

C. Limit and minimize removal of protective coverings or wrappings during installation. Maintain protective covering in place until Final Acceptance.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls, stairs, curbs and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating railings without field measurements. Coordinate stairs and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
2. Trimming and fitting at site are not acceptable.

1.9 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, concrete inserts, anchor bolts, and items with integral anchors

that are to be embedded in concrete or masonry. Deliver such items to Project site in a timely manner for installation.

B. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, a single source capable of fabricating and providing galvanized and painted steel pipe railings of uniform appearance and level of finish as detailed on the Drawings.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Plates, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

2.3 CARBON STEEL

A. Bar, and plate to be hot-dipped galvanized: ASTM A123.

2.4 FASTENERS

A. General: Provide the following:

~~1.~~ Galvanized and Painted Steel Railings: Hot-dipped galvanized steel fasteners.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components: Railings are of a short enough size that they should be fabricated as single pieces without requiring interconnection.

D. Anchors: Where required, provide cast-in-place chemical or torque-controlled expansion anchors, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E488 conducted by a qualified independent testing agency.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

C. Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges of bar stock to a radius of approximately 1/32 (0.03125) inch. Remove sharp or rough areas on exposed surfaces.

C. Form work true to line and level with accurate angles and surfaces.

D. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may potentially accumulate internally within the railing structure. Locate weep holes in inconspicuous locations and always on the undersides and low points or pipe and tube railing units.

E. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

F. Connections: Fabricate railing panels with full length welded connections, unless otherwise indicated.

G. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at bar connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces with no evidence of a welded joint.

H. Form changes in direction of guardrails and handrails as follows:

1. By miter cutting and welding at elbow bends.

I. Brackets, Flanges, Fittings, and Anchors: Provide brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated.

J. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

K. Assemble railings sections in the shop to greatest extent possible. Wrap railings individually for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in the same railing section or adjacent railing pieces are not acceptable.

2.8 PAINTED FINISH FOR RAILINGS

A. System Type: Epoxy/Polyurethane. Basis of design system: Tnemec.

B. Surface Preparation: Contact Tnemec representative for recommendation.

1. Scott McConnell, Coating Consultant, TNW Inc., 7929 2nd Avenue South, Seattle, WA 98108, Tel.: 206-762-5755 scott@tnwsolutions.com.

C. Primer: Tnemec Series N69 Hi-Build Epoxoline II, DFT (Dry Film Thickness) 2.0 to 3.0 mils.

D. Finish Coat: Series 73, 1074 or 1075 Endura-Shield, DFT 2.0 to 3.0 mils.

E. Total DFT: 4.0 to 6.0 mils.

F. Finish Coat Color: Match Architect’s approved sample for building or per Owner’s Representative.

G. Alternative paint systems compatible with zinc coatings by Sherwin Williams, Benjamin Moore, PPG or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to painting, examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 (0.0625) inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 (0.25) inch in 12 feet.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and exposed fasteners where necessary for securing railings to embedded support plates and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Non-Welded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in Part 2 "Fabrication" Article whether welding is performed in the shop or in the field.

3.4 ANCHORING POSTS

A. Form or core-drill holes not less than 6 inches deep into concrete and 3/4 inch larger than outside diameter of post, or to accept expansion bolts, for installing posts in concrete and stone paving. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Leave anchorage joint exposed with anchoring material flush with adjacent surface, unless noted otherwise on Drawings.

C. Anchor posts to metal surfaces with flanges, angle type, or hardscape type as required by conditions, connected to posts and to metal supporting members.

3.5 ADJUSTING AND CLEANING

A. Clean stainless steel by washing thoroughly with mild soap and clean water after unwrapping protective coverings. Rinse with clean water and towel dry.

3.6 PAINTING APPLICATION

A. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry. Determine the condition of the galvanized surface in order to employ proper surface preparation. Two conditions are possible:

1. Newly galvanized steel shall have been exposed to the atmosphere for no more than 48 hours with few zinc compounds on the surface.
2. After 48 hours galvanized surfaces will be considered partially weathered.

B. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

C. Galvanized-Metal Substrates: Remove grease and oil residue from fabricated galvanized metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

1. Removal of excess zinc:
    a. Dross particles must be ground flat to match the surrounding zinc coating. If the coating cannot be ground flat, the parts will not be acceptable.
    b. Zinc skimming particles, although not cause for rejection of the galvanized part, shall be removed before painting.
    c. Bumps, runs and drips shall be re oved by grinding or filing. Take care to remove only the excess zinc material, leaving a flat surface.
    d. Grinding and filing must be completed before chemical cleaning of the parts.
        1) Visible sparking during the grinding process indicates that base steel has been reached. If sparks fly, the coating must be repaired before painting. Comply with requirements of ASTM A780.

2. Removal of organic chemicals:
    a. Organic chemicals shall be removed with an alkaline solution, acidic solution, or solvent cleaning. Follow manufacturer’s directions for mixing of cleaning solutions.

3. Rinse and dry after application of cleaning solutions. Rinse twice if using an acid cleaner.
4. Profile after drying. Profile by sweep or brush blasting, by application of a wash primer, acrylic passivation pretreatment, or surface grinding. If performing any grinding the surface shall be blown off with compressed air.

D. Apply paints as soon as possible after cleaning and profiling. In no case allow more than 12 hours to pass between profiling and painting.

E. Apply paint according to manufacturer’s written instructions.

1. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturer.

F. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat but provide sufficient difference in shade of undercoats to distinguish each separate coat.

G. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

H. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

I. Paint Application:

1. Remove dust and other foreign materials from substrate immediately prior to applying each coat.
2. Apply each coat to uniform coating thickness in accordance with manufacturer's instructions, not exceeding manufacturer's specified maximum spread rate for indicated surface; thins, brush marks, roller marks, orange-peel, or other application imperfections are not permitted.
3. Allow manufacturer's specified drying time, and ensure correct coating adhesion, for each coat before applying next coat.
4. Re-prepare and re-coat unsatisfactory finishes; refinish entire area to corners or other natural terminations.

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

END OF SECTION 05 52 10

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. The intent of Division 26, Electrical Specifications and Drawings is to provide a complete and workable facility, with complete systems as required by applicable codes, as indicated, and as specified.

B. Include work specified in Division 26, Electrical and as indicated on Drawings. Include appurtenances, connections, fasteners, and accessories required to make a complete working system, whether indicated or not indicated.

C. Refer to Division 01, General Requirements.

1.2 RELATED SECTIONS

A. Division 01, General Requirements

B. Division 26, Electrical

1.3 REFERENCES

A. The latest adopted revisions of the publications listed below apply to these Specifications as referenced:

1.	IBC	International Building Code
2.	NEC	National Electrical Code
3.	NFPA	National Fire Protection Association
4.	NEMA	National Electrical Manufacturers Association
5.	NECA	National Electrical Contractors Association
6.	ANSI	American National Standards Institute
7.	IEEE	Institute of Electrical and Electronic Engineers
8.	UL	Underwriters Laboratories

1.4 SYSTEM DESCRIPTION

A. Ground Systems:

1. Maintain complete existing ground systems.
2. Include conduit system, neutral bus, and equipment grounding conductors as required by Contract Documents and by applicable codes.

B. System Identification:

1. Clearly identify elements of the Project electrical system to indicate the loads served, or the function of each item of equipment, connected under this work.
2. Comply with requirements of Division 26, Electrical, and with applicable codes.

C. Drawings:

1. Drawings are diagrammatic. They do not show every offset, bend, tee, or elbow, which may be required to install work in the space, provided and avoid conflicts with other construction.
    a. Prior to installing work, take field dimensions, and note conditions available for, installation.
    b. Follow the Drawings as closely as practical to do so, and install additional bends, offsets, and elbows where required by installation conditions.
        1) Additional offsets, bends, and other connectors are subject to approval by Project Engineer.
        2) Install additional offsets, bends, and other connectors without additional cost to Owner.
    c. The right to make any reasonable changes in outlet location prior to roughing in is reserved to the Owner's Representative.

2. Luminaire Designations:
    a. Lower case letters adjacent to devices or luminaires indicate switching arrangement or circuit grouping.
    b. Numbers adjacent to devices indicate circuit connection.

3. Circuits and Switching:
    a. Do not change branch circuiting and switching indicated; nor combine homeruns, without Engineer's prior approval.
    b. Do not combine or change feeder runs.

4. Circuit Conductors:
    a. Cross or hash marks on conduit runs indicate quantity of No. 12 copper branch circuit conductors, unless otherwise noted.
    b. Where such marks do not appear, provide quantity of circuit conductors to the outlets shown to perform the control or circuiting indicated.
    c. Include ground, travelers, and switch legs required by the circuiting arrangement indicated.
    d. Provide a dedicated neutral conductor with each circuit. Do not use a shared neutral conductor between phases unless, requested or directed.

1.5 SUBMITTALS

A. Comply with Division 01, General Requirements.

B. Contractor Responsibilities:

1. Submit submittals one time and in proper order.
2. Ensure equipment will fit in the space provided.
3. Deviations from the Drawings and Specifications specifically noted in the submittals. Failure to comply will automatically void any implied approval for use of the equipment on this project.

C. Shop Drawings and Equipment Data:

1. Combine electrical shop drawings and equipment data in Submittal binders.
2. Include in Submittal binders:
    a. Complete index of materials and equipment as required by Specifications to be documented by submittals.
    b. Fully describe equipment furnish per manufacturer's detailed specifications.
    c. All deviations from the Drawings and Specifications, noted on the submittals. Failure to comply will automatically void any implied approval for use of the equipment on this project.

D. Installation Drawings:

1. Submit prior to starting installation.
2. Show outlets, devices, terminal cabinets, conduits, wiring, and connections required for the complete system described.

E. Record Drawings:

1. Keep record drawings up to date as the work progresses.
2. Show changes, deviations, addendum items, change orders, corrections, and other variations from the Contract Drawings.
3. Keep record drawings at the jobsite and available for the Architect's review.
4. At the completion of the work, incorporate all deviations from the installation drawings to indicate as-built conditions.

F. Operation and Maintenance Data:

1. As specified in Division 01, General Requirements.
2. Provide a separate manual or chapter for each system as follows:
    a. Lighting System
3. Description of system.
4. Operating Sequence and Procedures:
    a. Step-by-step procedure for system start-up, including a pre-start checklist.
        1) Refer to controls and indicators by nomenclature consistent with that used on panels and in control diagrams.
    b. Detailed instruction in proper sequence, for each mode of operation (i.e., day-night, staging of equipment).

c. Shutdown Procedure:

1) Include instructions for stopping and securing the equipment after operation.
2) If a particular sequence is required, give step-by-step instructions in that order.

5. Preventive Maintenance:

a. Schedule for preventive maintenance.

1) State the recommended frequency of performance of each preventive maintenance task such as cleaning, inspection, and scheduled overhauls.

b. Cleaning: Provide instructions and schedules for all routine cleaning and inspection with recommended lubricants.

c. Inspection: If periodic inspection of equipment is required for operation, cleaning, or other reasons, indicate the items to be inspected and give the inspection criteria.

d. Provide instructions for lubrication and adjustments required for preventive maintenance routines. Identify test points and given values for each.

6. Manufacturers' Brochures:

a. Include manufacturers' descriptive literature covering devices and equipment used in the system, together with illustrations, exploded views, and renewal parts lists.

b. Clearly define manufacturers' standard brochures so that the information applying to the actual installed equipment.

7. Results of performance testing, as specified in PART 3 of this Section.

G. Submittals Procedures:

1. Review and recommendations by the Engineer are not to be construed as change authorizations.
2. Either if discrepancies are discovered between the materials or equipment submitted, and the Contract Documents, prior to or after the data is processed, the Contract Documents govern.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Products and equipment comply with Oregon Revised Statute (ORS) 453.005(7)(e) prohibiting pentabrominated, octabrominated, and decabrominated diphenyl ethers. Where products or equipment within this specification contains these banned substances, provide complying products and equipment from approved manufacturers with equal performance characteristics.

2. Provide work and materials conforming to:
    a. Local and State codes.
    b. Federal and State laws and regulations.
    c. Other applicable laws and regulations.
3. Obtain and pay for all permits, licenses, and inspection certificates required by authorities having jurisdiction.
4. Pay any other fees required by governing authorities for work of this Division.

B. Install only electrical products listed by a recognized testing laboratory, or approved in writing by the local inspection authority as required by governing codes and ordinances.

1.7 SITE VISITATION

A. Visit the site prior to bidding and become familiar with existing conditions and other factors which may affect the execution of the work. Complete coordination of installation of equipment with prior bid packages previously issued. Include related costs in the initial bid proposal.

1.8 COORDINATION

A. Coordinate Work of This Division with all other trades to ensure proper installation of electrical equipment.

1. Review Drawings of other trades or crafts to avoid conflicts with cabinets, counters, equipment, structural members, and other possible impediments to electrical work.
2. Report potential conflicts to the Design Team prior to rough-in.
3. Proceed with rough-in following Design Team directives to resolve conflicts.
4. Civil Drawings govern.

B. Verify the physical dimension of each item of electrical equipment to fit the available space. Contractor’s responsibility includes:

1. Coordination of the equipment to fit into the available space.
2. Access routes through the construction.

C. Layout Drawings:

1. Equipment arrangement shown on Drawings is diagrammatic to indicate general equipment sizing and spatial relationship. Include, as part of distribution equipment submittal, a scaled floor plan, which includes equipment shown with their submitted sizes. Include all conduit routing, both aboveground and underground, including termination points at equipment. Submit for Engineer’s review prior to commencing work.

D. Where electrical connections are required for equipment provided as Work of other Divisions, coordinate rough in and wiring requirements for that equipment with its supplier and installer prior to commencing work. Notify Design Team and Engineer of any discrepancies between the actual rough in and wiring requirements, and those identified on Drawings for resolution prior to installation.

E. Arrange raceways, wiring, and equipment to permit ready access to switches, motors, and control components.

1. Keep doors and access panels clear.

F. Coordinate underground work with other contractors working on the site.

1. Coordinate particularly with contractors installing storm sewer, sanitary sewer, water, and irrigation lines to avoid conflicts.
2. Common trenches may be used with other trades, providing clearances required by codes and ordinances are maintained.

1.9 CHANGE ORDERS

A. Supplemental cost proposals by the Contractor accompanied with a complete itemized breakdown of labor and materials. At the Architect's request, make available estimating sheets for the supplemental cost proposals. Separate and allocate labor for each item of work.

1.10 WARRANTY

A. Provide a written warranty covering the work of this Division as required by the General Conditions.

B. Apparatus:

1. Free of defects of material and workmanship and in accord with the Contract Documents.
2. Built and installed to deliver its full rated capacity at the efficiency for which it was designed.
3. Operate at full capacity without objectionable noise or vibration.

C. Include in Contractor's warranty for Work of Division 26, Electrical system damage caused by failures of any system component.

PART 2 - PRODUCTS

2.1 GENERAL

A. Where specified materials or methods conflict with applicable codes, the more stringent requirement applies.

B. Provide apparatus built and installed to deliver its full rated capacity at the efficiency for which it was designed.

C. Ensure that entire electrical system operates at full capacity without objectionable noise or vibration.

D. Materials and Equipment:

1. Use materials and equipment that are:
   a. New
   b. Quality meeting or exceeding specified standards.
   c. Free of faults and defects.
   d. Conforming to Contract Documents.
   e. Of size, make, type, and quality specified.
   f. Suitable for the installation indicated.
   g. Manufactured in accordance with NEMA, ANSI, UL, or other applicable standards.
   h. Otherwise as specified in Division 01, General Requirements.
2. Equipment not meeting all requirements will not be acceptable, even though specified by name.
3. Where two or more units of the same class of equipment are furnished, use products of the same manufacturer.
   a. Component parts of the entire system need not be products of same manufacturer.
4. Basis of Design:
   a. Consider the Basis of Design equipment scheduled or specified by performance or model number.
   b. If other equipment is provided in lieu of the Basis of Design equipment, assume responsibility for all changes and costs which may be necessary to accommodate this equipment, including, but not limited to:
      1) Different sizes and locations for connections.
      2) Different dimensions.
      3) Different access requirements.
      4) Other differences.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Provide a complete properly operating system for each item of equipment specified.
2. Install materials in a neat and professional manner.
3. Comply with equipment manufacturer’s written instructions, the best industry practices, and the Contract Documents.
4. Comply with latest published NECA Standard of Installation, and provide competent supervision.

B. Clarification:

1. Where there is a conflict among manufacturer's instruction, best practice, and the Documents, request clarification from the Design Team prior to rough-in.
2. Engineer's decision will be final.
3. Remove and correct work installed without clarification at no cost to the Owner.

C. Existing concrete, block, or brick walls are considered not accessible and may require use of Surface Mounted Raceway (SMR) if existing concealed raceway and device boxes are not available for reuse or do not meet the intent of the design (i.e., proximity to egress path, point of use, etc.). Coordinate route and installation where SMR is required with the Architect/Engineer prior to rough-in. Responsible for reinstalling SMR routed without such prior approval to the Architect's satisfaction.

D. Existing stud walls (wood or metal) with or without blocking with plaster, plasterboard, or paneling finish are considered accessible with accessible ceiling, attic, tunnel, or crawl space above, below, or adjacent. Remove, patch, and repair finished surface as required to conceal rough in for new device locations. If it is determined that a specific instance will not permit concealment of rough-in due to obstructions such as beams, headers, and other structural elements, prior approval before rough-in from the Architect is required.

3.2 INSTALLATION IN RATED CONSTRUCTION

A. Install intumescent material around ducts, conduits, and other electrical elements penetrating rated construction.

B. Comply with firestop materials manufacturer written instructions to prevent spread of smoke or fire through sleeves or block-outs penetrating rated fire barriers.

C. Provide firestop materials specified in Division 07, and as follows:

1. Capable of passing a 3-hour test per ASTM E-814 (UL 1479).
2. Consisting of material capable of expanding nominally eight times when exposed to temperatures of 250 degrees F-350 degrees F.
3. An alternate method utilizing intumescent materials in caulk or putty complying with Division 07, Thermal and Moisture Protection Section, "Through-Penetration Firestop Systems" may be used.

3.3 EXCAVATION AND BACKFILL

A. Perform all necessary excavation and backfill for the installation of electrical work in compliance with Division 31, Earthwork.

B. Direct Burial Cable or Non-Metallic Conduit:

1. Minimum 3-inch cover of sand or clean earth fill placed around the cable or conduit on a leveled trench bottom.
2. Lay steel conduit on a smooth level trench bottom, so that contact is made for its entire length.

3. Where the electrical conduit is being laid, remove water from trench.

C. Place backfill in layers not exceeding 8-inches deep and compact to 95 percent of maximum density at optimum moisture to preclude settlement.

1. Interior: Bank sand or pea gravel.
2. Exterior: Excavated material with final 8-inches clean soil.

D. Following backfilling, grade all trenches to the level of surrounding soil. Dispose excess soil at the site as directed.

E. Provide 6-inches wide vinyl tape marked ELECTRICAL in backfill, 12-inches below finished grade, above all high voltage cable or conduit runs.

F. Coordinate patching of all asphalt or concrete surfaces disturbed by this work with General Contractor.

3.4 ALIGNMENT

A. Install panels, cabinets, and equipment level and plumb, parallel with structural building lines.

B. Install distribution equipment and electrical enclosures fitted neatly, without gaps, openings, or distortion.

C. Properly and neatly, close unused openings with approved devices.

D. Fit surface panels, devices, and outlets with neat, appropriate, trims, plates, or covers without overhanging edges, protruding corners, or raw edges.

3.5 CUTTING AND PATCHING

A. General:

1. Comply with Division 01, General Requirements.
2. Restore to original condition new or existing work cut or damaged by installation, testing, and removal of electrical Work.
3. Patch and finish spaces around conduits passing through floors and walls to match the adjacent construction, including painting or other finishes.
4. Clean up and remove all dirt and debris.

B. Make additional required openings by drilling or cutting. Use of jackhammer is prohibited.

C. Cut oversize fill holes so that a tight fit is obtained around the objects passing through.

1. In rated construction, comply with Division 07, Thermal and Moisture Protection.

D. Where alterations disturb lawns, paving, walks, and other permanent site improvements, repair and refinish surfaces to condition existing prior to commencement of work.

3.6 PROTECTION OF WORK

A. Protect electrical work and equipment installed under this Division against damage by other trades, weather conditions, or any other causes.

1. Equipment found damaged or in other than new condition will be rejected as defective.

B. Keep panels, luminaires, and electrical equipment covered or closed to exclude dust, dirt, and splashes of plaster, cement, paint, or other construction material spray.

1. Equipment not free of contamination is not acceptable.

C. Provide enclosures and trims in new condition, free of rust, scratches, and other finish defects.

1. If damaged, properly refinish in a manner acceptable to the Architect.

3.7 UNINTERRUPTED SERVICE

A. Maintain electrical service to all functioning portions of the building throughout construction.

B. Pre-arrange with Owner outages necessary for new construction.

1. Comply with Division 01, General Requirements.
2. Apply for scheduled shutdowns minimum 4 weeks prior to time needed and reconfirm a minimum of 72 hours prior to time needed.
3. Contractor is liable for any damages resulting from unscheduled outages or for those not confined to the pre-arranged times. Damages include costs incurred by the Owner and by the Owner's tenants.

C. Maintain signal and communication systems and equipment in operation at all times.

1. Outages of these systems shall be treated the same as electrical power outages.

D. Maintain telephone services in accordance with Division 01, General Requirements.

3.8 DEMOLITION AND SALVAGE

A. General:

1. Remove or relocate all electrical wiring, equipment, luminaires, etc., as may be encountered in removed or remodeled areas in the existing construction affected by this work.
2. Disconnect electrical service to hard-wired equipment scheduled for removal under other Divisions of Work.
3. Wiring which serves usable existing outlets restored and routed clear of the construction or demolition.
4. Safely cut off and terminate wiring abandoned and removed to leave site clean.

B. Reuse of Existing:

1. Existing concealed conduits in good condition may be reused for installation of new wiring where available.
2. Existing undamaged, properly supported surface conduits may be reused where surface conduits are called for, if the installation meets all workmanship requirements of the Specifications.
3. Where new wiring is added or existing wiring disturbed in existing branch circuit raceways, existing wires replaced with new.

C. Salvage and Disposal:

1. Removed materials, not containing hazardous waste, not scheduled for reuse shall become the property of the Contractor for removal from the site, except for those items specifically indicated on the Demolition Drawings for salvage or reuse.
2. Materials containing, or possibly containing, hazardous waste identified for removal and disposal by the Owner's Hazardous Waste Contractor.
3. Neatly store salvaged items at one location at the site where directed by the Owner's Representative.
4. Salvage properly operating circuit breakers from panels scheduled for removal and use to replace faulty or inadequate breakers in existing panels scheduled to remain.

3.9 COMPLETION AND TESTING

A. General:

1. Comply with Division 01, General Requirements.

B. Upon completion, test systems to show that installed equipment operates as designed and specified, free of faults and unintentional grounds.

1. Schedule system tests so that several occur on the same day.
2. Coordinate testing schedule with construction phasing.
3. Conduct tests in the presence of the Architect or its representative.
4. Notify Architect of tests 48 hours in advance.

C. Engage a journeyman electrician with required tools to conduct equipment tests. Arrange to have the equipment factory representative present for those tests where the manufacturer's warranty could be impacted by the absence of a factory representative.

D. Perform tests per the requirements of each of the following systems:

1. Lighting System
2. Lighting Control System

E. Provide a written record of performance tests and submit with operation and maintenance data.

3.10 COMMISSIONING

A. Complete phases of work so the system, equipment, and components can be checked out, started, calibrated, operationally tested, adjusted, balanced, functionally tested, and otherwise commissioned. Complete systems, including subsystems, so they are fully functional.

B. Perform commissioning as specified in Section 01 91 00, General Commissioning Requirements, the technical sections, and Section 26 08 00, Commissioning of Electrical Systems.

1. Unless specified otherwise in the technical sections, provide factory startup services for the following items of equipment:
    a. Lighting Control Systems

C. Participation in Commissioning:

1. Provide skilled technicians to checkout, startup, calibrate, and test systems, equipment, and components.
2. The Engineer reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment or system.

D. Resolution of Deficiencies:

1. Complete corrective work in a timely fashion to permit timely completion of the commissioning process. Experimentation to render system performance permitted.

E. Verification and Documentation:

1. Once each test is performed, have the commissioning manager observe the physical responses of the system and compare them to the specified requirements to verify the test results.
2. Submit site observation reports for deficiencies in the system.
3. Record the result of individual checks or tests on the pre-approved checklist, test, and report form from the commissioning plan and submit results for review.

END OF SECTION 26 05 00

SECTION 26 05 19 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:

1. Conductors - 600V
2. Connectors - 600V and Below

1.2 RELATED SECTIONS

A. Division 01, General Requirements

B. Division 26, Electrical

C. Section 26 05 33, Raceways and Boxes for Electrical Systems

D. Section 26 05 53, Identification for Electrical Systems

1.3 REFERENCED STANDARDS

A. ASTM: American Society For Testing and Materials:

1.	ASTM B 3	Soft or Annealed Copper Wire
2.	ASTM B 8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
3.	ASTM B 33	Tinned Soft or Annealed Copper Wire for Electrical Purposes

B. ICEA: Insulated Cable Engineers Association:

1.	S-95-658	Non-shielded 0-2 kV Cables

C. IEEE: Institute of Electrical and Electronic Engineers:

1.	IEEE 383	Type Test of Class IE Electric Cables, Field Splices, and Connections

D. UL: Underwriters Laboratories:

1.	UL 44	Rubber-Insulated Wires and Cables
2.	UL 83	Thermoplastic-Insulated Wires and Cables
3.	UL 1277	Type TC Power and Control Tray Cable

1.4 SUBMITTALS

A. Submit product data for the following materials:

1. Single conductor 600V power and control conductors.

B. Submittals of the following materials consist only of a listing of the manufacturer's name and the applicable catalog numbers of the items to be utilized:

1. Connectors
2. Branch Circuit Conductor Splices
3. Splices with Compression Fitting and Heat-Shrinkable Insulator

C. Submit cable test data per testing requirements of PART 3.

1.5 QUALITY ASSURANCE

A. Copper Conductors: Indicated sizes considered minimum for ampacities and voltage drop requirements.

B. Conductors for special systems as recommended by the equipment manufacturer except as noted.

C. Deliver conductors to the job site in cartons, protective covers, or on reels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Conductors - 600V:

1. General
2. Essex
3. Southwire
4. Or approved equal.

B. Connectors - 600V and Below:

1. Burndy
2. Anderson
3. Or approved equal

2.2 CONDUCTORS – 600V

A. Type:

1. Copper: 12 AWG minimum size unless noted otherwise. 12 AWG and 10 AWG, stranded, 8 AWG or larger, Class B concentric or compressed stranded.

2. Aluminum: Not allowed.
3. Conductors with continuous colored jackets are acceptable; refer to color-coding in PART 3.
4. Conductors with manufacturers no lube continuous jacket coatings are acceptable.

B. Insulation:

1. THHN/THWN-2 for conductors 6 AWG and smaller.
2. XHHW-2 for conductors 4 AWG and larger.

2.3 CONNECTORS – 600V AND BELOW

A. Branch Circuit Conductor Splices:

1. Twist-on wire connectors: 3M Insulated Electrical Spring Connector (312/512), Ideal Industries Wing-Nut, or Buchanan B-Cap.

B. Cable Splices:

1. Compression tool applied sleeves, Kearney, Burndy, or equivalent with 600V heat shrink insulation.
2. Submit proposed splice location to the Engineer for review, except where indicated on the plans

C. Terminator Lugs for Stranded Wire:

1. 10 AWG Wire and Smaller: Spade flared, tool applied.
2. 8 AWG Wire and Larger: Compression tool applied.
3. Setscrew type terminator lugs furnished as an integral part of distribution equipment, switches and circuit breakers will be acceptable.

PART 3 - EXECUTION

3.1 CONDUCTORS

A. Pulling compounds may be used for pulling conductors. Clean residue from the conductors and raceway entrances after the pull is made.

B. Pulleys or Blocks:

1. Use for alignment of the conductors when pulling.
2. Pulling in accordance with manufacturer’s specifications regarding pulling tensions, bending radii of the cable, and compounds.

C. Make up and insulate wiring promptly after installation of conductors. Do not pull wire in until bushings are installed and raceways terminations are completed. Do not pull wire into conduit embedded in concrete until after the concrete poured and forms stripped.

D. Provide a dedicated neutral conductor with each branch circuit, do not use a shared neutral conductor between phases unless specifically requested or directed.

E. For remodel work or where shared neutrals are used by equipment such as systems furniture, provide a breaker handle tie as required for the phases sharing the neutral conductor.

3.2 CONNECTORS

A. Terminate control and special systems with a tool applied spade flared lug when terminating at a screw connection.

B. Screw and bolt type connectors made up tight and retightened after an 8-hour period.

C. Apply tool applied compression connectors per manufacturer's recommendations and physically checked for tightness.

3.3 COLOR CODING

A. Color code secondary service, feeders, and branch circuit conductors. Phase color code to be consistent at feeder terminations, A-B-C left-to-right, A-B-C top-to-bottom, or A-B-C front-to-back. Color code is as follows:

120/240V 208Y/120V	Phase	480V 480Y/277V
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray*
Green	Ground**	Green
* or white with colored (other than green) tracer		
**Ground for isolated ground receptacles green with yellow tracer.		

B. Use solid color compound or solid color coating for 12 AWG and 10 AWG branch circuit conductors and neutral sizes.

C. Phase conductors 8 AWG and larger color code using one of the following:

1. Solid color compound or solid color coating.
2. Stripes, bands, or hash marks of color specified above.
3. Colored as specified using 3/4-inch wide tape. Apply tape in half overlapping turns for a minimum of three inches for terminal points and in junction boxes, pull boxes, troughs, manholes, and handholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Apply tags to cable stating size and insulation type where cable markings are tape covered.

D. Switch legs, travelers, etc., consistent with the phases to which, connected or a color distinctive from that listed.

E. Color-coding of the flexible wiring system conductors and connectors.

F. For modifications and additions to existing wiring systems, conform color-coding to the existing wiring system.

3.4 FIELD TESTING

A. 600V Rated Conductors: Test for continuity. Conductors 100A and over in meggered after installation and prior to termination. Provide the megger, rated 1,000V DC, and record and maintain the results, in tabular form, clearly identifying each conductor tested.

1. Replace cables when test value is less than 1 megohms.
2. Cable test submittal include results, equipment used, and date.

END OF SECTION 26 05 19

SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:

1. Metallic Conduits
2. Non-Metallic Conduits
3. Wireways
4. Fittings
5. Metallic Boxes
6. Non-Metallic Boxes

1.2 RELATED SECTIONS

A. Division 01, General Requirements

B. Division 26, Electrical

C. Section 26 05 19, Low Voltage Electrical Power Conductors and Cables

D. Section 26 05 53, Identification for Electrical Systems

PART 2 - PRODUCTS

2.1 GENERAL

A. Raceways and conduits of specified types for electrical system wiring, except where clearly indicated otherwise.

B. Fittings, boxes, hangers, and appurtenances required for the conduits and raceways.

C. Size raceways and conduits as indicated. Where no size indicated, conduit may be the minimum code permitted size for the quantity of conductors installed, based upon NEC tables for conductors with type THW insulation.

2.2 METALLIC CONDUITS

A. Rigid Metal Conduit (RMC):

1. Smooth surfaced, heavy wall mild steel tube of uniform thickness and temper, reamed and threaded at each end and protected inside and out with galvanizing, sherardizing, or equivalent process.

2. Comply with NEC Article 344.

B. Electrical Metallic Tubing (EMT):

1. Smooth surface, thin wall mild steel tube of uniform thickness and temper, galvanized or sherardized on the outside, and enameled on the interior.
2. Comply with NEC Article 358.

C. Flexible Conduits (Flex):

1. Flexible Metallic Conduit:
   a. Interlocking single strip steel construction, galvanized inside and out after fabrication.
   b. Comply with NEC Article 348.

2. Liquid Tight:
   a. Similar to flexible metallic conduit, except encased in a liquid tight polyvinylchloride or equivalent outer jacket over the flexible steel core.
   b. Comply with NEC Article 350.

2.3 NON-METALLIC CONDUITS

A. Rigid Non-Metallic Conduit:

1. Type II PVC Schedule 40 or 80, suitable for use with 90 degree C rated wire.
2. Conform to UL Standard 65l and carry appropriate UL listing for above and below ground use.
3. Comply with NEC Article 352.

2.4 WIREWAYS

A. Troughs: Steel, painted, square in cross section, preformed knockouts on standard spacing, screw cover.

B. Fittings: Tees, elbows, couplings as required for configuration shown on the Drawings.

2.5 FITTINGS

A. RMC:

1. Threaded Locknuts: Sealing type where used with NEMA 2, 3, 3R, 4, and 12 enclosures.
2. Threaded Bushings: 1-1/4-inch and larger, insulated, grounding type as required under Section 26 05 26, Grounding and Bonding for Electrical Systems.
3. Threaded Couplings:
   a. Standard threaded of the same material and as furnished with conduit supplied.
   b. Erickson type couplings may be used where required to complete conduit runs larger than 1-inch.

B. EMT:

1. Connectors:

a. Steel compression ring or steel set screw type for conduit termination, with insulated throat, suitable for conditions used.

b. Use lay-in grounding type bushings where terminating grounding conductors.

2. Couplings: Steel compression ring or steel set screw type, concrete tight.

C. Threadless: RMC couplings and box connectors may be steel threadless, compression ring or set screw type for use with conduits 1-inch and smaller where installed in poured concrete locations or where limited working space makes threaded fittings impractical.

D. Weatherproof Connectors: Threaded

E. Expansion Couplings: Equivalent to O.Z. type EX with jumper.

F. Seal-Offs: With filler fiber, compound, and removable cover.

2.6 METALLIC BOXES

A. Flush and Concealed Outlet Boxes: Galvanized stamped steel with screw ears for device ring mounting, knock-out plugs, mounting holes, fixture studs if required, RACO or equivalent.

B. Surface Outlet Boxes: Galvanized stamped steel same as above for use on ceilings; cast steel or aluminum with threaded hubs or bosses for use on walls.

C. Systems:

1. Boxes for systems devices as recommended by the systems manufacturer, suitable for the equipment installed.
2. Equip with grounding lugs, brackets, device rings, etc., as required.

2.7 NON-METALLIC BOXES

A. PVC, molded enclosures, threaded hubs.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Conceal conduits in finished spaces. Concealed conduits run in a direct line with long sweep bends and offsets. Where RMC and IMC embedded is in concrete below grade or in damp locations make watertight by painting the entire male thread with Rustoleum metal primer or equivalent before assembly.

B. Route exposed conduit parallel or at right angles to structural building lines and neatly offset into boxes. Conduits attached directly to building surfaces closely follow the surfaces.

C. Rigidly secure RMC and IMC terminations at boxes, cabinets, and general wiring enclosures with double locknuts and bushings or approved fittings. Screw in conduit and engage at least five threads in hub where conduit boxes with threaded hubs or bosses are used. Use insulating bushings for conduits 1-1/4-inches or larger.

D. Keep conduit and raceways closed with suitable plugs or caps during construction to prevent entrance of dirt, moisture, concrete, or foreign objects. Clean and dry raceways before installation of wire and at the time of acceptance.

E. Pack spaces around conduits with polyethylene backing rods and seal with polyurethane caulking to prevent entrance of moisture where conduits are installed in sleeves or block-outs penetrating moisture barriers.

3.2 CONDUIT

A. RMC:

1. Use in areas for wiring systems.
2. Install for exposed runs of medium voltage circuits outside of the electrical rooms.
3. Install where subject to mechanical injury.
4. Install with threaded fittings made up tight.

B.

C. EMT:

1. Securely support and fasten whether exposed or concealed at intervals of nominally every 8-feet and within 24-inches of each outlet, ell, fitting, panel, etc.
2. Use in other dry protected locations for circuits rated 600V and less.
3. Do not install in areas where exposed to damage, such as vehicular or pedestrian.

D. Flex:

1. Use for connections where installation flexibility is required with a minimum 12-inches slack connection.
2. Limit flex length to 36-inches for exposed equipment connections and 72-inches in concealed ceiling and wall cavities.
3. Use PVC jacketed flex in wet locations, areas subject to washdown, and exterior locations.

E. PVC:

1. Type II Schedule 40 and 80 PVC may be used underground and in and under interior slabs, poured concrete walls, and where scheduled or noted on the Drawings.
2. Make connections with waterproof solvent cement.
3. Provide RMC at 60 degree and larger bends and where penetrating slabs.

3.3 FITTINGS

A. Assemble continuous and secured metallic raceways and conduits to boxes, panels, etc., with appropriate fittings to maintain electrical continuity. Cut square and reamed smooth conduit joints with fittings drawn up tight.

B. Do not use Crimp-on, tap-on, indenter type, malleable iron, or cast set screw fittings.

3.4 BOXES

A. General:

1. Outlet Boxes: Code required size to accommodate wires, fittings, and devices.
2. Provide multi-gang boxes as required to accept devices installed with no more than one device per gang.
3. Equip metallic boxes with grounding provisions.

B. Size and Type:

1. Junction boxes installed in accessible ceiling or wall cavities or exposed in utility areas minimum of 4-inches square, 1-1/2 inches deep with appropriately marked blank cover.
2. Boxes for the special systems suitable for the equipment installed. Coordinate size and type with the system supplier.

C. Pull Boxes:

1. Provide pull boxes where shown for installation of cable supports or where required to limit the number of bends in conduits to not more than three 90-degree bends.
2. Use galvanized boxes of code-required size with removable covers installed so that covers will be accessible after work is completed.

3.5 PULL WIRES

A. Install nylon pull lines in empty conduits larger than 1-inch where routing includes 25-feet or more in length or includes 180 degrees or more in bends.

B. Where conduits requiring pull lines are stubbed out and capped, coil a minimum of 36-inches of pull line and tape at termination of conduit for easy future access. Label pull lines as to conduit starting or terminations point and intended future use.

END OF SECTION 26 05 33

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:

1. Labels

1.2 RELATED SECTIONS

A. Division 01, General Requirements

B. Division 26, Electrical

C. Section 26 05 19, Low Voltage Electrical Power Conductors and Cables

D. Section 26 05 33, Raceways and Boxes for Electrical Systems

E. Section 26 50 00, Lighting

PART 2 - PRODUCTS

2.1 LABELS

A. Pre-printed:

1. Permanent material pre-printed with black on white, with adhesive backing.
2. Manufacturer:
    a. Brady
    b. 3M
    c. Or equal.

B. Engraved Laminated Plastic:

1. 3-ply laminated plastic, colors indicated herein, with beveled edges, engraved letters, and stainless steel screw attachment.
2. Nameplate length to suit engraving.
3. Adhesive attachment is not acceptable.

C. Clear Plastic Tape:

1. Black (normal) or red (emergency or standby) 12 point Helvetica medium text, clear adhesive backing, field printed with proper equipment for device labeling.

2. Manufacturers:
    a. Brother P-Touch
    b. Dyno-tape
    c. Kroy
    d. Or equal.

D. Wire Markers:

1. White with black numbers, adhesive-backed tape on dispenser roll.
2. Manufacturers:
    a. Brady
    b. 3M
    c. Or equal.

E. Marker Pen: Black permanent marker suitable for writing on metallic surfaces.

PART 3 - EXECUTION

3.1 GENERAL

A. Nameplate and text coloring:

1. Normal: Black nameplate with white lettering.

3.2 RACEWAYS AND BOXES

A. Label pull boxes and junction boxes for systems with paint or marker pen on box cover identifying system. Where box covers are exposed in finished areas, label inside of cover.

B. Color label covers as follows:

1.	480Y/277V wiring	Orange
2.	208Y/120V wiring	Black

C. Label each end of pull wires left in empty conduits with tags or tape indicating location of other end of wire.

3.3 EXISTING EQUIPMENT

A. Equip existing branch circuit panelboards scheduled to remain with new, accurate, typed, circuit directories where circuiting changes are made.

END OF SECTION 26 05 53

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:

1. Photosensor
2. Relays, Switchpacks, and Room Controllers
3. Power Supplies and Transformers
4. Low Voltage Control Wiring
5. Test Equipment

B. Responsibilities and participation under Division 26, Electrical in the automatic dimming system installation and commissioning process.

C. Installation, connection, adjustment, and testing of the equipment including labor, materials, tools appliances, wire, junction boxes and equipment necessary for and incidental to the delivery, installation and furnishing of a completely operational lighting control system

1.2 RELATED SECTIONS

A. Division 01, General Requirements

B. Division 26, Electrical

C. Section 26 50 00, Lighting

1.3 GENERAL REQUIREMENTS

A. Provide qualified personnel for participation in commissioning tests, including seasonal testing required after the initial commissioning.

B. Providing equipment, materials, and labor necessary to correct deficiencies found during the commission process which fulfill contract and warranty requirements.

C. Provide Operating and Maintenance Data and Record Drawings to the Test Engineer for verification, organization, and distribution.

D. Provide assistance to the Test Engineer to develop and edit descriptions of system operation.

E. Providing training for the systems specified in this Division with coordination by the Test Engineer and Commissioning Agent.

1.4 SUBMITTALS

A. Shop drawings:

1. Submittal drawings with a complete system diagram to show quantity of devices, location in the building, dimensions and required wiring.
2. Provide physical samples of user interface devices and visually exposed control devices for approval by Owner.

B. Product data with wiring schematics for system and user interface components

C. Installation and Record Drawings

D. Operation and Maintenance Manuals:

1. Include product data of system components, one line diagrams of installed components and their locations throughout the building, a final floor plan noting the locations of devices installed above ceilings, behind access panels or in concealed but accessible spaces and the lighting zones or devices they control.
2. Final relay schedule with the zone of control, location of control zone, voltage, power feed, time clock setting, photocell set point, switch, or dimmer stations controlling the relay, and sweep function set points will be provided by the contractor.

1.5 DEFINITIONS

A.	BACNET	Protocol for integration with BAS/BMS/EMS
B.	BAS / BMS / EMS	Building Automated System, Building Management System, Energy Management System
C.	CS	Control Station
D.	D	Dimming Wall Switch
E.	DT	Dual Technology (PIR + U)
F.	FC	Footcandles. The metric for measuring light levels / illuminance levels
G.	GUI	Graphic User Interface
H.	LCP	Lighting Control Panel
I.	LED	Light Emitting Diode
J.	LonWorks	Protocol for integration with BAS/BMS/EMS
K.	OS/VS	Occupancy Sensor / Vacancy Sensor,

L. Occupancy sensors provide automatic on and automatic shut-off.

1. Vacancy sensors provide automatic shut-off only, and require manual-on.

M. PC Photocell

N. PIR Passive Infrared Technology

O. RS RS-232 Connection for AV Integration

P. SC Scene Control

Q. TC Timeclock, or astronomical timeclock

R. U Ultrasonic Technology

S. WS Wall Switch

T. WS/O Wallbox Occupancy Sensor Switch

1. Wall Switch with integrated Occupancy Sensor

1.6 SYSTEM DESCRIPTION

A. Relays and Lighting Control Panels:

1. Analog and Digital: Lighting control panel and relays to accept line voltage input as well as input from any combination of timeclock input and/or daylight sensors and produce the required effect (switching or dimming).

B. Photoelectric Daylight Harvesting:

1. Exterior Areas:

a. Reduce electric energy consumption during daylight hours by reducing the light output of the electric lighting system via switching in response to available daylight.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer:

1. Wattstopper LMCP 0-10V

B. Approved Basis of Design Alternate Manufacturers:

1. Cooper Controls
2. Acuity Controls (nLight, LC&D, Sensor Switch)
3. Hubbell

C. Products described in this section are to be provided by the single BOD (basis of design), or approved alternate, manufacturer, listed above, or by a compatible, BOD approved third party alternate manufacturer.

1. Manufacturer series numbers are identified herein to establish the minimum level of quality for each product.
2. Comparable products that meet the requirements of the specification by other acceptable manufacturers identified herein are acceptable with prior approval.
3. Other or equivalent Manufacturers and Products: Submit Substitution Request, complying with requirements of Division 00, Procurement and Contracting Requirements.

2.2 PHOTOSENSOR

A. General Requirements:

1. Use NEC Class 2 wiring for low voltage communication.
2. Can be replaced without reprogramming.
3. Incorporate time delay logic to prevent cycling due to clouds and other short-term influences to lighting levels.
4. Accept outdoor photo sensing heads. Photo sensing control permit the user to specify the actual footcandle level where desired switching occurs.

B. Outdoor / Rooftop:

1. Outdoor models have a hood over the aperture to shield the sensor from direct sunlight.
2. The outdoor sensor circuitry completely encased in an optically clear epoxy resin.
3. Range between 0 and 750 FC.

C. Analog: Exterior: Wattstopper LMPO-200 or approved

2.3 RELAYS AND LIGHTING CONTROL PANELS

A. Analog/Digital:

1. Devices interconnected via low voltage cabling.
2. Configurable to produce the following sequences of operation by handheld IR or RF remote or on-board dip-switch style controls.
    a. Timeclock
    b. Daylight Harvesting:
        1) Accepts input from daylight sensing equipment and switches lights on or off accordingly.

B. Manual Bypass

1. Provide low-voltage or line-voltage switch compatible with lighting control panels to allow a user to manually bypass relay and lighting control panel settings.

2.4 POWER SUPPLIES AND TRANSFORMERS

A. Provide from same manufacturer of equipment served.

B. Compatible with specified photocells and dimming control station protocols.

C. Where indicated on luminaire schedule, provide luminaire power supplies with field-adjustable lighting output.

D. Refer to Section 26 50 00, Lighting, for product specification on luminaire power supplies and transformers.

2.5 LOW VOLTAGE CONTROL WIRING

A. 14 AWG shielded wiring, Category 5e cable, or as recommended by the manufacturer.

2.6 TEST EQUIPMENT

A. Provide multi-function digital Illuminance meter with detachable receptor head with the following characteristics:

1. Receptor: Silicon photocell type
2. Illuminance Units: Lux or footcandles (switchable)
3. Measuring range: 0.1 to 19,990 lux, 0.01 to 1,999 footcandles
4. Accuracy: ±4 percent ±1 digit of displayed value
5. Cosine Correction Characteristics: Within ±1 percent at 10 degrees; within ±5 percent at 60 degrees.
6. Measuring functions: Illuminance, integrated illuminance, average illuminance.
7. Temperature/humidity drift: Within ±3 percent ±1 digit (of value displayed at 68 degrees F) within operating temperature/humidity range.
8. Operating conditions: 32 degrees F to 104 degrees F) at less than 85 percent humidity.

B. Provide proof of calibration within 12 months of use. Calibration performed by an independent calibration lab approved by the manufacturer of the meter.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Submittal data required prior to ordering and installation.

B. General Testing:

1. Functionally test control devices to ensure that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with approved drawings, specifications, and manufacturers installation instructions.
2. Prepare and complete report of test procedures and results and file with the Owner.
3. Install items per manufacturers written instructions.

C. Low Voltage Wiring:

1. Install in conduit where running through inaccessible areas. Provide plenum rated wiring in accessible ceiling spaces.
2. Test CAT5/6 cables terminated on site prior to wiring of digital lighting control systems. Provide evidence of successful testing to engineer and owner. Factory pre-terminated cabling is not subject to this requirement.
3. Coordinate low voltage wiring connection and location with luminaires to be controlled.

D. Photocell:

1. Install surface mounted on recessed junction box in location best suited for accurate measurement.
2. Exterior photocell to face north.

3.2 WORK PRIOR TO COMMISSIONING

A. Complete phases of work so the system can be powered, tested, adjusted, and otherwise commissioned. Under Division 26, Electrical, complete systems, including subsystems, so they are fully functional. This includes the complete installation of equipment, materials, wire, controls, etc., in accordance with the contract documents and related directives, clarifications, change orders, etc.

B. Specific pre-commissioning responsibilities under Division 26, Electrical are as follows:

1. Factory startup services for the following items of equipment:
   a. Lighting Control System

2. Normal startup services required to bring each system into a fully operational state. This includes complete installation and cleaning. The Test Engineer will not begin the commissioning process until each system is documented as being installed complete.

3.3 SEQUENCE OF COMMISSIONING

A. Division 26 responsible for commissioning.

B. Provide to Engineer prior to start of commissioning layout drawings indicating proposed location of measurement points. Proceed with commissioning after review and acceptance by Engineer.

C. Illuminance measurements oriented horizontal, facing up, at 30-inches above finished grade. Measurements for a control group occurs at the same location. Ensure constancy of local surface reflectance conditions throughout commissioning of each control group.

D. Ensure no personnel or outside influence affects the amount of flux striking the receptor head during the recording session.

E. Document measurements in clearly understandable format for review by the Engineer. Include time of measurement, temperature, and relative humidity.

F. Measure illuminance at least two hours after local sunset, but before timeclock-schedule dimming period, with full output of electric lighting. Record average illuminance for a 2-hour period.

G. Measure illuminance at least two hours after timeclock-scheduled dimming period begins. Record average illuminance for a 2-hour period.

H. Set each photocell to 150 percent of electric-only lighting contribution.

I. Field-adjustable lighting outputs

1. Provide adjustments to luminaire light output so that design target FC levels as started are drawings are met.
2. Adjust illuminance of lighting so that light output is consistent, within +/-5 percent, between each fixture. Light measurements and subsequent adjustments to apply to both full-on lighting output and 50 percent dimmed-mode output.

J. Submit recorded data to Engineer for review.

3.4 PARTICIPATION IN COMMISSIONING

A. Provide skilled technicians to start up systems within Division 26, Electrical. The same technicians made available to assist in completing the commissioning program as it relates to each system and their technical specialty. Under Division 26, Electrical, ensure that the qualified technician(s) are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments, and problem resolutions at no additional cost to the Owner.

B. System problems and discrepancies may require additional technician time, redesign, and reconstruction of systems and system components. The additional technician time made available for the subsequent commissioning periods until the required system performance is obtained at no additional cost to the Owner.

C. Qualifications of technicians include expert knowledge relative to the specific equipment involved, adequate documentation and tools to service the commission the equipment.

3.5 RESOLUTION OF DEFICIENCIES

A. In some systems, misadjustments, misapplied equipment, and deficient performance will result in additional work required to commission the systems.

B. Complete work under the direction of the Engineer, with input from the Contractor, and equipment supplier.

C. Complete corrective work in a timely fashion to permit timely completion of the commissioning process.

D. If deadlines pass without resolution of the problem, the Owner reserves the right to obtain supplementary services, equipment, or both, to resolve the problem.

E. Costs incurred to solve the problems in an expeditious manner will be the Contractor's responsibility.

3.6 TRAINING

A. Participate in the training of Owner's engineering and maintenance staff, as required in Divisions 01 through 26, on each system and related components.

B. Training will be conducted jointly by the contractor and the equipment suppliers.

3.7 SYSTEMS DOCUMENTATION

A. In addition to the requirements of Division 01, General Requirements, update contract documents to incorporate field changes and revisions to system designs to account for actual constructed configurations.

B. Division 26, Electrical, record drawings include floor plans and the individual daylight control systems.

END OF SECTION

SECTION 26 50 00 - LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:

1. Lenses
2. Housings
3. Finish
4. Lamps and Sockets
5. Power Supplies
6. Exterior Luminaires
7. Extra Material
8. Disposal and Replacement

1.2 RELATED SECTIONS

A. Division 01, General Requirements

B. Division 26, Electrical

C. Section 26 05 19, Low Voltage Electrical Power Conductors and Cables

1.3 DEFINITIONS

A.	BACNET	Protocol for integration with BAS/BMS/EMS
B.	BAS	Building Automation System
C.	BMS	Building Management System
D.	EMS	Energy Management System
E.	CCT	Correlated Color Temperature
F.	CRI	Color Rendering Index
G.	CS	Control Station
H.	D	Dimming Wall Switch
I.	DT	Dual Technology (PIR + U)

J. FC Footcandles

1. The metric for measuring illuminance light levels

K. GUI Graphic User Interface

L. LCP Lighting Control Panel

M. LED Light Emitting Diode

N. LonWorks Protocol for integration with BAS/BMS/EMS

O. MTBF Minimum Time Between Failures

1. Total hours of testing / Number of failures

P. OS/VS Occupancy Sensor / Vacancy Sensor,

1. Occupancy sensors provide automatic on and automatic shut-off.
2. Vacancy sensors provide automatic shut-off only, and require manual-on.

Q. PC Photocell

R. PIR Passive Infrared Technology

S. Power Supply Ballasts and LED drivers

T. RS RS-232 Connection for AV Integration

U. SC Scene Control

V. TC Timeclock, or astronomical timeclock

W. U Ultrasonic Technology

X. WS Wall Switch

Y. WS/O Wallbox Occupancy Sensor Switch

1. Wall Switch with integrated Occupancy Sensor

1.4 QUALITY ASSURANCE

A. The lighting design for this project was based on luminaire types and manufacturers as specified.

B. Basis of Design manufacturers are pre-qualified to bid on products where specified. Inclusion of manufacturer and product series does not relieve specified manufacturer from providing product as described in luminaire schedule; modifications to standard product, if required, include with initial bid.

C. Alternate manufacturers listed in the Luminaire Schedule do not require prior approval but included with the shop drawing submittal. Inclusion of manufacturer and product series as an alternate does not relieve the manufacturer from providing product equivalent to the basis of design as described in luminaire schedule; modifications to standard product, if required, include with initial bid.

1.5 GENERAL REQUIREMENTS

A. Where a luminaire type designation has been omitted and cannot be determined by the Contractor, request a clarification from the Architect in writing and provide a suitable luminaire type as directed.

B. Exterior pole lights have an appropriated pole base as part of the assembly. For pole lights in pedestrian areas, use a flush pole base. Pole lights in parking areas a raised base used. Pole bases, footings, and structural components reviewed and approved by a state licensed structural engineer prior to ordering and installation.

C. Coordinate voltage requirements to each luminaire as indicated on drawings.

D. Verify luminaires carry a valid UL or ETL listing. Luminaires located in outdoor locations to carry and appropriate wet or damp listing as required for the mounting application.

E. Procure luminaires through a distributor located within 200 miles of the project site with a valid business license in the state the project is located.

F. Upon request of the Engineer, or Owner, provide back-up pricing in a unit cost breakdown per luminaire. Back-up pricing includes distributor net pricing, contractor net pricing, final owner pricing and mark-ups and discounts (lot price or all-or-none) associated with the luminaires.

G. Lighting related change orders to include back-up pricing noted above for review by the Engineer and Lighting Designer.

H. Provide manufacturer’s warranty covering 5 years on drivers from date of purchase. Luminaire manufacture to operate driver at or below the required driver warranty temperature. Luminaire manufacturers failing to operate the driver, at the project required ambient temperature and within the driver manufacturer warranty parameters, will be responsible for driver warranty related costs over the warranty period.

1.6 SUBMITTALS

A. Submit the following in accordance with Section 26 05 00, Common Work Results for Electrical:

1. Shop Drawings, to include:
    a. Product Data:
        1) Provide manufacturer’s published product data information.
        2) This information is to be relevant to the specified product only.
        3) Submittals limited to not more than three sheets for each type specified.

4) They are specifically not to have configurations available included for review.
5) Submittals that contain information that is not relevant to the product specified will be rejected in total and resubmission will be required.

b. Luminaire dimensions on a fully dimensioned line drawing.
c. Lamp information, including array configuration:

1) For LED lamps: proof of conformance with the following: ANSI C78.377-2015, IES LM 79-2008, IES LM 80-2008, IES LM 82-2012, IES LM 84-14, IES LM 85-14, IES TM 21-2011, IES TM 28-14 and special certifications required by the contract documents.

d. Mounting details including clips, canopies, supports, and methods for attachment to structure. Provide equipment required for row configurations.
e. UL/ETL Labeling Information
f. Manufacturer's Warranty

2. Operation and Maintenance Data:

a. Prepare two copies of a Lighting Systems Maintenance Manual consisting of the following in a hard-cover binder for review. After review, Architect will deliver one copy to Owner. Manual to include:

1) One complete set of final submittals of actual product installed, including product data and shop drawings. Include product data for actual power supply and transformer installed where applicable.
2) List of lamps used in Project, cross-referenced to fixture types, with specific manufacturer's names and ordering codes.
3) Re-lamping instructions for lamps that require special precautions (LED, tungsten halogen, metal halide, etc.).
4) Lighting fixture cleaning instruction, including chemicals to be used or avoided.
5) Parts list of major luminaire components and ordering information for replacement
6) Copies of manufacturer warranties on product.

3. Certificates for Poles and Accessories: Manufacturer's documentation that products are suitable for the luminaires to be installed and comply with designated structural design criteria.
4. Manufacturer's Installation Instructions:

a. Indicate application conditions and limitations of use stipulated by product testing agency.
b. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

5. Closeout Submittals:

a. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.
b. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
c. Maintenance Materials: Furnish for Owner's use in maintenance of project.

PART 2 - PRODUCTS

2.1 GENERAL

A. Luminaires new and complete with mounting accessories, junction boxes, trims, and lamps.

B. Luminaire assemblies UL listed.

C. Luminaires UL listed appropriate to mounting conditions and application.

D. Luminaires installed under canopies, roofs, or open areas and similar damp or wet locations to be UL listed and labeled as suitable for damp or wet locations.

2.2 LENSES

A. Mechanically secured from within the housing.

B. As specified in the Luminaire Schedule.

2.3 HOUSINGS

A. Dimensions: As recommended by the luminaire manufacturer or as specified in the luminaire schedule.

B. For wet and damp use, LED-based luminaire to be sealed, rated, and tested for appropriate environmental conditions and may not be accomplished by using an additional housing or enclosure

2.4 FINISH

A. Visible surfaces to be of color and texture as directed in Luminaire Schedule.

B. Prepare steel components for finishing with a 5-step zinc phosphating process prior to painting.

C. Paint luminaire (including painted component parts) after fabrication unless specifically noted in the Luminaire Schedule.

D. Exposed aluminum surfaces:

1. Satin etched and anodized in the color as indicated in the Luminaire Schedule.
2. Treat with an acid wash and clear water rinse prior to painting.
3. Electrostatically paint or powder coat and oven bake in the color indicated in the Luminaire Schedule.

E. Exposed steel surfaces:

1. Treat with acid wash and clear water rinse, then prime coat.

2. Electrostatically paint or powder coat and oven bake in the color indicated in the Luminaire Schedule.

2.5 LAMPS AND SOCKETS

A. Lamp each luminaire with the suitable lamp cataloged for the specific luminaire type and as indicated by the manufacturer, or as specifically indicated in the Luminaire Schedule, or as specified herein.

B. LED lamps to meet or exceed 50,000 hours as defined by LM-80-08 based on both the ambient temperature listed and the LEDs B10L70 performance curve as published by the LED lamp manufacturer.

C. LED lamps that are integral into the housing; light bars, diodes, boards and other, to be rated and tested for use in the fixture specified and compatible with the driver tested and compatible with that fixture.

D. Color Rendering Index (CRI):

1. As indicated in the luminaire schedule

E. Correlated Color Temperature (CCT) per luminaire schedule: Color consistency not to exceed a +/- tolerance of greater than two MacAdam Ellipses over the life of the luminaire.

2.6 POWER SUPPLIES

A. Rate for use with the LED array specified:

1. Warranty array and driver as an assembly.
2. 5 year full replacement, non-pro-rated warranty is required on electronic components.

B. Luminaires requiring more than one driver are not permitted, unless specified in the luminaire schedule.

C. Power supplies used in enclosed and gasketed luminaires listed for use in wet locations, Type 1 construction.

D. Rate for the expected ambient temperature in which they are installed.

1. Exterior installed power supplies rated to start the lamps at 0 degrees F.

E. Operate for a (+/- 10 percent) supply voltage of 120V through 277VAC at 60Hz.

F. Power Factor: 0.9 minimum

G. Lifetime minimum:

1. 50,000 hours at full load and 77 degrees F ambient
2. Ten-year expected life while operating at maximum case temperature and 90 percent non-condensing relative humidity.

H. Minimum time between failures (MTBF) greater than 300,000 hours at full load and 77 degrees F ambient, in accordance with MIL-HDBK-217.

I. Driver and luminaire electronics deliver illumination that is free from objectionable flicker as measured by flicker index (ANSI/IES RP-16-10).

1. Flicker index to be less than 5 percent at frequencies below 1000 Hz.

J. Label systems using tandem wired luminaires be labeled accordingly. Locate label in the lamp compartment of each luminaire and identify the function of that luminaire. Do not make the label visible from room.

K. Total Harmonic Distortion less than 20 percent and meet ANSI C82.11 maximum allowable THD requirements at full output. Imbalance current is not allowed to exceed full output THD at any point in the dimming curve.

L. Withstand up to a 1,000V surge without impairment of performance as defined by ANSI C62.41 Category A.

M. Housing have circuit diagrams and lamp connections applied thereto.

N. Reduction of Hazardous Substances (RoHS) compliant.

O. Provide no light output when the analog control signal drops below 0.5 V, or the DALI/DMX digital signal calls for light to be extinguished and consume 0.5 watts or less in this standby. Control deadband between 0.5V and 0.65V included to allow for voltage variation of incoming signal without causing noticeable variation in fixture to fixture output.

P. Dimming Drivers:

1. Dimming power supplies controlled by a common controller by the same manufacturer.
2. Manufacturer to have minimum 5 years of experience in manufacturing dimmable electronic lighting drivers.
3. LED dimming to be equal in range and quality to a commercial grade incandescent dimmer. Quality of dimming to be defined by dimming range, freedom from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, and stable when input voltage conditions fluctuate over what is typically experience in a commercial environment.
    a. Demonstration of this compliance to dimming performance will be necessary for substitutions or prior approval.
4. Provide step-free, continuous dimming to black from 100 percent to 0.1 percent and 0 percent relative light output, or 100 – 1 percent light output and step to 0 percent where indicated. Driver responds similarly when raising from 0 percent to 100 percent.
    a. Driver to be capable of 20 bit dimming resolution for white light LED drivers or 15 bit resolution for RGBW LED drivers.
5. Track evenly across multiple fixtures at light levels, and provide input signal to output light level that allow smooth adjustment over the entire dimming range.
6. Limit inrush current.

7. No visible change in light output with a variation of plus/minus 10 percent line voltage input.
8. Configure a linear or logarithmic dimming curve, allowing fine grained resolution at low light levels
9. Basis of Design Product: eldoLED or subject to compliance and prior approval with specified requirements of this section, one of the following:
    a. eldoLED
    b. Philips
    c. Osram Sylvania
    d. Tridonic
    e. General Electric
10. Dimming Protocols:
    a. If not otherwise noted on the luminaire schedule, dimming LED drivers to be 0-10V.
    b. 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers:
        1) Meet IEC 60929 Annex E for General White Lighting LED drivers.
        2) Connect to devices compatible with 0 to 10V Analog Control Protocol, Class 2, capable of sinking 0.6 ma per driver at a low end of 0.3V. Limit the number of drivers on each 0-10V control output based on voltage drop and control capacity.
        3) Must meet ESTA E1.3 for RGBW LED drivers
        4) 0-10V input protected from line voltage miswire, and immune and output unresponsive to induced AC voltage on the control leads.
    c. As indicated in the luminaire schedule.

2.7 EXTERIOR LUMINAIRES

A. Label fixtures from the factory for use in the designed installation. Verify labeling and installation requirements with the NEC and applicable codes and standards:

1. External Label: ANSI C136.15
2. Luminaires must have locality-appropriate governing mark and certification.

B. The luminaire must be subjected to 100,000 cycles of 2 Gs at the resonant frequency of the luminaire (between 5 and 30 Hz) applied at the center of gravity of the luminaire on three primary axes per ANSI C136.31 without damage to the luminaire. Luminaire must be fully functional upon test completion.

C. Luminaire must be IP and/or UL-listed for damp or wet locations, as appropriate for exterior application. Wiring cavity must be field accessible for service or repair needs.

D. Luminaires must be fully assembled and electrically tested before shipment from factory.

E. Optical cavity must be a minimum IEC 60529/IP65.

F. Rate luminaires for -4 degrees F to 104 degrees F operation.

G. Provide luminaires with a NEMA distribution pattern as indicated in the luminaire schedule.

H. Project Conditions Coordination:

1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under Work of Other Sections, or by others.
2. Coordinate elevation to obtain specified foundation height.
3. Notify Owner of conflicts or deviations and obtain direction prior to proceeding with Work.

I. Exterior Lenses:

1. For lenses not integral to the LED lamp, construct the luminaire optical enclosure (lens/window) of clear and UV-resistant polycarbonate, acrylic, or glass.

J. Unless otherwise indicated, provide cast-in-place embedded style concrete foundations with constructed forms for square foundations or round foundations with spirally wrapped treated paper forms. Provide concrete, anchor bolts, and reinforcing steel as indicated in the Drawings.

K. Poles:

1. Provide poles of material and form as indicated in the luminaire schedule or as required by local jurisdiction and/or local codes if they are more stringent.
2. Provide poles with a hand-hole and removable hand-hole coverplate that matches the material and finish of the pole. Install covers with vandal resistant bolts. Locate hand-hole located approximately 18-inches above the pole base.
3. Provide poles with an internal ground lug easily accessible from the hand-hole.
4. Provide poles with a base plate welded to the pole utilizing a backup ring and full-penetration welded connection.
5. Provide a one piece base cover to completely cover foundation hardware.
6. Aluminum Poles:
    a. Seamless extruded aluminum shafts fully welded to a cast aluminum anchor base assembly.
        1) Provide shaft square, straight, and meeting requirements of AASHTO Standard Specifications.
        2) Pole Height: As indicated in the Luminaire Schedule.

7. Pole Finish:
    a. Provide external surfaces of the pole, base cover, support arms, and luminaires finished in the same material and color.
    b. Provide poles chemically cleaned, rinsed, phosphatized, sealed, and dried.
    c. Apply an electrostatic application of polyester-power paint to external surfaces.
    d. Oven-bake complete unit to form a homogeneous, non-porous surface. Provide completed finish with no sags, drips, oxidation, or runs.

8. Anchor Bolts:
    a. Provided size, length and quantity as recommended by pole manufacturer.
    b. Fabricate anchor bolts from hot rolled carbon steel bar with an L bend on one end.
    c. Provide galvanized anchor bolts with a minimum of 12-inches on the threaded end.
    d. Provide bolt circle and bolt projection dimensions with manufacturer’s Shop Drawings.

9. Wrap poles in a protective material for shipment to the Project site.

2.8 EXTRA MATERIAL

A. Furnish extra materials described below. Match product installed and packaged with protective covering for storage and identified with labels describing contents.

1. Touch-Up Paint: 2 gallons, to match color of pole finish.

2.9 DISPOSAL AND REPLACEMENT

A. LED manufacturer is responsible for the disposal of expired LED arrays and heat sinks. Clearly label fixture with return information, disposal procedures and manufacturer disposal contact information.

B. Owner will pay for shipping.

C. Manufacturer is required to inform the owner of new power requirements and /or lumen output values if new replacement components prior to shipping replacement parts.

D. Label disposal and replacement information inside the luminaire and in the project operation and maintenance manuals along with O&M requirements listed in Division 01, General Requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Meet general requirements of NFPA 70, National Electric Code.

B. Pole Luminaires:

1. Provide cast-in-place concrete foundations for pole mounted luminaires.
2. Concrete: As specified in Division 03, Concrete.
3. Foundation Forms: As indicated.
4. Place anchor bolts in foundation as recommended by manufacturer in the required bolt circle size.
5. Tie reinforcing steel in foundation to the anchor bolts to form a solid cage.
6. Tamp wet concrete during pouring to assure complete coverage below, around and within the cage and form.
7. Hand finish top of foundation to produce a smooth, level surface.
8. Provide a minimum 10-foot copper-clad steel ground rod at each pole base. Connect from ground rod to the ground lug in the pole with minimum AWG 8 copper conductor.
9. Install pole mounted luminaires plumb with luminaires level, and with reflector distribution in the direction indicated in the Drawings.
    a. Grout around the pole base at the foundation to close openings.
    b. Install pole base cover over exposed installation hardware.

3.2 PROJECT CLOSEOUT

A. Leave luminaires clean at the time of acceptance of the work. If luminaires are deemed dirty by the Engineer at completion of the work, clean them at no additional cost.

END OF SECTION 26 50 00

SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Clearing and grubbing.
2. Stripping and stockpiling topsoil.
3. Removing above- and below-grade site improvements.
4. Disconnecting, capping, or sealing site utilities.

1.2 SUBMITTALS

A. Product Data for each type of product indicated.

1.3 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to remain on Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site and disposed of properly.

1.4 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 Owner or authorities having jurisdiction.

B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion- and sediment-control and tree and vegetation-protection measures are in place.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 31 20 00 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTAT CONTROL

A. Provide temporary erosion- and sedimentation-control measures. Requirements for temporary erosion-and-sedimentation-control are specified in Section 31 25 00 “Erosion and Sediment Controls.”

3.3 UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.

B. Interrupting 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 not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's written permission.

C. Excavate for and remove underground utilities indicated to be removed.

3.4 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, 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 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. Completely remove stumps and remove roots, obstructions, and debris to a depth of 18 inches below exposed subgrade.
4. Use only hand methods for grubbing within protection zones.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.5 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, and gutters at existing full-depth joints unless indicated otherwise. Neatly saw-cut length of existing pavement to remain with vertical faces prior to removing existing pavement.

3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. 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.

B. 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. Do not interfere with other Project work.

END OF SECTION 31 10 00

SECTION 31 20 00 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preparing subgrades
2. Excavating and backfilling for structures.
3. Base course for concrete pavements.
4. Base course for asphalt paving.
5. Excavating and backfilling for utility trenches.

1.2 SUBMITTALS

A. Product Data.

B. Aggregate Sieve Analysis.

C. CDF: Design mix and trial 28-day compressive strength test results.

1.3 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Course placed between the subgrade, and concrete, or hot-mix asphalt paving.

C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.

F. Fill: Soil materials used to raise existing grades.

G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

H. Subgrade: Surface or elevation remaining after completing excavation, or the top surface of a fill or backfill immediately below base course, drainage fill, drainage course, or topsoil materials.

I. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

J. Unified Soil Classification System:

1. GW: Well-graded gravels; gravel/sand mixtures with little or no fines.
2. GP: Poorly-graded gravels; gravel/sand mixtures with little or no fines.
3. GM: Silty gravels; poorly-graded gravel/sand/silt mixtures.
4. GC: Clayey gravels; poorly-graded gravel/sand/clay mixtures.
5. SW: Well-graded sands' gravelly sands with little or no fines.
6. SP: Poorly-graded sands; gravelly sands with little or no fines.
7. SM: Silty sands; poorly, graded- sand/gravel/silt mixtures.
8. SC: Clayey sands; poorly-graded sand/gravel/clay mixtures.
9. ML: Inorganic silts; sandy, gravelly, or clayey silts.
10. CL: Lean clays; inorganic, gravelly, sandy, or silty, low to medium-plasticity clays.
11. OL: Organic, low-plasticity clays and silts.
12. MH: Inorganic, elastic silts; sandy, gravelly or clayey elastic silts
13. CH: Fat clays; high-plasticity, inorganic clays.
14. OH: Organic, medium to high-plasticity clays and silts
15. PT: Peat, humus, hydric soils with high organic content.

1.4 PROJECT CONDITIONS

A. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth moving operations.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Engineer and then only after arranging to provide temporary utility services according to requirements indicated.

C. Site Information: Research public utility records and verify existing utility locations prior to ordering any material. Notify the Engineer immediately if any discrepancies are found in the project survey.

D. See Geotechnical report titled OSU Arts and Education Complex by Foundation Engineering, Inc. dated February 18, 2020 for additional information and requirements.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups as approved by the Geotechnical Engineer per ASTM D 2487, or a combination of approved groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups that are rejected by the Geotechnical Engineer per ASTM D 2487, or any combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve or use Oregon Standard Specifications for Construction 1-inch-0-inch BASE AGGREGATE.

E. Select Fill: 1-inch minus, clean, well-graded crushed gravel or rock as approved by the Geotechnical Engineer.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with 100 percent passing a 3-inch sieve and not more than 12 percent passing a No. 200 sieve. As approved by the Geotechnical Engineer as “Granular Site Fill”.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve or use Oregon Standard Specifications for Construction ¾-inch—0-inch BASE AGGREGATE.

H. Backfill and Fill:

1. Satisfactory soil materials
2. Initial trench backfill: Use Oregon Standard Specifications for Construction ¾-inch—0-inch BASE AGGREGATE.

I. Controlled Density Fill (CDF), also referred to as “Controlled Low Strength Material (CLSM): Highly flowable, lean concrete mix of fly ash, cement, fine aggregates, water and admixtures meeting the following other criteria:

1. Portland Cement: ASTM C150, Type I or II.
2. Aggregates: Non-expansive or reactive with 100 percent passing a 3/8-inch sieve and less than 10 percent passing the No. 200 sieve. Aggregates shall meet the requirements of ASTM C33.

3. Fly ash: Conform to ASTM C618, Class F unless otherwise approved.
4. Water: Potable.
5. Admixtures: As necessary to improve flowability without segregation.
6. Compressive Strength: CDF shall attain a 28-day compressive strength of 100 psi – 200 psi.

2.2 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene 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 the 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 to comply with local practice or requirements of authorities having jurisdiction or as follows:

1. Red: electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

B. Tracer Wire: 12 AWG minimum solid copper insulated High Molecular Weight Polyethylene (HMW PE) tracer wire or approved equal. The tracer wire insulation shall be green for sewer pipe and blue for waterlines and be a minimum of 45 mil. thick. Joints or splices shall be waterproof. The wire shall be rated for 30 Volt.

C. Separation Fabric: Woven geotextile, specifically manufactured as a separation geotextile; made from polyolefins, polyesters, or polyamides; and with the following properties determined according to ASTM D 4759 and referenced standard test methods:

1. Grab Tensile Strength: 180 lbf minimum; ASTM D 4632.
2. Tear Strength: 68 lbf minimum; ASTM D 4533.
3. Puncture Strength: 371 lbf minimum; ASTM D 6241.
4. Apparent opening size: No. 30 maximum; ASTM D 4751.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations. Provide protective insulating materials as necessary.

B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 31 Section “Site Clearing.”

C. Protect and maintain erosion and sedimentation controls, which are specified in Division 31 Section “Erosion and Sediment Control” during earth moving operations.

D. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

E. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

F. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

G. Protect all areas designated to receive pervious pavers or pervious pavement from excessive compaction.

3.2 EXPLOSIVES

1. Explosives: Do not use explosives.

3.3 EXCAVATION

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions without prior approval by the Engineer.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.4 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

B. Place separation geotextile over prepared subgrade where indicated, overlapping ends and edges at least 24 inches. Secure in place to prevent wrinkling.

3.5 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 6 inches each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade and bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material, 4 inches deeper elsewhere, to allow for bedding course. Hand excavate for bell of pipes.
2. Excavate utility structures to provide 6 inches clearance (enlarge as needed) to allow for compaction of backfill material.

3.6 SUBGRADE INSPECTION

A. Coordinate inspection with Geotechnical Engineer.

B. Proof-roll subgrade with a pneumatic-tired dump truck to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades. Do not proof-roll subgrade in infiltration facilities.

C. Soft pockets and areas of excess yielding that have been identified shall be scarified and moistened or aerated, or removed and replaced with suitable soil materials to the depth required. Re-compact and retest until specified compaction is obtained.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Geotechnical Engineer, without additional compensation.

3.7 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Engineer.

3.8 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

B. Stockpile soil materials away from edge of excavations.

C. Do not store within drip line of remaining trees.

3.9 BACKFILLS AND FILLS

A. Backfill: Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for record documents.
3. Inspecting and testing underground utilities.

4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.10 UTILITY TRENCH BEDDING

A. Place bedding on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

3.11 UTILITY TRENCH BACKFILL

A. Trenches under Footings: Backfill trenches excavated under footings with satisfactory soil or approved backfill to within 18 inches from the bottom of footings elevation; fill remaining trench excavation with concrete up to the elevation of bottom of footings. Concrete is specified in "Cast-in-Place Concrete."

B. Place and compact initial trench backfill material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

C. Place and compact final backfill of satisfactory soil to final subgrade elevation.

D. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

E. Install tracer wire in a continuous fashion above the utility in such a manner as to be able to properly trace utility lines without loss or deterioration of signal or without the transmitted signal migrating off the tracer wire. Bring tracer wire to the surface at every box, vault, drainage structure, or manhole.

3.12 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under site wall footings, use engineered fill.

5. Under and around utility structures, use engineered fill.

3.13 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 3 percent and is too wet to compact to specified dry unit weight.

3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 12 inches in loose depth for material compacted by heavy compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 95percent.

3.15 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1/2 inch.
3. Pavements: Plus or minus 1/2 inch.

3.16 BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place base course under pavements and walks as follows:

1. Shape base course to required crown elevations and cross-slope grades.
2. Place base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
3. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.17 FIELD QUALITY CONTROL

A. Perform and coordinate inspection and testing for earthwork installed in the public right-of-way as required by the City of Corvallis Standard Construction Specifications.

B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Testing Agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet or less of trench length, but no fewer than two tests.

E. With the approval of the Engineer, proof-roll testing of subgrade and/or aggregate base may be substituted for other compaction testing.

F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.18 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

D. Weather permitting and as approved, stormwater infiltration facility plants shall be installed as soon as possible after placing and grading the growing media in order to minimize erosion and further compaction.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 31 20 00

SECTION 31 25 00 - TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.1 SUMMARY:

A. This section includes the following:

1. Prevention of erosion due to construction activities.
2. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.

1.2 PERFORMANCE REQUIREMENTS

A. Comply with all requirements of U.S. Environmental Protection Agency for erosion and sedimentation control, as specified for the National Pollutant Discharge Elimination System (NPDES), under requirements for the 2012 General Permit for Discharges from Construction Activities.

B. Also comply with all more stringent requirements of State of Oregon Erosion and Sedimentation Control Manual.

C. Follow an Erosion and Sedimentation Control Plan.

D. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.

E. Revisions to ESCP: Coordinate any changes to the ESCP with the City of Corvallis Erosion Control Inspector. Keep copies of all ESCP revisions on site.

F. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.

G. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.

1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.

H. Inspections:

1. Inspections must be conducted by a person who:

a. Is knowledgeable in the principle and practice of erosion and sediment controls, and

b. Possesses the skills to assess conditions at the construction site that could impact stormwater quality, and
c. Is knowledgeable in the correct installation of the erosion and sediment controls, and
d. Is able to assess the effectiveness of sediment and erosion control measures selected to control the quality of stormwater discharges from the construction activity.

2. Visual monitoring requirement: all areas of the site disturbed by construction activity must be inspected to ensure that BMPs are in working order. Locations where vehicles enter or exit the site shall be inspected for evidence of off-site sediment tracking as well as areas used for storage of materials that are exposed to precipitation for evidence of spillage or other potential to contaminate stormwater runoff. In addition, inspect all discharge points identified in the ESCP for evidence of or the potential for the discharge of pollutants, and to ascertain whether erosion and sediment control measures are effective in preventing significant impacts to surface waters. Where discharge points are inaccessible, nearby downstream locations must be inspected to the extent that such inspections are practicable.
3. All ESCP controls and practices must be inspected according to the following schedule:

Site Condition	Minimum Frequency
1. Active Period	Daily when stormwater runoff, including runoff from snowmelt, is occurring. At least once every two weeks, regardless of whether stormwater runoff is occurring.
2. Prior to the site becoming inactive or in anticipation of site inaccessibility	Once to ensure that erosion and sediment control measures are in working order. Any necessary maintenance and repair must be made prior to leaving the site.
3. Inactive periods greater than 14 consecutive calendar days	Once every 2 weeks.
4. Periods during which the site is inaccessible due to inclement weather	If practical, inspections must occur daily at a relevant and accessible discharge point or downstream location

4. Recordkeeping Requirements: Document all visual inspections in an onsite logbook. If there are no findings, simply record the inspection date, and inspector's name. In addition, record any findings, including:

a. At the designated discharge location(s):

1) Where to make observations:

a) At the discharge location if the discharge is to a conveyance system leading to surface waters;
b) From the discharge point to 50 feet downstream if the discharge is to surface waters; and

c) At any location where more than 1/2 of the width of the receiving surface water is affected.

2) How to make observations:

a) For turbidity and color, describe any apparent color and the clarity of the discharge, and any apparent difference in comparison with surface waters.

b) Describe any sheen or floating material, or record that it is absent. If present, it could indicate concern about a possible spill or leakage from vehicles or materials storage.

b. If a site is inaccessible due to inclement weather, record the inspections noted at a relevant discharge point or downstream location, if practical.

c. Locations of BMPs that need to be maintained, inspections of all BMPs, including erosion and sediment controls, chemical and waste controls, locations where vehicles enter and exit the site, status of areas that employ temporary or final stabilization control, soil stockpile area, and non-stormwater pollution (e.g. paints, oils, fuels, adhesives) controls.

d. Locations of BMPs that failed to operate as designed or proved inadequate for a particular location;

e. Locations where additional BMPs are needed that did not exist at the time of inspection; and

f. Corrective action required and implementation dates.

g. All inspection records and monitoring results must be kept on site and maintained by the permit registrant. The records shall list the construction site name as it appears on the registrant's permit and the file or site number. These records must be made available to DEQ, Agent, or local municipality upon request. These records must be delivered or made available to DEQ within 3 working days of request. These inspection records and monitoring results must be maintained for at least 3 years after project completion. In addition, a copy of the ESCP and revisions must be retained on site and made available on request to the DEQ, Agent, or the local municipality. During inactive periods of greater than 7 consecutive calendar days, the ESCP must be retained by the permit registrant but does not need to be at the construction site.

I. Erosion On-Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.

1. Control movement of sediment and soil from temporary stockpiles of soil.
2. Prevent development of ruts due to equipment and vehicular traffic.
3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

J. Erosion Off-Site: Prevent erosion of soil and deposition of sediment on other properties due to construction activities for this project.

1. Prevent windblown soil from leaving the project site.
2. Prevent tracking of mud onto public roads outside site.

3. Prevent mud and sediment from flowing onto sidewalks and pavements.
4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

K. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.

1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
2. If sediment basins are used as temporary preventive measures pump dry and remove deposited sediment after each storm.

L. Sedimentation of Waterways Off-Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.

1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.

M. Open Water: Prevent standing water that could become stagnant.

N. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.3 SUBMITTALS

A. Product Data: For materials indicated in ESCP and additional materials included in ESCP revisions.

B. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.

PART 2 PRODUCTS

2.1 MATERIALS

A. Wattles: Straw-filled tube of flexible netting.

1. Straw must be certified weed free forage.
2. Netting to consist of seamless, high density polyethylene and ethyl vinyl acetate and contain ultra-violet inhibitors.

B. Bio-filtration Bags: Bark or woodchip filled bag of flexible netting.

1. Fill material shall be clean, 100 percent recycled wood or compost product.
2. Bags shall be made of nylon mesh.

C. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; with the following properties:

1. Average Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D 4751.
2. Permittivity: 0.05 sec^-1, minimum, when tested in accordance with ASTM D 4491.
3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D 4355 after 500 hours exposure.
4. Tensile Strength: 100 lb-f, minimum, in cross-machine direction; 124 lb-f, minimum, in machine direction; when tested in accordance with ASTM D 4632.
5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D 4632.
6. Tear Strength: 55 lb-f, minimum, when tested in accordance with ASTM D 4533.
7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.

D. Silt Fence Posts: One of the following, minimum 4 feet long:

1. Steel U- or T-section, with minimum mass of 1.33 lb per linear foot.
2. Softwood, 4 by 4 inches in cross-section.
3. Hardwood, 2 by 2 inches in cross-section.

E. Gravel: As called out on the details.

F. Inlet protection filter sack: as shown on plans.

G. Sediment curtains

H. Flocculants: Chemical used to aid settling of small particles.

1. Product Manufacturers:

a. Stormklear GelFloc
b. Or approved equal.

I. Erosion Control Blankets: as shown on plans.

J. Compost Socks: Mixed yard debris compost-filled tube of synthetic or cotton fiber.

K. Concrete Washout Container: Temporary containment system for cementitious material wash-outs.

1. Product Manufacturers:

a. Eco-Pan
b. Or approved equal.

L. Concrete Wash-out Pit: As shown on Plans.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.2 PREPARATION

A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.3 SCOPE OF PREVENTIVE MEASURES

A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.

B. Construction Entrances: Traffic-bearing aggregate surface.

1. Width: As required; twenty (20) feet, minimum.
2. Length: fifty (50) feet, minimum.
3. Provide at each construction entrance from public right-of-way.
4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.

C. Linear Sediment Barriers: Made of silt fences, wattles, or compost socks.

1. Provide linear sediment barriers:

a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.

2. Space sediment barriers with the following maximum slope length upslope from barrier:

a. Slope of Less Than 2 Percent: 100 feet.
b. Slope Between 2 and 5 Percent: 75 feet.
c. Slope Between 5 and 10 Percent: 50 feet.
d. Slope Between 10 and 20 Percent: 25 feet.
e. Slope Over 20 Percent: 15 feet.

D. Inlet Protection Filter Sack: Protect each inlet using the following measures:

1. Woven fabric bag insert set beneath inlet grate.
2. Bio-filtration bags blocking entire inlet face area.

E. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.

F. Soil Stockpiles: Protect using one of the following measures:

1. Cover with polyethylene film, secured by placing soil or sand bags on outer edges.

2. Cover with mulch at least 4 inches thickness of pine needles, sawdust, bark, wood chips, or shredded leaves; or, 6 inches of straw or hay;

    a. As approved by Owner's Representative.

G. Temporary Seeding: Use where temporary vegetated cover is required.

H. Concrete Wash-out Container: Use when there is not sufficient space for a traditional concrete wash-out pit.

I. Concrete Wash-out Pit: Size as required to handle estimated concrete usage.

3.4 INSTALLATION

A. Temporary Traffic-Bearing Aggregate Surface:

1. Excavate minimum of 6 inches.
2. Place geotextile fabric full width and length, with minimum 12 inch overlap at joints.
3. Place and compact at least 6 inches of 1.5 to 3.5 inch diameter stone.

B. Silt Fences:

1. Store and handle fabric in accordance with ASTM D 4873.
2. Use nominal 36 inch high barriers with minimum 48 inch long posts spaced at 6 feet maximum, with fabric embedded at least 6 inches in ground.
3. Install with top of fabric at nominal height and embedment as specified.
4. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches, with extra post.
5. Fasten fabric to wood posts using one of the following:

    a. Integral pockets.
    b. Four 3/4 inch diameter, 1 inch long, 14 gage nails.
    c. Five 17-gage staples with 3/4 inch wide crown and 1/2 inch legs.

6. Fasten fabric to steel posts using wire, nylon cord, or integral pockets.
7. Wherever runoff will flow around end of barrier, provide temporary splash pad or other outlet protection.

C. Bio-Filter Bag:

1. Install bags in continuous rows with ends butting tightly, with one bag at each end of row turned uphill.
2. Anchor bags with at least two stakes per bag, into the ground.

D. Inlet Protection Filter Sack:

1. Install per manufacturer's recommendations.

E. Wattles

1. Install wattles in 3-5-inch minimum deep trench that is constructed along the contour, perpendicular to the slope or direction of flow.
2. Embed wattle with a 1-inch by 1-inch hardwood stake every 4 lineal feet, driven at least 18 inches into the ground. A stake shall be placed within two feet of the end of the wattle.
3. Adjacent rolls shall tightly abut.

F. Concrete Wash-out Container:

1. Install per manufacturer's recommendations on level ground.

G. Concrete Wash-out Pit:

1. Install as shown on Plans.

3.5 MAINTENANCE

A. Inspect preventive measures routinely (daily), within 24 hours after the end of any storm that produces 0.5 inches or more rainfall at the project site, and daily during prolonged rainfall.

B. Repair deficiencies immediately.

C. Silt Fences:

1. Promptly replace fabric that deteriorates unless need for fence has passed.
2. Remove silt deposits that exceed one-third of the height of the fence.
3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.

D. Bio-Filtration Bags:

1. Promptly replace bags that fall apart or otherwise deteriorate unless need has passed.
2. Remove silt deposits that exceed one-half of the height of the bags.
3. Repair bag rows that are undercut by runoff or otherwise damaged, whether by runoff or other causes.

E. Inlet Protection Filter Sacks

1. Promptly replace sacks that are damaged or deteriorated unless the need has passed.
2. Remove silt deposits that exceed the containment area of the sack.

F. Wattle Rows:

1. Promptly replace wattles that fall apart or otherwise deteriorate unless need has passed.
2. Remove silt deposits that exceed one-half of the height of the wattles.
3. Repair wattles that are undercut by runoff or otherwise damaged, whether by runoff or other causes.

G. Clean out temporary sediment control structures weekly and relocate soil on site.

H. Place sediment in appropriate locations on site; do not remove from site.

I. Concrete Wash-out Container: Properly call container provider to pick up pan when full and replace with empty pan or properly disopose of concrete waste material. Concrete waste to be recycled by container provider.

3.6 CLEAN UP

A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Owners Representative.

B. Clean out temporary sediment control structures that are to remain as permanent measures.

C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION 31 25 00

SECTION 32 12 16 - ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hot-mix asphalt patching.
2. Hot-mix asphalt paving.

B. Related Requirements:

1. Section 31 20 00 "Earth Moving" for subgrade preparation, fill material, aggregate subbase and base courses, and aggregate pavement shoulders.
2. Section 32 17 23 "Pavement Markings" for pavement marking paint and thermoplastic materials.

1.2 SUBMITTALS

A. Product Data: For each type of product. Include technical data and tested physical and performance properties.

1. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the work.
2. Job-mix Designs: For each job mix proposed for the Work.

B. Material Certificates: For each paving material.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the City of Corvallis Standard Specifications and Section 0744 of the 2021 Oregon Standard Specifications for Construction for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expect before time required for adequate cure, or if the following conditions are not met:

1. Tack Coat: Minimum surface temperature of 60 deg F.
2. Asphalt Base and Surface Course:

Dense Graded Mixes	Surface Temperature
Less than 2 inches	60 degrees F
2 inches – 2 1/2 inches	50 degrees F
Greater than 2 1/2 inches	40 degrees F

3. If placing asphalt between March 15 and September 30, temperature may be lowered 5 degrees F.
4. Do not use field burners or other devices to heat the pavement to the specified minimum temperature.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil based materials, 55 deg F for water-based materials, and not exceeding 95 deg F.

C. Thermoplastic Pavement-Markings: Proceed with pavement markings only on clean, dry surfaces, minimum ambient or surface temperature shall be 50 deg F.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. Conform to the requirements of 00744 of the 2021 Oregon Standard Specifications for Construction.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO M 320 or AASHTO MP 1a, PG 64-22.

B. Tack Coat: ASTM D 977 or AASHTO M 140 emulsified asphalt.

2.3 AUXILIARY MATERIALS

A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled tires, asphalt shingles, or glass from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.

2.4 MIXES

A. Recycled Content of Hot-Mix Asphalt: Postconsumer recycled content plus one-half of preconsumer recycled content not more than 30 percent by weight.

1. Surface Course Limit: Recycled content no more than 30 percent by weight.

B. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Provide mixes conforming to section 00744 of the 2021 Oregon Standard Specifications for Construction.
3. Base Course: Level 3, 1/2 inch dense, HMAC
4. Surface Course: Level 3, 1/2 inch dense, HMAC

PART 3 - EXECUTION

3.1 EXAMINATION

A. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.

1. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Apply tack coat uniformly to vertical asphalt surfaces. Apply at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Placing Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

E. Asphalt and sand seal edges where new asphalt concrete meets existing pavement.

3.3 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.4 PLACING HOT-MIX ASPHALT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Spread mix at a minimum temperature of 250 deg F.
2. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.5 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."

3.6 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent or greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

G. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

H. Compaction to a specified density will not be required for thin pavements such as leveling, patches, or where the nominal compacted thickness of a course of asphalt concrete pavement will be less than 2 inches.

3.7 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.
2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch.
2. Surface Course: 1/8 inch.
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.
4. Difference between adjacent panels: 1/8 inch.

3.8 CORRECTION OF DEFECTS

A. Correct all defects in materials and work at no additional cost to the owner, as follows:

1. Fouled Surfaces: Immediately repair, clean, and re-tack fouled surfaces that would prevent full bond between successive lifts of mixture.
2. Boils, Slicks, and Oversized Material: Immediately remove and replace boils, slicks, and oversized materials with fresh mixture.
3. Segregation: Take immediate corrective measures when segregation or non-uniform surface texture is occurring in the finished mat. If segregation continues to occur, stop production until a plan for providing uniform surface texture is approved by the Port.
4. Roller Damage to the Surface: Immediately correct surface damage from rollers with additional fresh mixture or by other means approved by the owner.
5. Longitudinal Joints: Take immediate corrective measures when open longitudinal joints are being constructed or when the elevation of the two sides of a longitudinal joint does not match. If problems with the longitudinal joint continue to occur, stop production until a plan for providing tight, equal elevation longitudinal joints is approved by the owner.
6. Corrective Measures: Take immediate corrective measures when the specified compaction density is not being achieved.
7. Other Defects: Remove and replace any HMAC that:

    a. Is loose, broken, or mixed with dirt.
    b. Visually shows too much or too little asphalt.
    c. Is defective in any way.

3.9 FIELD QUALITY CONTROL

A. Perform and coordinate inspection and testing for asphalt paving in the public right-of-way as required by the City of Corvallis Standard Construction Specifications.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Verify density by random testing of the compacted surface with calibrated nuclear gauges. Determine the density by averaging QC tests performed by a Certified Density Technician (CDT) with the nuclear gauge operated in the backscatter mode according to AASHTO T 335 at one random location for each 100 tons of asphalt concrete placed, but take no less than 10 tests per shift. Do not locate the center of a density test less than 1 foot from the panel edge. Calculate the Moving Average Maximum Density (MAMD) according to ODOT TM 305.

D. Replace and compact hot-mix asphalt where core tests were taken.

E. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.10 WASTE HANDLING

A. Except for material indicated to be recycled, remove excavated materials from Project Site and legally dispose of them in an EPA-approved landfill.

END OF SECTION 32 12 16

SECTION 32 13 13 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Driveways.
2. Vehicular Concrete Paving.
3. Parking lots.
4. Curbs and gutters.
5. Sidewalks.

B. Related Requirements:

1. Section 31 20 00 "Earth Moving" for subgrade preparation, fill material, aggregate subbase and base courses, and aggregate pavement shoulders.
2. Section 32 17 23 "Pavement Markings" for pavement marking paint and thermoplastic materials.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Admixtures
4. Curing compounds
5. Applied finish materials.
6. Bonding agent or epoxy adhesive.
7. Joint fillers.

D. Minutes of preinstallation conference.

E. Jointing and scoring layout shop drawing.

1.3 QUALITY ASSURANCE

A. Ready-Mix-Concrete 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.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 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.

C. ACI Publications: Comply with ACI 301 unless otherwise indicated.

D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1.4 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 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 with 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.

2.2 STEEL REINFORCEMENT

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports

according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified.

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C 150, portland cement Type I

   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: ASTM C 33, Class 4M, uniformly graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: Potable and complying with ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: 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. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
3. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.

2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd.

B. Moisture-Retaining Cover: ASTM C 171, 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 1, Class B, dissipating.

F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

2.5 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips.

B. 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 requirements.

2.6 WHEEL STOPS

A. Wheel Stops: Precast, air-entrained concrete 2500-psi minimum compressive strength, 6 inches high by 9 inches wide by 72 inches long. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.

1. Dowels: Galvanized steel, 3/4 inch in diameter, 10-inch minimum length.

2.7 DETECTABLE WARNINGS

A. Detectable warnings: ADA truncated domes aligned in a square or radial grid pattern complying with current ADAAG guidelines. Detectable warnings shall be replaceable, plastic, cast-in-place pavers.

1. Color: Brick Red for installations in the public right-of-way (Federal Color 22144).
2. Size: Per plan.
3. Manufacturers: Access Tile, ADA Solutions, or approved equal.

2.8 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, with the following properties:

1. Compressive Strength (28 Days): 4,000 psi
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: 4-1/2 percent plus or minus 1.5 percent for 1-inch nominal maximum aggregate size.

B. Use a qualified testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.

C. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

1. When temperature is between 85 deg F 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 EXAMINATION AND PREPARATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading and elevation tolerances. See Section 31 20 00 “Earth Moving.”

B. Remove loose material from compacted subbase surface immediately before placing concrete.

C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides 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. After the forms have been set to correct grade, the grade shall be thoroughly tamped, either mechanically or by hand, at both the inside and outside edges of the base of the forms. Forms shall be staked into place with no less than 3 pins for each 10-foot section. A pin shall be placed at each side of every joint.

C. Form sections shall be tightly locked and shall be free from play or movement in any direction. The forms shall not deviate from true line by more than 1/4 inch at any joint. Forms shall be so set that they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment.

D. The alignment and grade elevations of the forms shall be checked and corrections made by the Contractor immediately before placing the concrete. When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.

E. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.3 STEEL REINFORCEMENT

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, 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.

3.4 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges 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.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints. If sufficient concrete is not available to finish the current panel, the Contractor shall remove the fresh concrete back to the nearest transverse joint.

1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
2. Butt Joints: Use epoxy bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips, except at vertical faces such as building and site walls. See Landscape details for isolation joints at vertical faces.

1. Locate Isolation Joints as follows:

a. Vehicular Concrete Pavements: abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
b. Curbs, Islands, and Traffic Separators: opposite abutting expansion joints in abutting concrete, over existing expansion joints in concrete underlying the new concrete structure, at each point of tangency in the structure alignment, and not over 200 foot spacing.
c. Driveways, Walks, Monolithic Curbs and Sidewalks: between driveways and concrete pavement, transversely in walks opposite expansion joints in adjoining curbs and elsewhere so the distance between joints does not exceed 45 feet, transversely in walks at a distance of 16 feet to 8 feet from ends of walks which abut curbs, and around poles, posts, boxes, and other fixtures which protrude through or against the structures.

2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.

6. 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. Locate to match jointing of existing adjacent concrete paving where applicable.

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooved 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 once concrete has hardened sufficiently such that the cutting action will not tear, abrade, or otherwise damage the surface and before developing random contraction cracks. The sawing of any joints shall be discontinued or omitted if a crack occurs at or near the joint location before or during sawing. Concrete panels that have started cracking before or during the saw cutting of the joints shall be removed and replaced at no expense to the Owner.
3. Doweled Contraction 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.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.5 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, 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 time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, placing, and consolidating concrete.

E. Do not add water to concrete during delivery or at Project site.

F. Do not add water to fresh concrete after testing.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

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.

H. Place concrete in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.

1. Remove and replace concrete that has been placed for more than 15 minutes without being covered by top layer, or use bonding agent if approved by Engineer.

I. 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.

J. Screed paving surface with a straightedge and strike off.

K. Commence initial floating using bull floats or darbies to impart 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 surface treatments.

L. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.

M. Do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.

N. 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.

O. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to 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. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.6 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared, and 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 (Pedestrian Areas): 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-Coarse-Textured Broom Finish (Roadways and Parking Areas): 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.

C. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a ¼ inch (6mm) radius. Repeat tooling of edges after applying surface finished. Eliminate tool marks on concrete surfaces.

3.7 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.

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-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. 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.

3.8 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: ¼ inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot-long, unleveled straightedge not to exceed ¼ inch.
4. Joint Spacing: ½ inch .
5. Contraction Joint Depth: Plus 1/4 inch, no minus.
6. Joint Width: Plus 1/8 inch, no minus.
7. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
8. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
9. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
10. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.

3.9 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Engineer.

B. Allow concrete pavement to cure for 28 days and be dry before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

3.10 WHEEL STOPS

A. Securely attach wheel stops to paving with not less than two galvanized-steel dowels located at one-quarter to one-third points. Firmly bond each dowel to wheel stop and to pavement. Securely Install dowels in drilled holes in the paving and bond dowels to wheel stop. Recess head of dowel beneath top of wheel stop.

3.11 FIELD QUALITY CONTROL

A. Perform and coordinate inspection and testing for concrete paving in the public right-of-way as required by the City of Corvallis Standard Construction Specifications.

B. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

C. 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 250 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 concrete mix. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each 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 composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of four standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test 2 specimens at 7 days and 2 specimens at 28 days.

    a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.

D. 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.

E. Test results shall be reported in writing to Engineer, 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.

F. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.

G. 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 Engineer.

H. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.

I. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.12 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Engineer.

B. Drill test cores, where directed by Engineer, 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 paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 13 13

SECTION 32 13 16 - SITE CONCRETE PLACEMENT AND FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies cast-in-place concrete for site paving and concrete site elements, as well as special finishes and concrete coloring. Work of this Section also includes reinforcement, concrete materials, mixture design, placement procedures, and finishes, for site applications of concrete. Concrete work and materials specified herein may be at variance with concrete components specified in Section 03 3000, Cast-In-Place Concrete, and thus are not interchangeable.

B. Work of this Section includes but is not necessarily limited to:

1. Pedestrian concrete pavement, its placement and broom finishing.
2. Curbs.
3. Seat walls.
4. Stairs and ramps.
5. Tooling of all score joints.
6. Anti-graffiti coating of vertical elements.
7. Isolation joints with embedded joint filler, backing rod and sealant.

C. Furnish all labor, equipment, materials, tools, and transportation to complete the installation of site concrete in its various applications as shown on the Drawings.

1.2 REFERENCES

A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority.

1. American Concrete Institute (ACI).
   a. ACI 117 – Specification for Tolerances for Concrete Construction and Materials.
   b. ACI 301 – Specifications for Structural Concrete for Buildings.
   c. ACI 301-96 (section 5.3.3.4) – Types of Rubbed Finishes.
   d. ACI 303.1 – Cast-in-Place Architectural Concrete.
   e. ACI 305.1 – Hot Weather Concreting.
   f. ACI 306.1 – Cold Weather Concreting.
   g. ACI 308R – Curing Concrete.

2. American Society of Testing Materials, International (ASTM).
   a. ASTM A36 – Standard Specification for Carbon Structural Steel.
   b. ASTM A82 – Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
   c. ASTM A497 – Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.

d. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
e. ASTM A1064 – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
f. ASTM C33 – Standard Specification for Concrete Aggregates.
g. ASTM C94 – Standard Specification for Ready-Mixed Concrete.
h. ASTM C150 – Standard Specification for Portland Cement.
i. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
j. ASTM C330 – Standard Specification for Lightweight Aggregates for Structural Concrete.
k. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.
l. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
m. ASTM C989 – Standard Specification for Slag Cement for Use in Concrete and Mortars.
n. ASTM C1017 – Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
o. ASTM C1116 – Standard Specification for Fiber-Reinforced Concrete.
p. ASTM C1602 – Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
q. ASTM D1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
r. ASTM D2240 – Standard Test Method for Rubber Property—Durometer Hardness.
s. ASTM D2370 – 98(2010) Standard Test Method for Tensile Properties of Organic Coatings.

3. Standard Specifications for Road, Bridge and Municipal Construction, WSDOT 2021 Edition.

1.3 SUBMITTALS

A. General: In addition to the following, comply with submittal requirements in ACI 301.

B. Product Data: For each type of product indicated for incorporation into the Work.

C. Samples: Submit samples of materials as specified and as otherwise requested by the Landscape Architect, including names, sources and description.

1. Joint sealant color chips from selected manufacturer.
2. Joint sealant sand: 1/4 pound in sealed plastic bag of each color proposed.

D. 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.
2. Include substantiating substantial test data to show compliance with ACI 318 Chapter 5.

E. Steel Reinforcement Shop Drawings: For form tie layout in walls where, throughout any portion of their length, they will exceed 18-inches in height when measured from finish grade.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94 requirements for production facilities and equipment.

B. Source Limitations: Obtain each type of cement of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

C. Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents:

D. Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

E. Protect surrounding areas, paving, and improvements.

F. Protect trees and shrubs from damage including roots, excessive compaction of adjacent soil and intrusion of materials into soil during execution of the Work.

G. Protect base rock from intrusion of foreign materials. Protect finished concrete paving from traffic and vandalism to provide adequate curing time.

1.5 PAVING MOCK-UPS

A. Provide on-site for Owner's approval.

B. Concrete Pavements: All of the various concrete pavements shall have one full depth panel, a minimum of 6-feet by 6-feet in size, prepared to reflect adjacencies of color and finish for Owner's Representative's review and approval. Panels to be finished and cured to reflect anticipated result for the work of this Section. Concrete pavement types to be as follows:

1. Standard Concrete pavement for pedestrian traffic, with medium broom finish.

PART 2 - PRODUCTS

2.1 FORMWORK

A. Furnish formwork and formwork accessories according to ACI 301. Notify Landscape Architect when formwork has been completed and may be observed. Notify two working days in advance of anticipated completion.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615, Grade 60, deformed.

B. Plain-Steel Wire: ASTM A82, as drawn.

C. Plain-Steel Welded Wire Reinforcement: ASTM A1064, fabricated from as-drawn steel wire into flat sheets.

D. Dowel Bars: ASTM A615, Grade 60, non-deformed.

E. Dowel Plates: ASTM A36, 1/4" x 4-1/2" x 4-1/2" with plastic pocket former.

1. Diamond Dowel by PNA Construction Technologies or approved equal.

F. Deformed-Steel Welded Wire Reinforcement: ASTM A497, flat sheet.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout Project:

1. Portland Cement: ASTM C150, Type I or II.
   a. Fly Ash: ASTM C618, Class C.
   b. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.

B. Normal-Weight Aggregate: ASTM C33, graded, 1-1/2 inch maximum aggregate size.

C. Water: ASTM C1602, potable.

2.4 ADMIXTURES

A. Air-Entraining Admixture: ASTM C260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will 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 C494, Type A
2. Retarding Admixture: ASTM C494, Type B
3. Water-Reducing and Retarding Admixture: ASTM C494, Type D
4. High-Range, Water-Reducing Admixture: ASTM C494, Type F
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494, Type G
6. Plasticizing and Retarding Admixture: ASTM C1017, Type II

2.5 RELATED MATERIALS

A. Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber, or ASTM D1752, cork or self-expanding cork.

B. Joint Sealant: Shall be an elastic, low-modulus, one-component, moisture-curing, non-sag polyurethane sealant requiring no mixing and no priming of surfaces to which it is to be applied.

1. Available colors shall include limestone, stone gray, tan, black, and bronze. Color samples shall be provided for Landscape Architect's selection.
2. Acceptable Product: Pourthane NS by W. R. Meadows; or approved equal.

C. Sealant Sand: Washed builders' sharp sand, in color range to match adjacent concrete and sealant. Apply while sealant is tacky.

D. Form Release: Vegetable oil-based form release agent conforming to the following requirements:

1. 100% biodegradable and non-petroleum based.
2. VOC compliant.
3. Does not include emulsifiers or solvents and is not diluted with water.
4. Does not require mixing prior to use.
5. Non-staining.
6. Capable of maintaining release qualities for more than 24-hours.
7. Basis of Design Product: Spec Release or approved equal.

2.6 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 ounces per square yard when dry.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

2.7 CONCRETE SEALER

A. Penetrating sealer: Basis of Design: Micro-Seal™ HD as manufactured by RainGuard Pro Co., Phoenix, AZ 85009, Tel.: (949) 515-8800, or equal.

2.8 ANTI-GRAFFITI COATING

A. All seat walls and vertical concrete surfaces above standard curb height shall be treated with an anti-graffiti coating. Coating shall maintain the natural permeable finish of the concrete, be non-sacrificial, non-yellowing and isocyanate free. 10 year warranty.

1. Basis of Design: VandlGuard® IsoFree® Aliphatic Urethane 2K Anti-Graffiti Coating as manufactured by RainGuard Pro Co., Phoenix, AZ 85009, Tel.: (949) 515-8800.
2. Or equal.

2.9 CONCRETE MIXTURES

A. Comply with ACI 301 requirements for concrete mixtures.

B. Normal-Weight Concrete: Prepare design mixes, proportioned according to ACI 301, with minimum compressive strength of 4,000 psi at 28 days.

1. Maximum Water-Cementitious Materials Ratio: 0.45.

2. Slump Limit: 4 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.

3. Air Content: Maintain within range permitted by ACI 301.

2.10 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94 and ASTM C1116 and furnish batch ticket information.

1. When air temperature is above 90°F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine areas to receive concrete for conditions that will adversely affect the execution, quality, and performance of Work. Do not start Work until unsatisfactory conditions have been corrected.

3.2 STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.3 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges 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 paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated.
2. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
3. Provide tie bars at sides of paving strips where indicated.

4. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
5. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
6. Doweled Joints: Install plate dowels, dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler 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, to match jointing of existing adjacent concrete paving:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/8-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces
   a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.

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.
   a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.

3. Doweled Contraction Joints: Install plate dowels and support assemblies at joints where indicated.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/8-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.4 CONCRETE PLACEMENT

A. All dirt, debris and water should be removed before placing concrete.

B. Comply with ACI 301 for measuring, batching, mixing, transporting, and placing concrete. Use equipment for placing that will avoid mix separation, splatter and trapped air to the greatest extent possible.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

D. Do not add water to concrete during delivery, at Project site following test sampling, or during placement.

E. Consolidate concrete with mechanical vibrating equipment, following ACI recommendations.

3.5 FINISHING FORMED SURFACES

A. Site Walls: Smooth formed finish as defined in ACI 301-96. After removal of forms wall surfaces shall receive a rubbed finish per section 5.3.3.4 of ACI 301-96. All tie holes and defects to be patched. Forms are to be removed as early as permitted with patching and removal of fins to follow quickly. Apply a smooth rubbed finish no later than the day after form removal.

1. Rough form finish on all surfaces not exposed to public view. Remove fins 1/4 inch or more in height.
2. Smooth form finish on all surfaces exposed to public view. All fins must be removed, and the surface must have a rubbed finish.
    a. Wet surface and rub with a Carborundum brick or other abrasive until a uniform color and texture are achieved. Use no grout other than the cement paste that is drawn from the concrete by the rubbing process.

B. Related Unformed Surfaces: At tops of 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.

3.6 FINISHING UNFORMED SURFACES

A. General: Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleedwater appears on surface.

1. Do not further disturb surfaces before starting finishing operations.

C. Nonslip Broom Finish: Apply a nonslip broom finish to surfaces indicated and to exterior concrete platforms, steps, and ramps. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route direction.

3.7 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 with ACI 301 for hot-weather protection during curing.

B. If evaporation rate in first paragraph below is exceeded, ACI 305R states that plastic shrinkage cracking is probable. See manufacturers' literature or ACI 305R for estimated moisture-loss chart relating relative humidity, air and concrete temperature, and wind velocity to rate of evaporation.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb./sq. ft. per hour 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 formed and unformed concrete for at least seven days 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 all newly poured 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.
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.
4. Curing and Sealing Compound: Apply uniformly to slabs indicated in a 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. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

F. Application of Anti-Graffiti Coating:

1. Concrete may be coated after 5 days of cure.
2. Use an airless sprayer with a spray tip between 0.035mm to 0.051mm as recommended by manufacturer.
3. Apply one coat at 2 mils+ DFT (Dry Film Thickness) and let cure.
4. Perform post application test in an inconspicuous area to assure results are achieved.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Article.

B. Tests: Perform according to ACI 301.

1. Testing Frequency: One composite sample shall be obtained for each 100 cubic yards or fraction thereof of each concrete mix placed each day.

3.9 REPAIRS

A. Remove and replace concrete that does not comply with requirements in this Section.

END OF SECTION 32 13 16

SECTION 32 17 23 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes painted markings applied to asphalt and concrete pavement on site. See traffic plans for pavement markings in the public right-of-way.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PAVEMENT-MARKING PAINT

A. Pavement-Marking Paint: Sherwin Williams SETFAST Waterborne Traffic Marking Paint, or approved equal.

1. Color: As indicated.

B. Thermoplastic Pavement Markings: Type B-HS Pre-formed, fused thermoplastic film conformed to the requirements of 00867 of the 2021 Oregon Standard Specifications for Construction and AASHTO M 249

1. Manufacturers: 3M, Flint Trading, or approved equal.
2. Color: As indicted.

PART 3 - EXECUTION

3.1 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Engineer.

B. Allow paving to age for a minimum of 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils. Apply paint so that it cannot run beneath the stencil.

E. Install thermoplastic pavement markings as indicated on the drawings per the requirements of section 00867 and 00850 of the 2021 Oregon Standard Specifications for Construction.

END OF SECTION 32 17 23

SECTION 32 33 00 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following site furnishings:

1. Campus Standard Bench.
2. Tables and chairs, campus standard.
3. Trash and recycling receptacles, campus standard.

B. Furnish all, labor material and equipment necessary to install the site furnishing elements specified or as indicated on the Drawings.

1.2 REFERENCES

A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority.

B. ASTM International, (ASTM).

1. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
2. ASTM C33 – Standard Specification for Concrete Aggregates.
3. ASTM C150 – Standard Specification for Portland Cement.
4. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
5. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.
6. ASTM D9 – Standard Terminology Relating to Wood and Wood-Based Products.
7. ASTM D6386 Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting.

C. American Welding Society, (AWS)

1. AWS D-19.0 – Welding Zinc Coated Steel.

D. Oregon State University Capital Planning and Development, OSU Construction Standards, Section 32 33 00, Site Furnishing.

1.3 SUBMITTALS

A. General: Comply with the requirements of Section 01 33 00, Submittals.

B. Product Data. For each product indicated. Include manufacturer's catalog cut sheets, construction details, material descriptions, dimensions of individual components and profiles, finishes, field assembly requirements, and installation details.

C. Samples for Initial Selection: For units with factory-applied color finishes. Provide two sets of color chip samples, minimum size to be 6"x6".

D. Samples for Verification: For each type of exposed finish required, prepared on samples of size indicated in paragraph 1.3 C.

E. Material Sample Size: As applicable, not less than 8-inch long linear components and 6-inch square sheet components. Submittal of full-size product items is not required.

F. Product Schedule: For site furnishings. Use same designations as indicated on Drawings.

G. Material Certificates: For site furnishings, signed by manufacturers.

H. Maintenance Data: For site furnishings to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of site furnishing(s) through one source from a single manufacturer.

B. Construction: Construct each item and ship to the site in minimum number of sections.

C. Conflicts: Compare manufacturer's shop drawings of all products with the products shown on the Drawings.

PART 2 - PRODUCTS

2.1 FURNISHINGS:

A. Bench:

1. Radius Pipe Bending Company. Tel (541) 998-9700.
2. Product: Matt’s Bench, 6-foot length.
3. Color + Material: Powder coat steel, Black. OSU Black – Paint: Shall be Sherwin Williams “Tricorn Black” SW 6258; 50 percent gloss. Powder coat: Cardinal BK78 Black.

B. Combination Recycling and Trash Receptacle:

1. Available from Recycle Away, http://www.recycleaway.com/Triple-Recycling-Rendezvous-Receptacle-with-Bonnet-Top_p_319.html.
2. Local availability from RJH Enterprises, Corvallis, OR 97333, Tel.: (541)-753-5360.
   a. Shall have bonnet top to minimize rain collection.
   b. Receptacles shall be stainless steel. Optional color shall be powder-coat black (University standard color). Verify color selection with Owner’s Representative.

c. Four-chamber design with full height internal partitions and swinging doors that meet fire code for exterior use.
d. Plastic inserts: Rubbermaid “Slim-Jims” containers, 4 required per unit.

3. Reference OSU Construction Specifications Section 32 33 00, Diagram 32 33 00E for dimensions

C. Tables and Chairs:

1. Manufacturer: Landscape Forms, Kalamazoo, MI. 49048, Tel.: (800) 430-6209.
2. Model: Carousel; Catena tabletop. Grid chairs with and without backs; 3-5 seats to meet ADA requirements.
3. Tabletop: 42” diameter, 29” height.
4. Finish and color: Powder coat, black.

2.2 FABRICATION

A. To the greatest extent possible, fabrication shall be performed off-site at manufacturer’s facility and transported as a single unit to the Project site.

B. Metal Components Not Supplied as Element Accessories: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.

C. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.

D. Pipes and Tubes:

1. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

E. Preservative-Treated Wood Components: Complete fabrication of treated items before treatment if possible. If cut after treatment, apply field treatment complying with AWPA M4 to cut surfaces.

1. Any preservative treatment shall not discolor wood, nor shall there be any incising on the surface of the fence components.

F. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.

G. Factory Assembly: Assemble components in the factory to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Review locations where all site furnishing elements are to be placed. Confirm that all paving and hardscape work in or near site furnishing elements is complete. Where site furnishing elements are to be welded to plates embedded in the structural slab, provide furnishing element in a timely manner so that installation may be completed without causing delay to completion of surrounding hardscape.

3.2 CLEANING AND PROTECTION

A. Clean and protect all furnishings during and after installation prior to Owner's use of the furnishings.

END OF SECTION 32 33 00

SECTION 32 84 00 - PLANTING IRRIGATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Piping.
2. Sleeves for piping.
3. Manual valves.
4. Pressure-reducing valves.
5. Automatic control valves.
6. Double check valve assembly (DCVA) for backflow prevention.
7. Transition fittings.
8. Dielectric fittings.
9. Miscellaneous piping specialties.
10. Sprinklers.
11. Quick couplers.
12. Controller, Maxicom™ compatible.
    a. The University operates its automatic irrigation from a Maxicom® Multi-Site Irrigation Central Control System.
13. Vaults and boxes for automatic control valves, DCVA, gate valves, and all appurtenances and assemblies.
14. Both vertical and horizontal adjustment of existing valves, boxes for all irrigation appurtenances, all assemblies, piping, wiring, sprinklers, and meters and points of connection as necessary to maintain operation of existing irrigation system.
15. Water Audit upon completion.

B. Furnish labor, material and equipment required for the installation, adjustment, and controls for a complete working system.

C. Pre-construction and pre-installation walk-through shall be conducted with the architect and Owner's Representative for assessment of existing conditions.

D. Walk-through shall be conducted at time of Substantial Completion with the Landscape Architect and Owner's Representative.

E. Related Sections:

1. Section 22 05 00, “Common Work for Plumbing” for additional guidance.
2. Section 22 40 00, “Plumbing Fixtures” for backflow preventer.
3. Section 26 00 00, “Electrical” for controller connection.

1.2 REFERENCES

A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Should the requirements of any of the following referenced standards and specifications conflict with each other, the OSU Construction Standards shall prevail first, then the more stringent requirement.

B. American National Standards Institute, (ANSI)

1. ANSI B16.15 - 1985 (R1994) - Cast Bronze Threaded Fittings.

C. American Society of Irrigation Consultants

1. ASIC Guideline 100-2002 For Earth Grounding Electronic Equipment in Irrigation Systems.

D. American Society of Mechanical Engineers, (ASME)

1. ASME B16.18 - 1984 (R1994) - Cast Copper Alloy Solder Joint Pressure Fittings.
2. ASME B16.22 – 1995 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
3. ASME B31.3 – 2012 – Process Piping, ASME Code for Pressure Piping.
4. ASME B40.1 – Pressure Gauges and Gauge Attachments.

E. American Society for Testing and Materials, (ASTM International)

1. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A106 – Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
3. ASTM A733 – Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples.
4. ASTM B32 – Standard Specification for Solder Metal.
5. ASTM B42 – Standard Specification for Seamless Copper Pipe, Standard Sizes; 2010.
6. ASTM B43 – Standard Specification for Seamless Red Brass Pipe.
7. ASTM B88 – Standard Specification for Seamless Copper Water Tube.
8. ASTM B584 – Standard Specification for Copper Alloy Sand Castings for General Applications.
9. ASTM B828– Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
10. ASTM D1784 – Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
11. ASTM D1785 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
12. ASTM D2235 – Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings; 2004 (Reapproved 2011).
13. ASTM D2241 – Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

14. ASTM D2464 – Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
15. ASTM D2466 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
16. ASTM D2467 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
17. ASTM D2564 – Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
18. ASTM D2665 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe Fittings.
19. ASTM F402 – Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings.
20. ASTM F1545 – Standard Specification for Plastic-Lined Ferrous Metal Pipe, Fittings, and Flanges.

F. National Electrical Manufacturers Association, (NEMA)

1. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2008.

G. Oregon State University Construction Standards, Section 32 80 00, latest edition.

1.3 DEFINITIONS

A. Circuit Piping or Lateral Lines: Downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure only during flow.

B. Drain Piping: Downstream from circuit-piping drain valves. Piping is not under pressure.

C. Main Piping or Mainline: Downstream from point of connection to water distribution piping to, and including, control valves, quick coupler valves and mainline gate or ball valves. Piping is under water-distribution-system pressure.

D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50V or for remote-control, signaling power-limited circuits.

E. The following are industry standard abbreviations for plastic pipe materials:

1. PE: Polyethylene plastic.
2. PP: Polypropylene plastic.
3. PVC: Polyvinyl chloride plastic.
4. TFE: Tetrafluoroethylene plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Irrigation zone control shall be two-wire automatic operation with controller, decoders and automatic control valves.

B. Location of Sprinklers and Specialties: Design location is diagrammatic. Make minor adjustments necessary to avoid plantings and obstructions such as signage, existing and new plants and trees, and light standards. Maintain 100 percent irrigation coverage, including overlapping head-to-head coverage of sprinklers for areas indicated.

C. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:

1. Irrigation Main Piping: 50 psi.
2. Circuit Piping: 45 psi.

1.5 SUBMITTALS

A. Materials List: Within 30 days after award of Contract, and before any irrigation system materials are delivered to the job site, submit to the Owner's Representative a complete list of all irrigation system materials and components proposed to be furnished and installed. Include manufacturer's name and catalog number for each item. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Also include a written statement of anticipated coordination and cooperation with Plumbing contractor for timing and placement of City of Corvallis compliant submeter, and subsequent continuation with Point of Connection (POC) assembly.

B. Wiring Diagrams: For power, signal, and control valve wiring.

C. Record Drawings: Record Drawings: Provide Record Drawings illustrating actual as-built locations for all irrigation equipment per Division 1 Section "Project Closeout."

1. During the course of the installation, carefully show in red line on a print of the irrigation system Drawings, all changes made to the irrigation system during installation. This drawing to be labeled "Record Copy". Make available for inspection. Do not use for construction.
    a. The contractor shall keep as-built irrigation drawings updated daily and on site, available for review and examination.
2. Note lateral sizing on "Record Copy" as the system is installed. Use lateral sizing chart shown on the Drawings to size lateral lines.
3. Upon completion of the work, transfer all changes to a complete set of the construction drawings. Changes to work drawn to be cleanly erased and new work professionally drafted in proper locations. Dimension and note clearly all underground work located horizontally and vertically. Clearly mark each sheet with the words "As-Built" and date.
4. Submit As-Built Drawings for approval. If Drawings are not clear, or information is not complete, revise and resubmit for approval. Project will not be complete until As-Built Drawings are submitted and accepted by Owner's Representative.
5. Submit As-Built Digital Drawings after hard-copy drawings are approved. Digital drawings shall be in Auto CAD release 2007 format or newer and copied onto a compact disk. Submit at time of final review for irrigation system.

D. Qualification Data: For qualified Installer.

E. Zoning Chart: Provide two laminated zone layout maps and schedules upon completion, prior to water audit. Map shall incorporate all pre-existing and new zones. One 11"x17" laminated irrigation plan sized to fit inside controller enclosure indicating by varying colors the area of coverage for each control valve. Incorporate new valves with existing when preparing zoning chart. Show which valves are activated by each station on the controller. Show the location and valve number of each valve and the corresponding controller station number. The valve numbers shall be the valve numbers shown on the As Built Drawings. The Zone Map may be made from a cropped copy of the As-Built Drawings. Submit to the Owner's Representative at time of Substantial Completion for irrigation but prior to water audit.

F. Controller Timing Schedule: Submit 6 (six) 8-1/2 inches x 11 inches copies of an irrigation schedule. On the schedule, indicate the day(s) of the week each zone is watered, and the duration each zone is watered (in minutes).

G. Field Quality-Control Reports.

H. Tools: Submit to the Owner's Representative two sets each, as appropriate, of controller keys, quick coupler operating keys with matching hose swivels attached, gate valve keys, air compressor valve keys, valve box keys, wrenches for removal and adjustment of each type of sprinkler head used in the Work, and unique tools or devices needed to access, operate, adjust, or maintain the system. Submit after Substantial Completion and prior to Final Acceptance of the irrigation system.

I. Operation and Maintenance Data, Guide Manuals: Submit operating and maintenance guides for the entire system and for each piece of equipment in the system. Instructions for system winterization are to be included. Submit to the Owner's Representative at the time of Substantial Completion of the irrigation system.

J. Testing Certificates:

1. Certification of any newly installed backflow devices.
2. Hydrostatic pressure testing.

K. Water Audit:

1. Prior to Final Acceptance a water audit shall be performed, and a report completed by an Irrigation Association (IA) Certified Landscape Irrigation Auditor, conducted in accordance with the current IA audit standards for all new, as well as existing, irrigated zones. The audit report shall be approved by the OSU Landscape Manager. Final Acceptance is contingent on this approval.

1.6 QUALITY ASSURANCE

A. Provide at least one person who shall be present at all times during execution of this portion of the Work, and who is thoroughly familiar with the type of materials being installed and the manufacturer's recommended methods of installation, and who shall direct all work performed under this Section.

B. Except where more stringent requirements are specified, conform to the "Uniform Plumbing Code" as adopted and modified by the State of Washington and all legally constituted

authorities having jurisdiction. If more restrictive than those specified herein, notify the Owner's Representative prior to starting work.

C. All materials and equipment in the system to be new and be brands and types as shown in the plans or as specified herein, or as accepted by the Owner's Representative.

D. Installer Qualifications: An employer of workers that include a licensed plumber or journeyman plumber or a certified irrigation installer with a minimum of 10 years of experience, who shall be accountable and onsite to direct all irrigation work.

E. All solvent weld pipe fitters shall have "Bonder Qualification" card for ASME B31.3 and certification of successful solvent welding training to comply with the ASTM D 2855 standard.

1. Weld On provides training free of charge, see http://www.weldon.com/tech_training

F. 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.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver piping 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.

B. Store materials in areas designated by the Owner.

C. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

D. Use all means necessary to protect irrigation system materials from damage, theft and vandalism before, during, and after installation.

E. In the event of damage, immediately make all repairs and replacements necessary to the satisfaction of the Owner's Representative, and at no additional cost to the Owner.

1.8 PROJECT AND SITE CONDITIONS

A. Meet with Owner's Representative and Owner's Maintenance/Facilities staff to review scope of work of this contract prior to installing any parts of this system.

1. With Owner's Maintenance/Facilities staff, verify locations of main lines, meters, remote control valves, automatic controllers, and sleeves for wiring and piping.

B. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Owner's Representative's no fewer than three days in advance of proposed interruption of water service.
2. Do not proceed with interruption of water service without written permission of the Owner's Representative.

C. Locate and identify, with visible marking, existing underground utilities in the areas of work. Call Northwest Utility Notification Center (800) 424-5555. If utilities are to remain in place, provide adequate means of protection during excavation operations.

D. Should uncharted piping or other utilities be encountered during excavation, consult the utility owner immediately for directions. Cooperate with the Owner and public and private utility companies in keeping their respective services and facilities in operation. Repair damaged utilities to the satisfaction of the utility owner. The cost of repairing charted utilities shall be paid by the Contractor at no additional cost to the Owner.

E. Protect buildings, equipment, utilities, sidewalks, paving, reference points, monuments, railroad tracks, and markers on the site. Take extreme caution when trenching at adjacent to aggregate base courses, sand-set unit pavers and around existing trees and their root systems. No root cutting is allowed without prior approval. Protect adjacent properties. Protect work by others. Replace or repair damaged items at no cost to the Owner and to the approval of the Owner's Representative.

F. Coordinate with other trades affecting or affected by Work of this Section

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Spray Sprinklers: Equal to two percent of amount installed for each type and size indicated, but no fewer than two nozzle units of each size.
2. Bubblers: Equal to two percent of amount installed for each type indicated, but no fewer than two units.

1.10 MAINTENANCE

A. General: Concurrent with the one-year warranty period for planting and irrigation, the Contractor shall monitor and maintain the new irrigation system in an operational and water–efficient condition. Ensure balanced precipitation rates across zones and plant material types, no excessively wet or dry areas, properly functioning equipment, including, but not limited to, controller, backflow prevention device, valves and heads.

B. Maintenance Schedule: As a minimum level of maintenance, the Contractor shall, in conjunction with the Owner's personnel, perform the following:

1. Start up the system upon Final Acceptance.
2. Between October 15th and 31st of the first year following Final Acceptance, winterize the system by both draining and blowing out lines with compressed air.
3. Between May 1st and May 15th of the following year start-up and test for leakage and coverage. Adjust elevation of any valve boxes or irrigation heads that may have settled or lifted. Observe and correct any settling of trench backfill.
4. Following start-up, make monthly visits to the site to verify on-going proper coverage and sprinkler adjustment.

5. When the time comes for winterization following this first initial full growing season, (1 June through 15 October, inclusive), observe Owner's personnel performing the winterization maintenance procedure. Notify Owner's Representative in writing of this review and of the correctness or deficiencies observed.

C. Owner Inspection

1. Owner's Representative will inspect periodically during the maintenance period. Deficiencies will be noted and reported to the Contractor who will correct all deficiencies to the satisfaction of the Owner's Representative within five (5) working days after notification.
2. Eleven months after the date of Final Acceptance, the Owner's Representative and the landscape architect will make a final warranty walk-through review of the irrigation system. All deficiencies requiring correction will be noted. If the deficiencies are major in scope, it may result in an extension of the warranty period for the affected item after corrections are made.

1.11 WARRANTY

A. Warranty work and materials in writing for one year from the date of Final Acceptance, against defective workmanship and materials. All failures in workmanship or materials will be repaired at no additional cost to the Owner immediately after notification by the Owner's Representative.

B. Contractor shall be responsible for maintaining system and protecting it from all damage until date of Final Acceptance at no additional cost to Owner. This shall include damage caused by vandalism or adverse weather conditions.

1. A written notice of Final Acceptance will be issued by joint agreement of Owner's Representative and the Architect, upon completion or resolution of all Punch List items identified subsequent to Substantial Completion.

1.12 ONE-YEAR CORRECTION PERIOD

A. Repair any settling of backfilled trenches occurring during the one-year correction period at no additional cost to Owner. Include complete restoration of all damaged planting, pavement, and or other improvements.

1.13 SYSTEM COVERAGE

A. Proximate to the building, the system is designed to provide full, overlapping head-to-head coverage, less plant interference, on all planting areas. Layout of sprinklers shall be at 45 percent of published diameter. In areas of persistent wind adjust rotary sprinkler layout to 40 percent of published diameter spacing. It is anticipated that Contractor will exercise professional judgment in adjusting the location, height, slope of sprinkler heads without measurably changing the system design. No changes shall be made in the system design without the prior approval of the Architect. In meadow areas the design intent of the irrigation system is to provide ability to wet down meadow grasses for fire suppression.

1.14 SYSTEM FAMILIARIZATION

A. Upon acceptance of the system by Owner's Representative, Contractor shall provide the necessary keys and other tools necessary to operate, drain, and activate the system. Contractor shall train Owner's maintenance personnel and provide written instructions to ensure that the system operation, maintenance, and winterizing can continue after departure of the Contractor. Contractor will be liable for all damages or losses resulting from failure to comply with the provisions of this Article.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Galvanized-Steel Pipe: ASTM A 53, Standard Weight, Type E, Grade B.

1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53 or ASTM A 106, Schedule 40, Standard Weight, seamless-steel pipe with threaded ends.
2. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
3. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface, and female threaded ends.

B. Hard Copper Tube: ASTM B 88, Type K water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

C. Brass Pipe: ASTM B584 Alloy C84400 Standard Specifications for copper alloy sand casting for general applications.

1. Brass Pipe Nipples: ASTM B-43 seamless red brass pipe with threaded ends.
2. Brass Pipe Fittings: ANSI B-16.15 cast copper alloy threaded fittings.
3. Brass Unions: ANSI B-16.15, Federal Specification WW-U-516 for Type III, Class A and Class B cast copper alloy threaded unions.

D. PVC Pipe, General:

1. Material used in the manufacture of the pipe shall be domestically produced rigid PVC 1120 compound, Type I Grade I, with Cell Classification of 12454 as defined in ASTM D-1784.
2. Pipe shall continuously bear the National Sanitation Foundation seal of approval for potable water usage and comply with the following requirements for product marking ASTM D-2241, D-1785 and D-2665 as applicable. Markings shall include the following: manufacturers name; nominal pipe size; outside diameter system; material designation code; applicable Standard thermoplastic pipe Dimension Ratio designation code (SDR number) or pipe schedule, and corresponding pressure rating in psi for water at 73 degrees Fahrenheit.

3. Belled-end pipe shall have tapered sockets to create an interference-type fit, which meet or exceed the dimensional requirements and the minimum socket length for pressure-type sockets as defined in ASTM D-2672.
4. Pipe sizes 1/2 inch and 1-1/4 inch are not allowed.

E. Mainline PVC Pipe:

1. Main line pipe less than 3 inches in diameter shall be solvent welded Schedule 40 polyvinyl chloride ASTM D 2241 and ASTM D-1784 cell classification 12454-A, B.
2. Mainline piping from tap point to potable water line to be 200 psi rated fused HDPE or rigid metallic piping.
3. Mainline piping and fittings in irrigation point of connection assembly to be either Schedule 80 PVC, brass, or bronze.

F. PVC Lateral Line, Pressure Rated Pipe: ASTM D 2241, Schedule 40.

G. PVC Nipples and Fittings:

1. PVC Socket Fittings, Schedule 40: ASTM D 2466; and Schedule 80: ASTM D 2467, NSF approved.
2. PVC Pipe Nipples: ASTM D 1785, PVC 1120 compound, Schedule 80.
3. PVC Threaded Fittings, Schedule 80: ASTM D 2464.
4. Fittings for mainline gate valves, manual drain valves, air relief valve and quick couplers shall be threaded Schedule 80 PVC, ASTM D 2464, with Schedule 80 PVC nipples, ASTM D 1785, PVC 1120 compound.
5. All socket fittings for PVC Schedule 40 mainline pipe to be Schedule 80 PVC.
6. All socket fittings for PVC Schedule 40 lateral line pipe to be Schedule 40.
7. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket or threaded ends.

H. Sleeves: PVC pipe under all paving, sized to accommodate required sizes and numbers of pipes and wires, 6-inch minimum diameter, in no case less than twice the diameter of the pipe being sleeved.

1. White Schedule 40 PVC, ASTM D 1785 or Plastic Sewer Pipe ASTM D 3034, SDR-35, PVC conforming to ASTM D-1784, N.S.F. approved pipe.
2. For sleeve runs greater than 20 feet in length, service line polyethylene pipe shall be used.
3. For direct bury of irrigation wiring not co-mingled with irrigation piping use gray Sch. 40 electrical conduit.

2.2 PIPING JOINING MATERIALS

A. Pipe Solvent Cement:

1. PVC Solvent Cement, ASTM D-2564.
2. ‘Weld-On’ IPS 711 cement with P70 purple primer.

B. PVC Primer:

1. ‘Weld-On’ IPS P-70, ASTM F-656, Wet/Dry purple primer.

C. PVC Cleaner:

1. 'Weld-On' IPS C-65, SCAQMD 1168, Low V.O.C.

D. Pre-fabricated Swing Joint Assemblies:

1. Class 315 PVC construction with leak-proof "O-ring" seals. Size to match inlet size of pop-up rotor head or quick coupler. Marlex only for swing joints. Use is acceptable for all flows; lengths as required.

2.3 METER

A. Conform to City of Corvallis Public Utilities for standard installation product and installation details. Reference Civil specifications.

2.4 GENERAL-DUTY MANUAL VALVES

A. Isolation Gate Valve: 2.5 inch and smaller diameter shall be bronze (ASTM B-62) valve with bronze solid wedge, integral taper seats with a non-rising stem. All valves larger than 2.5 inch-diameter shall be threaded iron body, brass trimmed, resilient wedge, integral taper seats with non-rising stem, and square operating nut. Size same as pipe on which it is installed. Regardless of pipe size, first gate valve downstream of tap on potable water line shall be AWWA C509 with resilient wedge and 2-inch operating nut.

B. Drain Valves (Mainline Drain Valves): Bronze, angle-pattern, globe valve with screw-in bonnet, integral seat, 200 PSI CWP rating, conforming to MSS SP-80: 'Nibco' T-311-Y or equal, 1 inch minimum.

2.5 SPECIALTY VALVES

A. Quick Coupling Valve: New quick coupling valves are no longer allowed.

B. Hose Bib Valve: 3/4" inverted garden valve, heavy duty w/ floating seat, loose key. Nibco, Champion, or preapproved equal.

C. Remote Control Valves: Rain Bird PEB PRS-D Series. Globe type 200 psi rated. Size so that the midpoint of the valve flow range approximates the zone GPM. Size so that pressure loss through the valve is between 3 and 7 psi. For sprinkler zones, use pressure regulating units. Sizes as scheduled on Drawings.

D. Shut-Off Valves at Control Valves: USA manufacture, unionized angle-globe type sized to match mainline. 120 PSI cold water rated, construction to be brass or bronze with bronze cross type handle: Nibco, Champion or pre-approved equal.

E. Master Valve: Bermad 710 Series, normally open and flanged at both ends, globe configuration, or pre-approved equal, mainline size.

F. Backflow Preventer Assembly: Double-check valve assemblies: Febco 805, or equal. Size to be 2".

G. Pipe Supports for Master Valve and Backflow Preventer: Standon Pipe Support, size as required.

H. Water Hammer Arrestor: ASSE 1010 or PDI WH 201, with bellows or piston-type pressurized cushioning chamber and in sizes complying with PDI WH 201, Sizes A to F. Watts Series 15M2, or approved equal. Install below grade in polymer concrete vault.

I. In-Line Check Valves: Schedule 40 PVC spring check valve capable of being opened under normal operating pressure and with sufficient closing force to hold back the column of water in the pipes. Line size. 'KBI' or approved equal.

J. Pressure Reducing Valve (PRV): Basis of Design: Wilkens 500XL or approved equal. 2-inch size. Not required if static pressure gauges at 80 psi or less.

K. Ball Valves: Conbraco (Apollo) threaded, two-piece, standard port, bronze ball valve, 600-CWP.

2.6 VALVE BOXES

A. Valve Boxes and Vaults: HDPE plastic boxes (black), 'Carson Brooks', 'Armor' or equal, with locking top and 6-inch extensions to facilitate required depth of installation where applicable. Size box to encompass all valves and unions. Box assembly shall be deep enough to fully house valve assembly without components being buried. Box lid must close with minimum 1-inch clearance over shut-off valve stem in open position. Size to allow room for testing, manual operation, calibration, removal, maintenance of equipment, and 1-2 inches of clearance between piping, valves and valve boxes and 3-4 inches of clearance between valve bodies and drain rock. Lids shall be Green T-Top lids in lawns and Brown Mulch T-Top lids in plant beds unless otherwise noted. No more than one valve per valve box.

1. Valve boxes shall be located in planting areas to the greatest extent possible. Set and align boxes square to pavement or nearest hardscape area. Position so that a minimum of 30 inches of planting area is between valve boxes and hardscape.
2. Valve boxes in planting areas to be Rain Bird, Oldcastle (Ametek), Carson or pre-approved equal.
3. Valve boxes in pavement areas: Traffic rated, mark all lids with permanent "Irrigation" label. Brook's, Christy's, Oldcastle Precast or other pre-approved equal.

B. Set on compacted subgrade with masonry units under each corner and seal openings with filter fabric affixed to outside of valve box. Provide extensions as required. Sizes/model numbers as follows:

1. All automatic valves sized between 1 inch and 2 inches shall be installed in Carson or Rain Bird valve boxes, 11 inches by 17 inches.
2. All automatic valves sized larger than 2 inches shall be installed in Carson Jumbo valve boxes, 14 inches by 21 inches.
3. Isolation valves shall be installed in standard boxes.
4. Quick couplers shall be installed in 10-inch round Carson valve boxes.
5. Drain valves shall be installed in 5-1/4 inches round adjustable valve boxes.

6. Backflow Devices shall be installed in a 30-inch x 36-inch x 32-inch deep polymer concrete vault. Vault shall be bottomless with a minimum of 6 inches of 5/8" minus washed drain rock in the bottom for drainage.
7. Grounding rods shall be installed in 8-inch round valve boxes with black covers.
8. Flow meters shall be installed in standard valve boxes.
9. Filter assembly units shall be installed in jumbo valve boxes.
10. Pull boxes and splice boxes shall be standard boxes with green or brown lids depending on location..

C. Polymer Concrete Vaults: Fiber-reinforced composite vault for combination air and pressure relief valve, and water hammer arrestor: vault with single extension to provide required depth of installation. Provide 6 inches minimum clearance on all sides of equipment housed within, Utility Vault Company Model 2424, or approved equal.

1. For multiple automatic control valves in manifold configuration, use only a concrete vault with hinged metal lid.

D. Vaults: Concrete Vault with locking doors. Top to be natural concrete color. Vault shall be of sufficient size to allow for 6-inch minimum clearance on all sides of devices enclosed within.

E. Valve Box and Vault Accessories:

1. Drain Rock: 5/8 inch to l/4 inch clean and washed pea gravel, no fines.
2. Filter Fabric: Woven or non-woven geotextile for use in separating drain rock from subgrade in valve box and vault installations while providing adequate drainage.
3. Brick or Concrete Block Supports: (2)-4-inch by 8-inch by 4-inch bricks or (1) 8-inch by 8-inch by 4-inch concrete paver at each corner of valve box.
4. Pipe Supports for Master Valve and Backflow Preventer: Standon Pipe Support, size as required.

2.7 SWING JOINTS

A. 1/2-inch inlet sprinklers: Hunter SJ-512 with one additional 1/2-inch Marlex street ell at both top and bottom of assembly or approved equal assembly.

B. 3/4-inch inlet sprinklers: For nozzles with flows equal to or less than 6 GPM, use Hunter SJ-712 with additional top and bottom 3/4-inch Marlex street ells. For nozzle flows exceeding 6 GPM and/or systems with less than 50psi operating pressure, use Lasco 3/4-inch Four-Elbow Swivel Joints, T7-412, with additional 3/4-inch Marlex street ells on the inlet and outlet, or approved equal assembly.

C. 1-inch inlet sprinklers: Lasco 1-inch Four Elbow Swivel Joints, T9-412, with additional 1-inch Marlex street ells on the inlet and outlet, or Lasco G132-212, or approved substitution, with additional top and bottom 1-inch Marlex street ells or approved equal assembly.

D. Quick Couplers: Dura 1-A4-1-11-18 swing joint with DL-010 quick lock, approved equal substitution.

2.8 TRANSITION FITTINGS

A. General Requirements: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

B. Transition Couplings:

1. AWWA C219, metal sleeve-type coupling for underground pressure piping.

C. Plastic-to-Metal Transition Fittings:

1. Manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-socket or threaded end.

D. Plastic-to-Metal Transition Unions:

1. MSS SP-107, PVC four-part union. Include one brass threaded end, one solvent-cement-joint or threaded plastic end, rubber O-ring, and union nut.

E. Polyethylene to PVC Transition Fittings:

1. Con-Stab ID Seal® Fittings for PE to PVC transitions, line size.

2.9 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:

1. Description: Factory-fabricated union, NPS 2 and smaller.
   a. Pressure Rating: 150 psig minimum at 180° F.
   b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded ferrous.

C. Dielectric Couplings:

1. Description: Galvanized-steel coupling.
   a. Pressure Rating: 300 psig at 225°F.
   b. End Connections: Female threaded.
   c. Lining: Inert and noncorrosive, thermoplastic lining.

D. Dielectric Nipples:

1. Description: Electroplated steel nipple complying with ASTM F1545.
   a. Pressure Rating: 300 psig at 225°F.
   b. End Connections: Male threaded or grooved.
   c. Lining: Inert and noncorrosive, propylene.

2.10 MISCELLANEOUS PIPING SPECIALTIES

A. Pressure Gauges: ASME B40.1. Include 4-1/2-inch diameter dial, dial range of two times system operating pressure, and bottom outlet.

2.11 WYE STRAINER

A. For POC assembly: 2" size, Wye-pattern, Lead-Free Bronze ASTM B584, with strainer rated to 300 psi WOG @ 150°F minimum. The strainer must have retainer cap tapped for closure plug. Watts LF777S, Mueller 352M, Wilkins-Zurn SXL, or approved equal.

2.12 SPRINKLERS

A. Rotors: Hunter I-20, 4” pop-up.

B. Spray Heads: Rain Bird 1806-SAM-PRS, 6” pop-up.

C. Tree Bubblers: Rain Bird 1400 on fixed riser with Rain Bird P-85 shrub adapter.

2.13 CONTROL SYSTEM AND CONTROLLER

A. Control System: Connection to the existing campus system is anticipated. New controller will be required. Connect via onboard communication gear and new Ethernet infrastructure to the existing campus central control system.

1. Controller to be Maxicom® compatible.
2. Basis of Design: Rain Bird ESP-12LXMEF, 12-station controller with Flow Smart Module.
    a. Supplemental station modules shall be included as required to provide each control valve a single wire connection to the controller. Module to be ESPLXMSM’x’ where x may be 4, 8, or 12 depending on requirements to provide a complete and operational system.

B. Electrical Control Wire and Accessories:

1. Provide according to manufacturer's wire schedule for valve specifications. 14 gauge minimum. Type AWG-UF, bearing U.S. approval. Spare set of control wires to be run to each valve. Colors: Red (control valve), white (common), yellow (spare common), black (spare control),and blue (tracer).
    a. Use red and black jacket for flow sensor wire.
    b. Use orange control and white common for master valve.

C. Communication Wire:

1. Maxicom® Communication Wire: 19 AWG CATS min., PE 89 cable, 6 pair, or approved equal.
2. Communication cable (for flow sensor): Rain Master EV-CAB-SEN 2-conductor direct burial shielded copper wire, Houston Wire D1501802 or approved substitution (direct bury, shielded, 2 18-gauge copper wires with drain wire).

D. Communication Cable Splice and Cap: UR-2 butt splice kit 034005 or approved equal.

1. Splice is only allowed at the termination to connect to the flow sensor.

E. Electrical Conduit and Fittings: High-impact Schedule 80 PVC C-2000 compound, UL approved, gray color, size as required. Solvent-weld fittings.

1. All fittings and pipe shall be installed per all applicable electrical code and per Electrical Division 26 00 00. All electrical conduit needs to be hard pipe, no flex pipe.

F. Wire Connections:

1. Zone Control Wires: 3M Brand, DBY, Direct Bury Splice Kit or approved equal.
2. Communication Wires: UR-2 butt splice kit 034005 or pre-approved equal.
3. Splice is only allowed at the termination to connect to the flow sensor

G. Grounding:

1. Grounding rods shall be bare copper of 5/8" diameter or greater and a minimum of 8-feet in length. Install one copper grounding rod per irrigation controller. The top of each copper ground rod should be installed inside of a 10-inch round valve box. If a pedestal is being mounted, the ground rod may be installed through the pedestal base. The ground rod should be installed as close as practical to the controller.
2. All connections to grounding rods shall consist of either a Cadweld™ type clamp or screw clamp connection.
3. Connect a #6 AWG solid copper wire from ground lug on the controller motherboard to the copper ground rod.
4. Wire connections to grounding rods shall be bare copper and shall not have any sharp bends or kinks.

H. Ethernet Communication Connection: Shall be CATS 6 cable terminating outside of the irrigation controller enclosure. 1" direct bury Sch. 80 electrical conduit with sweep up to free-standing, Unistrut or similar supported, 6x6x6 NEMA 3R junction box with solid faceplate and drip shield top.

1. NEMA 3R junction box, UL listed, 6x6x6 inch size, fabricated of 16-gauge steel, gray polyester powdercoat after fabrication, and integral hasp for padlocking.

I. Pull Rope for Conduit: 1/4-inch diameter, 12-strand, 1200-lb. tensile strength braided polypropylene rope.

J. Trace Wire: Provide dedicated 14-gauge, insulated (blue color), solid copper trace wire for each lateral with serviceable end in respective valve box.

1. Protect trace wire by placing pressure treated 2x4’s above trace wire during backfilling.

K. Flow Sensors: Flow sensor size shall be Rain Bird 4” tee type sensor (FSxxxP), model M80104 or pre-approved equal. Flow sensor size shall be based upon capturing the flow in a range covering the lowest flow zone to the simultaneous operation of the highest flow zone (GPM) at full working pressure and a single quick coupler at 20 GPM.

L. Electrical Zone Control Wire and Accessories:

1. Insulated, single-strand copper, UL approved for direct burial, AWG-UF type (underground feeder) with no exceptions. Sized per manufacturer's recommendations, No. 14 gauge designated for 20 to 50 volts.
   a. Use red jacket for positive solenoid control valve connection wire.
   b. Use white jacket for dedicated master valve common wire.
   c. Use yellow jacket wire for spare common.
   d. Use black jacket for spare control wire.
   e. Use blue jacket wire for tracer wire.

2. Control Wire Connectors: 3M-DBY and DBR connectors or equal.
3. Communication cable (for flow sensor): Rain Master EV-CAB-SEN 2-conductor direct burial shielded copper wire, Houston Wire D1501802 or approved substitution (direct bury, shielded, 2 18-gauge copper wires with drain wire).
4. Communication Cable Splice and Cap: Preformed Line Products “Super Serviseal” closure with Poly-Bee sealant. Model No. 8006039 or approved equal.
5. Electrical Conduit and Fittings: High-impact Schedule 80 PVC C-2000 compound, UL approved, gray color, size as required. Solvent-weld fittings.

M. Grounding:

1. Grounding rods shall be bare copper of 5/8" diameter or greater and a minimum of 8-feet in length. Install one copper grounding rod per irrigation controller. The top of each copper ground rod should be installed inside of a 10-inch round valve box. If a pedestal is being mounted, the ground rod may be installed through the pedestal base. The ground rod should be installed as close as practical to the controller.
2. All connections to grounding rods shall consist of either a Cadweld™ type clamp or screw clamp connection.
3. Connect a #6 AWG solid copper wire from ground lug on the CS3000 Motherboard to the copper ground rod.
4. Wire connections to grounding rods shall be bare copper and shall not have any sharp bends or kinks.

N. Ethernet Communication Connection: Shall be CATS 6 cable terminating outside of the irrigation controller enclosure. 1" direct bury Sch. 80 electrical conduit with sweep up to free-standing, Unistrut or similar supported, 6x6x6 NEMA 3R junction box with solid faceplate and drip shield top.

1. NEMA 3R junction box, UL listed, 6x6x6 inch size, fabricated of 16-gauge steel, gray polyester powdercoat after fabrication, and integral hasp for padlocking.

O. Pull Rope for Conduit: 1/4-inch diameter, 12-strand, 1200-lb. tensile strength braided polypropylene rope.

P. Trace Wire: Provide dedicated 14-gauge, insulated (blue color), solid copper trace wire for each lateral with serviceable end in respective valve box.

Q. Controller Cabinet: Cabinet shall be Stainless NEMA Type 3 rated UL listed 24-inch x 36-inch x 12-inch: Strong Box SB24SS or approved equal.

1. Shall include 12-inch pedestal: Strong box PED-24SS or approved equal.
2. Wall mounted cabinet must be pre-approved by responsible OSU Landscape Manager.

2.14 OTHER MATERIALS

A. Identification Markers:

1. Detectable Warning Tape: Minimum 3-inch wide, 5 mils thick inert plastic tape with continuous layer of aluminum foil encased in the plastic. Tape identification shall match the utility being marked on all mainline. 'Terra Tape' Detectable, or equal.
2. Valve Identification Tags: Polyurethane tag with integral attachment neck and reinforced attachment hole. Tag shall be hot stamped alphanumeric lettering 1-1/8 inches in height. Christy (T. Christy Enterprises), or equal.
3. Control Wire Numbering Labels: Self-adhesive alpha-numeric labels; 3M or equal.

B. Protective Concrete Sprinkler Blocks: Christy Concrete Products, Inc., Model M30SBA, or equal.

C. Drainage Backfill: Washed and cleaned gravel or crushed stone, graded from 3/8 inch minimum to 1 inch maximum.

D. Bedding Sand: Class C Backfill (clean sand with no particle size larger than 1/4 inch) or No. 10 – 0 sand drainage blanket material conforming to ODOT Standard Specifications.

E. Concrete for Thrust Blocking: All concrete for thrust blocks shall achieve minimum strength of 3000 psi at 28 days. Use for 2-1/2 inch and up mainline piping.

F. All other materials not specifically described but required for a complete and proper irrigation system installation shall be new, first quality of their respective kinds, and subject to approval.

PART 3 - EXECUTION

3.1 GENERAL

A. Prior to all work of this section, carefully examine the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

B. Verify that irrigation system may be installed in strict accordance with all pertinent codes and regulations, the original design, the referenced standards, and the manufacturer's recommendations.

C. In the event of any discovered discrepancy, immediately notify the Owner's Representative. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved. Start of work denotes acceptance.

D. Install materials and equipment in strict accordance with manufacturer's written specifications and recommendations and all applicable codes.

E. Mockup review and approval: Each component assembly shall be mocked up initially as a functional and operating component of the system, in place and ready for inspection by the Owner's Representative, the irrigation designer and the resident engineer prior to the subsequent construction of additional same assemblies. The intent of the mockups to identify issues of interpretation and incorrect installations before they proliferate to minimize rework. Approved mockups may become incorporated into the work of this Section.

F. Provide continuous protection to keep rock, dirt, gravel, debris, and all other foreign materials from entering piping, valves, and other irrigation equipment.

G. In areas where contaminated soil is being removed uniformly to a depth of 12-inches, the burial depth of lateral lines may be reduced from 18-inches so that the laterals can be placed directly on the polypropylene construction fence mediation layer.

3.2 LAYOUT

A. Make all necessary measurements in the field to ensure precise fit of items in accordance with the original design.

B. Layout to follow as closely as practicable the design and control valve zoning as shown on the Drawings. Stake out locations of all proposed equipment with surveying paint for acceptance by Owner’s Representative, prior to trenching.

C. Full and complete coverage, including head-to-head coverage for sprinkler zones, without overthrow onto roadways, sidewalks or buildings is required unless otherwise shown on the Drawings or as accepted by Owner’s Representative.

D. Systems shall meet minimum optimal operating pressure at last head in each zone as shown on drawings. Notify Owner’s Representative immediately if any modification of piping layout or sizing will be required to accomplish this. Do not proceed until layout has been verified in the field with the Owner’s Representative.

E. Follow pipe layout plan making modifications as necessary to avoid trenching through roots of existing trees or other obstructions. Take care in protecting all existing tree root zones. Coordinate mainline and lateral piping with tree placement. Maintain a minimum of eight feet (8') of clearance between mainline piping and new or existing trees and a minimum of five feet (5') of clearance between lateral piping and new or existing trees. Provide greater clearance wherever practicable. Where circumstance does not allow for specified clearance, provide alternative mainline routing or provide as much clearance as possible. Specifically note these locations on record drawings.

F. Preferred location for valve boxes is in planting beds. If planting bed location is not possible the lawn areas would be considered as a second but less preferable option. Valve boxes shall be a minimum of 30” from nearest hardscape. Boxes shall be aligned orthogonally to edges of hardscape. See details for lid elevations. Mainline shall be run 24 inches from the edge of paving, or in lawn areas 24 inches from the edge of any adjacent planting bed. On sloping ground, the cover of the valve box shall be placed so that it is parallel to the ground surface rather than level.

3.3 WATER SOURCE

A. Connect system as indicated on Drawings. Arrange with the Owner for water shut-off, if necessary.

3.4 CONNECTION SEQUENCE

A. From upstream to downstream the connection sequence shall be as follows:

1. Tee connection to water service line.
2. Rigid metallic-brass or bronze-piping connection between tap and gate valve 1.
3. Gate valve 1 – Install within 5-feet of service line connection: AWWA, ductile iron epoxy coated, 250 psi minimum, with integral tapered seal, non-rising stem, 2-inch square operating nut, flanged. House valve in a cast iron frame and lid. Horizontal incoming and outgoing pipe at gate valve to have 2-3 feet of soil cover to finish grade on route to irrigation POC. Gate valve assembly to have upstream and downstream unions.
4. A minimum of 3-feet rigid metallic-brass or bronze-piping downstream from gate valve 1.
5. Wye strainer with upstream and downstream unions.
6. City of Corvallis compliant sewer submeter, flanged, with 100W ERT H2R mode (leak sensor) and factory potted cable.
7. DCVA backflow preventer.
8. Pressure reducing valve (if required) with downstream union (upstream union integral).
9. Master valve with upstream and downstream unions.
10. Flow sensor.
11. Quick coupler valve 1 (to allow for 'winter water' without activating entire system).
12. Drain valve.
13. Gate valve 2 – Nibco T-113 BHW, with bronze hand wheel. Provide assembly with upstream and downstream bronze or Sch. 80 unions in valve box sized to allow full serviceability and removal of gate valve. (Gate valve 2 used for winterization; when closed, inhibits backpressure to POC appurtenances when compressed air is introduced into system via quick coupler valve number 2.)
14. Quick coupler valve 2
15. Gate valves 3, 4, etc. if mainline tees into separate legs. One gate valve for each leg.

B. All gate valves to be housed in accessible enclosures.

C. All other appurtenances shall be housed in dedicated enclosures to allow full serviceability.

D. Install wye strainer perpendicular to piping, skew to one side of pipe and pitch strainer for optimal access and serviceability.

E. Provide one-foot (1') minimum clearance between each enclosure, or more as needed to provide sufficient soil support for spans with heavy appurtenances such as meter and backflow assembly.

F. Provide supports inside valve boxes as needed to support heavy appurtenances and long spans.

G. Do not use Sch. 40 PVC in the POC assembly sequence.

3.5 EARTHWORK AND TRENCHING

A. Excavating, trenching, and backfilling are specified in Division 31 Section 31 00 00 "Earthwork." Trenches shall be straight.

B. Locate existing utilities. Trench along routes as indicated on Drawings, adjusting as required to avoid existing utilities.

C. Install warning tape directly above pressure mainline piping, 12 inches below finished grades, except 6 inches below subgrade under pavement and slabs.

D. Drain Pockets: Excavate to sizes indicated. Backfill with cleaned gravel or crushed stone, graded from 3/4 to 3 inches to 12 inches below grade. Cover gravel or crushed stone with sheet of asphalt-saturated felt and backfill remainder with excavated material.

E. Provide minimum cover over top of underground piping according to the following:

1. Irrigation Mainline Piping: Provide 18 inches of soil over top of pipe.
2. Circuit (Lateral) Piping: 12 inches soil over top of pipe.
3. Drain Piping: 18 inches soil over pipe.
4. Piping between main and double check valve assembly: 24-inches minimum soil over pipe.
5. Sleeves: 18 inches under paving, 24 inches under roads.

F. Keep trenches free of pipe-damaging rocks and debris.

G. Trenches shall be 6-inches wide minimum. For parallel lines running together, trenches shall be a minimum of 12 inches wide and wide enough to allow all pipes to lie side by side with 6-inch minimum separation between pipes. There shall be no more than two pipes per trench.

H. Backfill:

1. Main Line: Sand bedding per Civil.
2. Laterals: Select on site fill per Civil.

I. Compaction:

1. Landscape areas, either lawns or planting beds: 90% maximum density per Civil.
2. Roads and Walkways: 95% maximum density per Civil.
3. Properly tamp all trenches using equipment designed for the task.
4. Where compaction results cannot be made by sand cone method or nuclear densometer, mound backfill over trench 10% greater than total fill to allow for settling.

J. Safety:

1. Do not begin excavation until arrangements have been made to protect the general public from holes, trenches, parked equipment, etc.
2. Before any excavation is left unattended for any length of time it shall be “safed up” by means of barricades, fences, flagging, warning signs and any other measures necessary to insure public safety.

K. Install warning tape directly above pressure piping, 12 inches below finished grades, except 6 inches below subgrade under pavement and slabs.

3.6 PREPARATION

A. Set stakes to identify locations of proposed irrigation system. Obtain approval of the Owner's Representative before commencing any excavation.

3.7 PIPING INSTALLATION

A. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.

B. Do not use solvent cement on threaded joints. Wrap joints with minimum three wraps of Teflon tape.

C. Ensure that the inside of the pipe remain clean. Pipe ends shall be protected and not left open. Remove all foreign matter and dirt from inside of pipe before lowering into trench.

D. Lay pipe in accordance with standard practices, on solid foundation, uniformly sloped, substantially supported at all locations. Install all pipe in straight runs. Do not install bent piping. Keep pipe markings visible.

E. Install groups of pipes parallel to each other, separated by 2-inches of clean bedding sand, spaced to permit valve servicing.

F. Underground lines shall have a minimum horizontal and vertical clearance of 12 inches from other utility lines. For lines crossing at angles from 45 degrees to 90 degrees with each other, maintain 6-inch vertical clearance. No line shall be installed parallel to and directly over another line.

G. Install fittings for changes in direction and branch connections.

1. For 90-degree turns in mainline pipe, regardless of diameter, install two 45-degree fittings. Plan indication of right angle turns of the mainline are for graphic clarity only, two 45-degree fittings are required to make a 90-degree bend.
2. For non-standard angles and bends, install double fittings to avoid stressing the pipe or fittings.

H. Install unions adjacent to valves and to final connections to other components with NPS 2 or smaller pipe connection.

I. Install flanges adjacent to valves and to final connections to other components with NPS 2-1/2 or larger pipe connection.

J. Lay piping on solid subbase, uniformly sloped without humps or depressions, free of sags and bends.

K. Provide Schedule 80 PVC piping, straight-line with no fittings, upstream and downstream of the flow sensor, 10 pipe diameters minimum upstream and 5 pipe diameters downstream from flow sensor when using PVC tee-mounted flow sensors for exterior points of connection only.

L. Install PVC piping in dry weather when temperature is above 40°F. Allow joints to cure at least 24 hours at temperatures above 40° F before testing. Obtain tight, inseparable joints.

M. Do no solvent welding of pipe when raining or when temperature is below 40°F.

N. No fittings are to be closer than 6 inches apart.

O. Install water regulators with shutoff valve and strainer on inlet and pressure gage on outlet. Install shutoff valve on outlet. Install aboveground or in control-valve boxes.

P. Water Hammer Arresters: Install between connection to building main and circuit valves in control-valve boxes.

Q. Install transition fittings for plastic-to-metal pipe connections according to the following:

1. Underground Piping:
   a. NPS 1-1/2 and Smaller: Plastic-to-metal male adapter transition fittings.
   b. NPS 2 and Larger: AWWA transition couplings.

R. Install dielectric fittings for dissimilar-metal pipe connections according to the following:

1. Underground Piping:
   a. NPS 2 and Smaller: Dielectric coupling or dielectric nipple.
   b. NPS 2-1/2 and Larger: Prohibited except in control-valve box.

2. Piping in Control-Valve Boxes:
   a. NPS 2 and Smaller: Dielectric union.
   b. NPS 2-1/2 to NPS 4: Dielectric flange.

3.8 IRRIGATION SLEEVES

A. Install sleeves made of Schedule 40 PVC pipe and socket fittings, and solvent-cemented joints.

B. Install piping in sleeves under parking lots, roadways, crushed rock paving and sand-bedded pavers, and sidewalks.

1. Install piping sleeves by boring or jacking under existing paving if possible.

C. Install separate sleeves for irrigation lines and control wires under pavement prior to placing pavement materials wherever possible.

D. Extend sleeves beyond pavement edge a minimum of 12 inches. Install sleeves with minimum 24 inches depth of cover to the top of the pipe.

E. If length of required sleeve is greater than the length of the unit of pipe, solvent weld joints. Otherwise, all sleeves shall be of one continuous length of pipe.

F. Tape ends of sleeve closed to keep soil out of the sleeve until irrigation lines and control wire are installed.

G. Permanently attach a single length of 14-gauge trace wire above the entire length of the sleeve.

H. Stake both ends of sleeves with a readily visible stake extending 12 inches above-grade and below-grade to the bottom of the sleeve. Mark the above-grade portion of the stake with the words “Irrig. Sleeve”. Remove stakes after sleeves are recorded on As-Built Drawings and after irrigation lines and control wires are installed and accepted by Owner’s Representative.

3.9 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe and plastic pipe larger than 2-1/2 inches diameter.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. 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. Copper-Tubing Soldered Joints: Apply ASTM B 813 water-flushable flux to tube end unless otherwise indicated. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.

E. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. Follow procedures as outlined in the "Weld-On Guide to Solvent Welding PVC Plastic Pipe & Fittings" http://www.weldon.com/pdf/weldon/WeldOn_SolventWelding_Guide_2013.pdf. For any conflicts between the Guide and specifications, the specifications shall govern.
3. PVC Pressure Piping: Join schedule number, ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Non-Pressure Piping: Join according to ASTM D 2855.

3.10 CONTROL WIRING

A. Install per manufacturer’s instructions with minimum 36-inch expansion loop at each controller.

B. All wire splicing to be made waterproof by using U.L. approved wire connectors and sealant. Follow manufacturer's instructions for installation.

C. All wire splicing shall occur only at the decoder or at the controller.

D. Lay wire in trenches adjacent to mainline or lateral lines for maximum protection. Place wires 18 inches below grade in electrical conduit where there are no pipes in the trench.

E. Bundle and tape wires together at 10-foot intervals.

F. Provide 24 inches expansion loops at least every 100 feet in runs of more than 100 feet in length, at changes in direction along the mainline, and at entrance and exits to all sleeves under paving. Provide 24-inch expansion coils at connection to control valves. Provide expansion loops in neat 1-inch diameter coils.

G. Master Valve Control Wires shall be yellow dedicated common wire for the master valve only, and with a yellow and white wire as a spare.

H. Flow Sensor Cable: Install communication cable from flow sensor to satellite controller as recommended by manufacturer. Provide a minimum of 36 inches of slack communication wiring in the flow sensor valve box and in the base of the controller pedestals and cabinets. Install flow sensor cable inside rigid electrical conduit. Splices between flow sensor and controller pedestal are not allowed.

3.11 LIGHTNING ARRESTORS AND GROUNDING RODS

A. Install lightning arrestors along the two-wire path at intervals no greater than 600 feet. Install in a suitable irrigation box per manufacturer's instructions. Lightning arrestors may be installed in proximity to decoders, with separation per manufacturer's instructions.

B. Install grounding rods at a right angle to the direction of the two-wire path and a minimum of 8-feet away from the two-wire path. Longer grounding rods will require equivalently greater separation. Grounding rods shall be driven into the earth in a vertical or slightly oblique position. The angle of the rod relative to the vertical shall be no more than 30 degrees.

C. Wire extensions connected to lightning arrestors shall use a Cadweld™ type clamp or screw clamp where the bare copper ground wire meets the green grounding wire from the Lightning Arrestor, never use wire nuts of any kind.

3.12 AUTOMATIC CONTROLLER

A. Provide conduits for all wiring entering cabinet and enclosure.

B. Follow manufacturer's instructions for wire hook-ups.

C. Verify organization of zones with the Owner’s Representative. Otherwise, follow the zone numbering as shown on Drawings.

3.13 ETHERNET CONNECTION ENCLOSURE

A. Bring Cat-6 ethernet communication cable to controller in direct bury 1" Sch. 80 electrical conduit. Conduit shall sweep up to free-standing NEMA 3R 6x6x6 junction box as shown in the detail.

B. NEMA 3R 6x6x6 junction shall be free-standing, positioned 6-12 inches away from the narrow side of the controller enclosure and 18-30 inches above finish grade. Connect junction box to controller enclosure with a 1" diameter rigid nipple. Do not directly affix junction box to controller. Coordinate junction box height and core for connecting nipple to avoid equipment inside controller.

C. Support for junction box shall be constructed of prefabricated metal framing components anchored in concrete pad. Firmly attached back plate of junction box to frame and secure Sch. 80 ethernet conduit by clamping to intermediate framing members.

3.14 VALVE INSTALLATION

A. General:

1. Install valve boxes in a neat and uniform pattern per manufacturer's directions, and as shown on the Drawings. If in proximity to pavement, align covers to be parallel to pavement edge. If placed in lawn areas box lids shall be flush with finish grade; if placed in planting beds, perch boxes 1-2" above the finish grade of mulch.
2. Install valve with 2 inches of clearance between top of valve and underside of valve box cover.
3. Install minimum of 1 cubic foot of drain rock in the bottom of all valve boxes.
4. Provide 3-inch clearance minimum between bottom of valve assembly and top of drain rock. Depth of drain rock to be 3" minimum.
5. Wrap and affix filter fabric to the exterior of the valve box to seal cut outs and inhibit soil intrusion.
6. Provide valve box extensions as required.
7. Provide brick supports on compacted subgrade at corners of boxes, and at the mid-points of the long sides of Carson 1730 size valve boxes.
8. Provide Sch. 80 blocked true union ball valve, Spears TU-2000 or approved equal, with integral union on upstream side of remote control valve assemblies. Provide schedule 80 PVC threaded nipples on both sides of the remote-control valve and one schedule 80 PVC union downstream of the valve.
9. Provide schedule 80 PVC threaded nipples and fittings at quick coupler and ball valves.
10. Thoroughly flush supply lines before installing valves.

B. Control Valves: Follow manufacturer's instructions and adjust pressure regulating module to achieve optimum operating pressure for each zone.

C. Drain Valves:

1. Install one drain valve in point of connection assembly downstream of backflow preventer. Position in sequence as indicated on the Drawings and as described in Article 3.04 of this Section.

2. Install manual drain valves at low points along mainline to ensure complete gravity drainage of all mainlines. More drain valves may be required than are shown on approved Shop Drawings. Provide required number of drain valves at no additional cost to the Owner.
3. Install one drain valve in point of connection vault immediately downstream of backflow preventer.
4. Pipe drain valves into approved drainage structures and where feasible connect to storm drainage system. Install drain piping with minimum of 18 inches of cover to top of pipe.
5. Drain Pockets: Where no drainage structures exist, excavate 1/3 cubic yard of soil material at discharge to drain valves. Backfill with drainage backfill to 12 inches below grade. Wrap drainage backfill with drainage fabric and backfill remainder with amended topsoil

D. Quick Coupling Valves: Install quick coupler valves at 100-feet on center intervals along all mainlines, plus one at the point-of-connection, or as indicated on the Drawings. Minimum stub out from mainline to quick coupler valve assembly to be 12" horizontal.

E. Isolation Valves: Install isolation valves along mainline at all points-of-connection, and upstream of all road crossings, and as shown on the Drawings. Install their valve boxes plumb to grade in a neat and uniform pattern as per manufacturer's directions, and as shown on Drawings.

F. Isolation Ball Valves for Pressure Testing: Install 8" diameter PVC pipe section over ball valve. Notch to permit passage of lateral pipe through the frame. Notches shall be deep enough to allow for 1-2 inches of clearance between brick supports under frame and lateral piping.

1. Wrap exterior of frame with filter fabric and affix to inhibit soil intrusion.
2. Place a Carson 910 valve box over the PVC frame, providing 2-3 inches of clearance between the top of the PVC frame and the bottom of the valve box lid.
3. Position box on brick supports, setting lid flush to grade in lawns, and perched 1-2 inches above finish grade of mulch layer in planting beds.

G. Pressure-Reducing Valves: Install in boxes for automatic control valves or above ground between shutoff valves.

3.15 BACKFLOW PREVENTER

A. Install per state and local codes, and as indicated in the Drawings. Install pipe supports as recommended by the manufacturer. Provide di-electric unions to insulate dissimilar metals in backflow assembly.

3.16 FLUSHING

A. Flush lines with water for a minimum of 5 minutes each zone prior to installation of irrigation heads.

B. Cap risers immediately after flushing.

3.17 TRACE WIRE

A. Provide all zones and mainlines with independent dedicated trace wiring.

B. Install a single wire on all piping without looping and doubling back as this nulls the signal when electromagnetically locating.

C. Connect wire segments with waterproof 3M DB series direct bury splices

D. Tape 14-gauge trace wire to top of pipe at 10-foot intervals.

E. Run a 36-inch loop of trace wire into each remote-control valve box for ease of detection. Do not cut and splice trace wires to control valves

3.18 PRESSURE TESTING

A. Notify the Owner's Representative five days before pressure testing.

B. Do not backfill trenches until piping is successfully pressure tested in the presence of Owner's Representative, Landscape Architect and Grounds' Representative.

1. Contractor may also elect to test low voltage wiring prior to backfilling

C. Mainline and lateral lines may be tested at different times to allow isolation of either.

D. Supply certified pressure gauge and force pump during tests.

E. Mainline Pressure Testing:

1. Thoroughly flush piping before pressure testing. Cap all fittings on mainline and fill with water. Install remote control valves and quick coupler valves after flushing and prior to mainline pressure testing. Automatic valves shall have upstream isolation blocked with true union ball valves in the open position, and the auto valves in the hydraulically closed position with flow control open.
2. Test mainlines to control valves at 120 psi for 4 hours. For successful test there shall be 0 psi pressure drop during the 4 hour test period. If pressure loss occurs, inspect the entire system, make water-tight, and retest until no pressure loss occurs for the testing period.
3. Pressure test must show no pressure loss for the specified period and be accepted by the Owner's Representative before backfilling of trenches will be allowed.
4. For quality control purposes the contractor may elect to test sections of mainline and/or sections with auto valve isolation ball valves closed or without quick coupler valves. However, for a comprehensive mainline test to be graded "passing" it is required that all auto valves and quick coupler valves be installed and pressurized as specified.

F. Lateral Line Testing

1. Thoroughly flush piping before testing. Install pre-fabricated swing assemblies with additional inlet and outlet Marlex ells with threaded PVC caps. Cap all fittings on lateral lines downstream of swing assemblies and fill with water.
2. Adjust bleed screws to open remote-control valves to allow a downstream pressure of 80 psi. Use motorized air compressor as needed to achieve pressure.

3. Maintain 80 psi pressure for 15 minutes, with no more than 5 psi pressure drop permissible during the 15-minute test period. Perform all hydraulic testing in the presence of the Owner's Representative.
4. Detect and repair leaks and retest system until acceptance is granted.
5. Thoroughly flush piping before testing and installation of sprinklers with protective sleeves.
6. Multiple zones may be tested at contractor's discretion; however, no more than 5 psi loss will be permissible when testing either single or multiple zones.
    a. To test a sprinkler zone(s) with pressure gauge upstream of auto valve(s), the water supply and pump must be isolated from the zone(s) being tested. At completion of testing, open water supply and go to a sprinkler swing assembly, remove cap or open ball valve to see continuous flow to verify that auto valve(s) was open and zone(s) was under test.
    b. To test an individual sprinkler zone with the pressure gauge located on a swing assembly in the zone being tested, apply pressure via a swing assembly, close the isolation ball valve upstream on the auto valve, purge air from piping, and test. Utilize threaded 1/2" PVC ball valves at all terminations to both purge air from piping, to improve chances for successful testing, and to verify zones are open at completion of testing as in the case of testing multiple zones.

3.19 BACKFILLING

A. Refer to Division 31 Section 31 00 00 "Earthwork" for backfilling.

B. Delay backfilling until piping is pressure tested and accepted.

C. Place clean sand or approved backfill 3 inches below, around and to 4 inches above all irrigation pipe. Fill the rest of the trench with approved material, free of rocks and debris capable of damaging pipe. Compact to adjacent soil density in 6 inches lifts.

D. Stones larger than 1-inch diameter are not allowed in backfill material.

E. Fill mainline with water at approximately 25 psi during backfilling operations.

3.20 SPRINKLER INSTALLATION

A. Install sprinklers after hydrostatic test is completed and approved.

B. Install sprinklers at manufacturer's recommended heights.

C. When installing on slopes, heads should have a placement angle half-way between vertical and perpendicular to the slope. Heads at the toe of a slope should be tilted slightly away from the slope to avoid driving water directly into the face of the slope. Heads just below the top of a slope should be tilted slightly toward the toe of the slope.

D. Install sprinkler heads of types, sizes, and coverage at locations shown on Drawings.

E. Minor changes in head location may be necessary to achieve head to head coverage at no additional cost to Owner. Notify Owner's Representative for approval prior to making any changes. Document all changes on Project Site As-built Drawings as they occur.

F. Provide freedom of movement at all swing and swivel joints.

G. Adjust and set nozzles for optimum performance as shown on Drawings.

H. Locate part-circle sprinklers to maintain a minimum distance of 4 inches from walls or building foundations and 2 inches from other boundaries, walks and pavement edges unless otherwise indicated.

3.21 AUTOMATIC IRRIGATION-CONTROL SYSTEM WIRING

A. Irrigation controller shall not be on a shared circuit.

B. Install control cable in same trench as irrigation piping and at least 2 inches beside piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.

C. Do not splice wiring without written approval of the Owner's Representative.

1. Provide permanent numbered labels on each side of splice connections.

3.22 CONNECTIONS

A. Comply with Uniform Plumbing Code requirements for piping for water supply from exterior water service piping, water meters, protective enclosures, and backflow preventers. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment, valves, and devices to allow service and maintenance.

C. Connect wiring between controllers and automatic control valves.

3.23 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Where there is more than one controller on the Project, install engraved plastic-laminate equipment nameplates and signs on each automatic controller.

1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

B. Install valve identification tags on each automatic control valve per manufacturer's recommendations.

C. Install adhesive control wire numbering labels 3-inches back from connection to terminal circuit board on each control wire to correspond with the valve station number at both ends of the

control wires. Label spare and trace wires. If operating a 2-wire system, no numbering will be required.

D. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tape over underground piping, during backfilling of trenches.

3.24 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Irrigation Coverage Test:

1. The coverage test procedure will be conducted by the Owner’s Representative only if the entire irrigation system is completely automated to include permanent electrical power.
2. Prior to the coverage test, make all required adjustments to the irrigation systems. Test the system to assure that all areas are irrigated completely and uniformly. Change or adjust heads and nozzles as required to provide full coverage, matching precipitation rates and meeting final grades. Do not spray onto pavement or structures.
3. When the sprinkler irrigation system is completed, but prior to planting, perform a coverage test in the presence of the Owner’s Representative to determine if the irrigation coverage for all planting areas is complete and adequate. Notify the Owner’s Representative 48 hours in advance for the irrigation coverage test.
4. Furnish all materials and perform all work required to correct any inadequacies, to the complete satisfaction of the Owner’s Representative. This shall include any changes affecting coverage due to any deviation from plans.
5. Operating sequence for all control valves must match the sequence as shown on the Drawings.
6. Provide a minimum of two working individuals for the duration of each coverage test. Each person provided by the contractor must have a two-way communication device for proper manipulation of the control valve sequencing of the irrigation system during the coverage test procedure. The lead individual must be a representative from the installing contractor’s company. During the irrigation coverage test, bring keys to unlock cabinets and valve boxes. Open all controller cabinets, enclosures, valve boxes which are part of the irrigation system.

7. At the end of the coverage test for any specified area, a Field Observation Report shall be generated by the Owner's Representative. This report shall serve as an Item/Action notification (Punch List) which may require the contractor to make changes and repairs as noted therein.
8. One return site observation shall be provided by the Owner's Representative to determine whether the items listed in the first site observation report have been corrected. After making the corrections noted in the Field Observation Report, notify the Owner's Representative at least 48 hours in advance, and perform another coverage test in the presence of the Owner's Representative for approval.
9. If the items have not been fully corrected or repaired to the complete satisfaction of the Owner's Representative, and as noted in the first Field Observation Report, the contractor must reschedule another field observation and shall bear all financial responsibility to reimburse the Owner for all costs incurred by the Owner's Representative for the failed field observation performed.
10. Any item listed in the Field Observation Report requiring action that is not considered to be a part of the original contract, must immediately be brought to the attention of the Owner. This shall be the responsibility of the contractor and must be done in a manner as to enable the contractor to correct the item prior to the next field observation.
11. Upon completion of each phase of work, the entire system shall be tested and adjusted to meet site specifications.

E. Any irrigation product will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.25 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that electrical wiring installation complies with manufacturer's submittal.

3.26 ADJUSTING

A. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.

B. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than 1/2 inch above, finish grade.

C. Adjust positions of sprinklers which may be obstructed by plant foliage, or work with landscape contractor to reposition blocking plant.

3.27 CLEANUP

A. Remove debris from project site as the work progresses, on a weekly basis at the minimum. Do not allow debris or waste materials to accumulate. Perform a final site cleanup upon completion or sooner, if directed by the Owner's Representative.

3.28 SUBSTANTIAL COMPLETION

A. Thoroughly flush, clean, adjust, and balance the entire irrigation system for complete coverage and efficient operation. Set heads to avoid over-spray on walks. Set up control wires to operate in an organized clockwise pattern. Upon 5 days written notice, demonstrate the entire system to the Owner's Representative, Landscape Architect and Grounds' Representative, proving that all valves and controls are properly operating and that the installed system is workable, clean, and efficient.

B. Contractor to deliver to the Owner the items scheduled for submittal at the time of the final inspection for irrigation.

C. The walk-through of the completed system with the Contractor, Owner's Representative, Landscape Architect, and Grounds' Representative will identify any items requiring correction and enumerate them on a Punch List for purposes of correction or adjustment by the contractor.

D. Contractor shall actively address items in need of correction, modification or adjustment and complete such required work within a period of 10 working days. Upon completion of Punch List items, contractor shall notify Owner's Representative and request review for Finial Acceptance in writing.

3.29 FINAL ACCEPTANCE

A. Owner's Representative, Landscape Architect, and Grounds' Representative will revisit the project with the contractor to review and observe successful completion of the Punch List. If there is concurrence that all Punch List items have been successfully completed, the contractor will be notified of Final Acceptance at the time of walk-through. A written notice of this verbal acceptance will be provided by the Owner's Representative within three working days.

B. If Punch List items remain incomplete or uncorrected, Final Acceptance will be withheld until such completion occurs. If any of the uncorrected or incomplete items are significant enough to require the Owner's Representative or the Landscape Architect to attend an additional walk-through, the time required for this walk-through will be charged to the contractor at consultant's current hourly billing rates, including time for travel.

3.30 ADDITIONAL REQUIREMENTS

A. Provide Owner's Maintenance Personnel with system familiarization and 8 hours minimum of instruction in maintenance and operation of the system in its entirety. Include specific instruction as necessary, for each piece of equipment installed.

B. Repair settling trenches. Include complete restoration of plantings, mulch, grades, pavements, or other improvements.

C. Water Audit: Shall be performed by an Irrigation Association (IA) Certified Landscape Irrigation Auditor, conducted in accordance with the current IA audit standards for all new, as well as existing, irrigated zones shall be completed. An audit report shall be approved by the OSU Landscape Manager or designee.

D. Fall Winterizing Visit: Return to the job site at the beginning of the first winter season to perform a general inspection of the system, test all valves, lines, sprinkler heads, vacuum breakers, repair all leaks and faulty work, check operation of the system, adjust spray patterns for full coverage, drain system, show maintenance staff location of all drain valves and blow out points and restore all areas where trenches have settled.

E. Spring Start-Up Visit: Return in spring after the first winter season for system check and if necessary, restore system for spring and summer operation. Explain system and operation methods to maintenance staff. Restore all areas where trenches have settled.

END OF SECTION 32 84 00

SECTION 32 91 13 - SOIL PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes planting soils specified by composition of the mixes, their production, blending, testing, furnishing, and placement.

B. Furnish labor, material and equipment required for the manufacture, placement and amendment of topsoil for areas to be planted, including the establishment of healthy soils to vigorously support the plant materials as enumerated and detailed. This Section also includes establishment of finish grades as shown on the Drawings and as specified herein.

C. Related Sections:

1. Section 32 93 00 "Plants" for placing planting soil for plantings and for application rates of mycorrhizal inoculum.

1.2 DEFINITIONS AND ACRONYMS

A. AAPFCO: Association of American Plant Food Control Officials.

B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.

C. CEC: Cation exchange capacity.

D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.

E. Deep Ripping: Disturbing the soil below the normal cultivation layer without inversion to break up traffic-induced or naturally occurring compaction layers.

F. Finish Grade: Elevation of finished surface of planting soil. Not the elevation of any added mulch layer.

G. Imported Soil: Soil that is transported to Project site for use. It is to be understood by implication that any imported shall test as suitable for its intended use—as backfill, as subsoil or as planting soil.

H. Infiltration: The movement of water into the soil surface.

I. Layered Soil Assembly: A designed series of planting soils, layered on each other that together produce an environment for healthy and vigorous plant growth.

J. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

K. NAPT: North American Proficiency Testing Program. A Soil Science Society of America program to assist soil-, plant-, and water-testing laboratories through inter-laboratory sample exchanges and statistical evaluation of analytical data.

L. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

M. Percolation: The movement of water within the soil matrix.

N. Planting Soil: Existing on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce an optimal soil mixture for plant growth.

O. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.

P. SSSA: Soil Science Society of America.

Q. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

R. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms. Rocks and gravel do not constitute an appropriate or suitable subsoil.

S. Surface Soil: Soil that is present at the top layer of the existing soil profile, the ‘A’ horizon. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.

T. USCC: United States Composting Council.

1.3 REFERENCES

A. General: Standards listed by reference, including revisions by the issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority.

1. ASTM International, (ASTM).
   a. ASTM C117 – Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.
   b. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
   c. ASTM C602 – Standard Specification for Agricultural Liming Materials.
   d. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft^3).

e. ASTM D1140 – Standard Test Methods for Amount of Material in Soils Finer than No. 200 (75-µm) Sieve.
f. ASTM D5268 – Standard Specification for Topsoil Used for Landscaping Purposes.

2. OSU Construction Standards, Section 32 90 00, Planting.

1.4 PREINSTALLATION MEETING

A. Pre-installation Conference: Conduct conference at Project Site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for application and use.
2. Include test data substantiating that products comply with requirements.
3. Include sieve analyses for aggregate materials.
4. Material Certificates and test reports: For site soil intended for reuse as planting soil, and each type of imported soil and soil amendment and fertilizer before delivery to the site, according to the following:
   a. Manufacturer's qualified testing agency's certified analysis of standard products.
   b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's Statement of Uniform Interpretation and Policy, (SUIP), #25.
   c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

B. Samples: For each bulk-supplied material, 1-quart volume of each in sealed containers labeled with content, source, and date obtained. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of composition, color, and texture.

C. Informational Submittals:

1. Qualification Data: For each testing agency.
2. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.
3. Field Quality Control Reports.

1.6 QUALITY ASSURANCE

A. Testing Laboratory Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed. Laboratories: Subject to compliance with requirements, provide testing by the following:

1. Analytical Laboratories serving northwest Oregon and western Washington:
   a. OSU Central Analytical Laboratory, 3017 Ag Life Sciences Bldg., Corvallis, OR 97331, Tel.: (541) 737-3067.

1) Contact prior to submitting any samples as this laboratory may be significantly slower than commercial laboratories.

b. A & L Western Agricultural Laboratories, 10220 SW Nimbus Ave., Bldg. K-9, Portland, OR 97223, Tel.: 503-968-9225.

c. Kuo Testing Laboratories, Inc., 337 S. First Ave., Othello, WA 99344, Tel.: (800)-328-0112.

d. Western Laboratories, Inc., P.O. Box 1020, Parma, ID 83660, Tel.: 208-722-6564.

e. Or approved equal laboratory currently listed on Oregon State University Extension Service's list of Laboratories Serving the project region.

2. Multiple Laboratories: At Contractor's option, work may be divided among qualified testing laboratories specializing in physical testing, chemical testing, and fertility testing.

3. All testing will be at the expense of the Contractor.

4. If tested products fail to meet the specifications, obtain other sources of material, retest and resubmit until accepted by the Owner's Representative.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction soil analyses on imported soil or on-site excavated soil, if intended for reuse as planting soil.

1. Notify Architect seven days in advance of the dates and times when laboratory samples will be taken from on-site location(s).
   a. General locations from which soil should be taken for testing are identified on the Planting Plan.

2. Timing of soil test on imported soil may be at any time, however the testing date shall be no older than 6 months from the date of anticipated use.

B. Preconstruction Soil Analyses: For each unamended soil type intended for use on the Project, furnish soil analysis and a written report by a qualified testing agency describing and quantifying recommendations for soil-amendments and fertilizers. Perform the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.

1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.8 SOIL-SAMPLING REQUIREMENTS

A. General; Sample Collection and Labeling:

1. Shrub and ground cover planting areas:
   a. Will receive imported topsoil. Soil sample shall be representative of the off-site source.

2. Division of Samples:
   a. Split each sample into two equal parts. Label packages identically. Send one set to the testing agency and the other set to the Owner's Representative for their records.

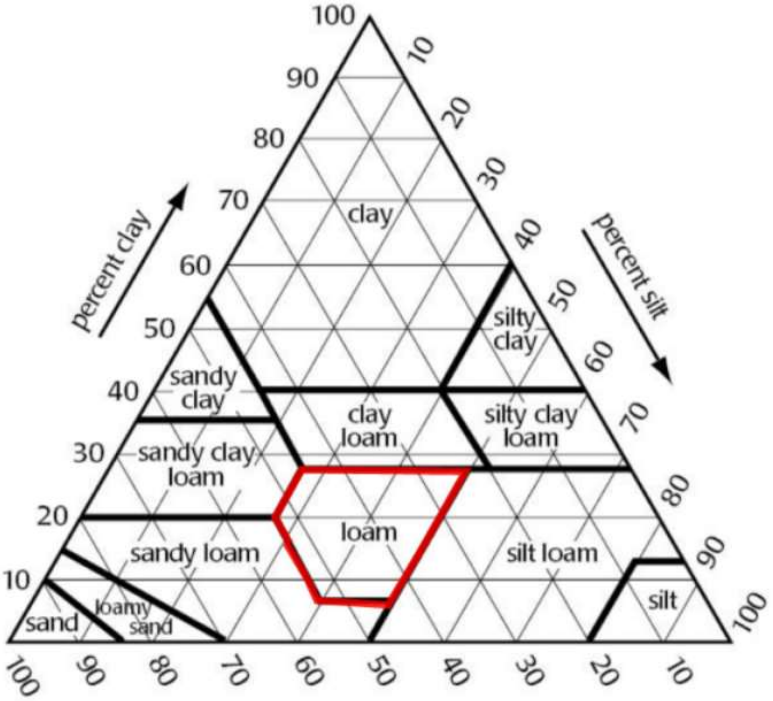
3. Labeling: Label each sample with the date, extraction location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.9 TESTING REQUIREMENTS

A. General: The Contractor shall provide the Owner's Representative a minimum of two soil samples with an accompanying soil test report from samples obtained randomly throughout the source field location or stockpile.

B. Physical Testing:

1. Soil Texture: Soil-particle, size-distribution analysis by the wet sieve method according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":
   a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
   b. Hydrometer Method: Report percentages of sand, silt, and clay.
   c. To be an acceptable imported or manufactured soil product, the component texture percentages (sand, silt and clay) must fall into the texture range of Loam.
   d. Soil products proposed for use which test outside of these texture categories for any of the three components—sand, silt or clay—will be rejected.
   e. Soil classification triangle is provided for reference purposes with suitable component ratios indicated:



2. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
3. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."

4. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis- Part 1-Physical and Mineralogical Methods"; at 85% compaction according to ASTM D698 (Standard Proctor).

C. Chemical Testing:

1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods.
2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1- Physical and Mineralogical Methods.
3. Metals Hazardous to Human Health: Test for presence and quantities of RCRA metals including aluminum, arsenic, barium, copper, cadmium, chromium, cobalt, lead, lithium, and vanadium. If RCRA metals are present, include recommendations for corrective action. Corrective actions may include finding an alternative source of planting soil.
4. Phytotoxicity: Test for plant-available concentrations of phytotoxic minerals including aluminum, arsenic, barium, cadmium, chlorides, chromium, cobalt, copper, lead, lithium, mercury, nickel, selenium, silver, sodium, strontium, tin, titanium, vanadium, and zinc.

D. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of SSSA NAPT WERA-103, including the following:

1. Percentage of organic matter.
2. CEC, calcium percent of CEC, and magnesium percent of CEC.
3. Soil reaction (acidity/alkalinity pH value).
4. Buffered acidity or alkalinity.
5. Nitrogen, parts per million, (ppm).
6. Phosphorous, ppm.
7. Potassium, ppm.
8. Manganese, ppm.
9. Manganese-availability, ppm.
10. Zinc, ppm.
11. Zinc availability, ppm.
12. Copper, ppm.
13. Sodium, ppm and sodium absorption ratio.
14. Soluble-salts, ppm.
15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
16. Other deleterious materials, including their characteristics and content of each.

E. Organic Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."

F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.

1. Fertilizers and Soil Amendment Rates: State recommendations in weight in pounds per 1,000 square feet for 6-inch depth of soil.

2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1,000 square feet for 6-inch depth of soil.

G. Test Age for Imported Soil: If the intention is to provide topsoil from an off-site manufacturing or blending source, the source stockpiles shall have been tested within the past six months. Source tests older than six months will be rejected.

H. Submit test results at least 12 weeks prior to anticipated date of the start of planting inistallation.

1.10 DELIVERY, STORAGE AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Do not move or handle materials when they are wet or frozen.
4. Accompany each delivery of bulk fertilizers, lime and soil amendments with appropriate certificates and load tickets.

PART 2 - PRODUCTS

2.1 IMPORTED TOPSOIL

A. Imported Topsoil: Basis of Design: Imported soil material conforming to ASTM D 5268. Shall be a natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles, conforming to USDA classification for Loam friable, pervious, and black or a darker shade of brown, or gray-brown, than underlying subsoil horizon; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1-inch in diameter in any dimension; free of weeds, roots, and other deleterious materials harmful to plant growth, and with the following physical properties:

1. Organic Matter: 6 percent minimum.
2. Sodium Adsorption Ratio (SAR): less than 6.0.
3. Saturation Extract concentration for Boron: less than 1.0.
4. pH range of from 5.7 to 7.5 (plus 0, minus 0.5).
5. Saturation Extract Conductivity: less than 4.0 dS/m @ 25° C. as determined in a saturation extract.
6. Non-soil components: Less than 1 percent by volume.
7. Heavy metal concentrations: Below the USDA per year load limit.
8. Minimal weed seed.

a. If regenerative noxious weeds (including, but not limited to, quack grass, nutsedge grass, Johnsongrass, poison ivy, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, bromegrass and horsetail) are present in the soil, all resultant growth including roots shall be removed throughout a one-year period following acceptance of planting work at no additional cost to Owner.

2.2 PLANTING SOILS SPECIFIED BY COMPOSITION

A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that shall be revised based on testing laboratory's recommendations after the preconstruction soil analyses are performed.

B. Planting Soil Type A (Trees, Shrubs and Lawn Areas): Manufactured soil consisting of manufacturer's basic sandy loam, loamy sand or loam with a sand constituent of 35% or greater according to USDA textures, blended in a manufacturing facility with stabilized organic soil amendments, and other materials to produce viable planting soil.

1. Additional Properties of Manufacturer's Basic Soil before Amending: Soil reaction of pH 5.6 to 7.0 and minimum of 6 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
2. Unacceptable Properties: Manufactured soil shall not contain the following unacceptable construction by-product materials:
   a. Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
   b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 5 percent by dry weight of the manufactured soil.
   c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand or gravel exceeding 1-1/2 inches in any dimension.

3. Blend manufacturer's basic soil with soil amendments and fertilizers recommended by laboratory test reports.

2.3 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: T, with a minimum of 99 percent passing through a No. 8 sieve and a minimum of 75 percent passing through a No. 60 sieve.
2. Class: O, with a minimum of 95 percent passing through a No. 8 sieve and a minimum of 55 percent passing through a No. 60 sieve.
3. Form: Provide lime in form of ground dolomitic limestone.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Aluminum Sulfate: Commercial grade, unadulterated.

E. Perlite: Horticultural perlite, soil amendment grade

F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve

G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.

1. Physical Characteristics:
   a. Particles size analysis (dry weight basis).

Sieve Designation	Percent Passing
No. 4	100%
No. 10	95%-100%
No. 18	90%-100%
No. 35	65%-100%
No. 60	0%-50%
No. 140	0%-20%
No. 270	0%-5%

   b. Reaction (pH) of the saturated sand extract shall be between 5.5 and 8.0 without high lime content.
   c. As determined from the saturation extract solution:
      1) Salinity (Ece) 0 – 3.0 dS/m
      2) Boron 0 – 1.0 ppm
      3) Sodium 0 – 20 meq/

2.4 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8.0; moisture content 35 to 55 percent by weight; 100 percent passing through 3/4-inch sieve; soluble salt content of 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste
3. Basis of Design Product: McFarlane's CompoStuff®.

B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture, with:

1. 100 percent passing through a 1/2-inch sieve,
2. pH of 3.4 to 4.8,
3. A soluble-salt content measured by electrical conductivity of maximum 5 dS/m.

C. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture.

1. Free of chips, stones, sticks, soil, or toxic materials.

D. Manure: Well-rotted, unleached, stable or cattle manure.

1. Containing not more than 25 percent by volume of straw, sawdust, or other bedding materials.
2. Free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.5 FERTILIZERS

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 1 percent nitrogen and 10 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

E. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release (2-years), commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: 21 or 10-gram tablets.
2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.
3. Acceptable Product: Scotts Agriform fertilizer tablets, or approved equal.

F. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

2.6 MYCORRHIZAL FUNGI

A. Dry, all-purpose, granular inoculant containing at least 9 species of Endo-mycorrhizae and 7 species of Ecto-mycorrhizae; 30,000 Endo- and 140 million Ecto- propagules per pound. Optionally may also include multiple species of beneficial bacteria and slow release 3-1-1 organic fertilizer.

1. Basis of Design product: MycoApply All-Purpose Granular by Mycorrhizal Applications, Grants Pass, OR 97528, Tel.: 866-476-7800.
   a. See Section 32 93 00, “Plants” for application rates.

2.7 DRAIN SAND

A. May also be referred to as sand backfill for drains. Shall consist of coarse washed sand, crushed, processed, or naturally occurring granular material. It shall be double-washed, free of wood waste or other extraneous, objectionable material, including clay and silt. Conform to the following adjusted gradation to minimize fines:

Sieve Size	Percent Passing
1/2"	100%
3/8"	98% – 100%
No. 4"	98% – 100%
No. 8	70% – 100%
No. 16	30% – 78%
No. 30	2% – 15%
No. 50	0% – 4%
No. 100	0% – 1%

PART 3 - EXECUTION

3.1 EXAMINATION AND PERCOLATION TESTING

A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance of soils and plant materials.

1. Verify positive drainage of subgrade conditions unless otherwise indicated. Verify that that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

B. Perform an infiltration test in each of the excavated planting bed areas before any placement of planting soil. Subgrades which do not infiltrate at a rate of 2.0 inches per hour shall be reworked to loosen and blend additional compost with subsoil to enhance drainage. Remediation of compacted subgrades shall include the auguring of drain chimneys in the beds.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Specifically Related to Drainage:

1. Achieving and verifying positive drainage means that the contractor shall make sure, by operation of the irrigation system, flood testing, or other method, that water flowing from

any hardscape surface is intercepted by either a drainage structure, or if not directly intercepted, that the water flowing into or across a softscape or planted area has an unobstructed route to a landscape area drainage structure.

a. Paths which may have compacted base courses, or metal landscape edging will be considered as obstacles to proper surface drainage.
b. In all situations where this occurs, dig a French drain trench on the uphill side of obstruction and install 4" perforated drain tubing sloped to drain and drainage structure. Cover with drain rock and bring drain rock to finish grade. At finish grade exposed rock should be in a band no wider than 6 inches.
c. Slope drain tubing 1.5% to an outlet point or structure uphill of the differentially compacted obstruction.
d. Hard pipe beneath obstruction to a dry well or drain chimney on downhill side.
e. Drain chimney shall be at least 5-feet deep and 12" in diameter and filled with drain rock conforming to ODOT Standard Specification Table 02630-2 for Open-Graded Aggregate. .
f. The surface water flow shall not be dammed, blocked or restricted by placement of topsoil or mulch.
g. Impoundment of water (ponding) will not be acceptable and shall be considered improper and insufficient soil preparation.
h. Grading of topsoil or mulch with a slope which permits erosion or scouring of soil or mulch material will be considered as improper and insufficient soil preparation.

E. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Landscape Architect and replace with new imported planting soil.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by soil preparation.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 PLANTING AREA ESTABLISHMENT

A. Prior to placing topsoil, loosen or scarify subgrade of planting areas to a minimum depth of 6 inches. Remove uncovered stones larger than 1-inch in any dimension and sticks, roots, rubbish, and other extraneous matter which is turned up by the scarification and legally dispose of them off Owner's property.

1. Thoroughly blend planting soil off-site or on-site before placement and spreading, or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend.
   a. Delay mixing fertilizer with planting soil if planting will not proceed within 3-4 days.
   b. If required by soil test analysis, mix lime with dry soil before incorporating fertilizer.

2. Spread planting soil to a depth indicated on drawings but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
    a. Spread approximately one-half the thickness of planting soil over loosened subgrade. Mix thoroughly into top 6 inches of subgrade. Grade out. Spread remainder of planting soil as second lift and finish grade.
    b. Mound planting areas as indicated on the Grading Plan. If no spot elevations are indicated, assume that all planting areas are to be gently built up toward the center point at a 4-5% slope.

B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with a visible loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades. Slope all surfaces for positive drainage. Crisp angle breaks between soil surface planes should only occur if specifically noted on the grading plan as a grade break and/or on the planting plan as a dividing line between plant types.

1. The Owner's Representative shall approve all rough grading prior to the installation of compost, fine grading, planting, and mulching.
2. Grade the finish surface of all planted areas to meet the grades shown on the drawings, allowing the finished grades to remain higher (10–15% of depth of soil modification) than the grades on the grading plan, as defined in paragraph Planting Soil Installation, to anticipate settlement over the first year.
3. Utilize hand equipment, small garden tractors with rakes, or small garden tractors with buckets with teeth for fine grading to keep surface rough without further compaction. Do not use the flat bottom of a loader bucket to fine grade, as it will cause the finished grade to become overly smooth and or slightly compressed.
4. Provide for positive drainage from all areas toward the existing inlets, drainage structures and or the edges of planting beds. Adjust grades as directed to reflect actual constructed field conditions of paving, wall and inlet elevations. Notify the Owner's Representative in the event that conditions make it impossible to achieve positive drainage.
    a. Exception: Depressions or low points created for the detention of stormwater may be specifically created and will be indicated on the Grading Plan.

5. Establish smooth, rounded transitions between slopes of different gradients and direction. Modify the grade so that the finish grade before adding mulch and after settlement is two to three inches below all paving surfaces or as directed by the drawings.
6. Fill all dips and remove any bumps in the overall plane of the slope. The tolerance for dips and bumps in shrub and ground cover planting areas shall be a 2 inch deviation from the plane in 10 feet. The tolerance for dips and bumps in lawn areas shall be a 1 inch deviation from the plane in 10 feet.

C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

D. Application of Mycorrhizal Fungi: At time directed by Architect, broadcast dry product uniformly over prepared soil at application rate specified. Application rates for plants of various sizes are listed in Section 32 93 00, Plants.

1. For restoration planting and as preparation for hydroseeding broadcast at a rate of 40 pounds per acre before or during seeding operation.

2. For application during the installation or aeration of lawn turf, apply at a rate of 1.5 pounds per 1,000 square feet.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:

1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D698. Space tests at no less than one for each 1,000 square feet of in-place soil or part thereof.
2. Soil preparation will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.5 PROTECTION

A. Protection Zone: Identify protection zones according to Section 01 56 39, Temporary Tree and Plant Protection.

B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. In terms of protection, treat soil areas as if plants were already installed.

C. Prohibit the following practices within these areas except as required to perform planting operations:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Vehicle traffic.
4. Foot traffic.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.

D. If planting soil or subgrade is over-compacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Landscape Architect and replace contaminated planting soil with new planting soil.

3.6 CLEANUP

A. During soil preparation, keep adjacent paving and construction clean and work area in an orderly condition. Remove trash and debris in containers from the site no less than once a week.

1. Immediately clean up any spilled or tracked soil, fuel, oil, trash or debris deposited by the Contractor from all surfaces within the project or on public right of ways and neighboring property.

B. Once installation is complete, wash all soil from pavements and other structures. Ensure that mulch is confined to planting beds and that all tags and flagging tape are removed from the site.

1. Make all repairs to grades, ruts, and damage to the work or other work at the site.
2. Remove and dispose of all excess planting soil, subsoil, mulch, packaging, and other material brought to the site by the Contractor,

C. Protect existing plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

3.7 DISPOSAL

A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION 32 91 13

SECTION 32 93 00 - PLANTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Section includes:

1. Plants, including trees, shrubs, groundcovers, ornamental grasses, and perennials.
2. Herbicides.
3. Planting fertilizers.
4. Mulches-organic (bark and compost) and inorganic (crushed basalt).
5. Application of mycorrhizal inoculum.

B. Furnish labor, material and equipment required for the procurement, delivery, placement and care of healthy plant material to promote its establishment and vigorous growth, as detailed.

C. Related Sections:

1. Section 32 80 00, Planting Irrigation for installation of automatic irrigation system.
2. Section 32 94 00, Planting Accessories, for tree stabilization materials, anti-transpirants, and tree watering devices.

1.2 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1

C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.

D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of plant required.

E. Basalt: A common dark-colored volcanic rock. Basis-of-design basalt shall be usually black or dark gray in color and uniformly featureless, being composed of mineral grains which are mostly indistinguishable to the naked eye.

F. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant specified.

G. Finish Grade: Elevation of finished surface of planting soil.

H. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

I. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

J. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

K. Planting Area: Areas to be planted.

L. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

M. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

N. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots. The area of transition between the root system and the stem or trunk.

O. Stem-Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

P. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

Q. Subsoil: All soil beneath the topsoil layer of the soil profile and typified by the lack of organic matter and soil organisms.

1.3 REFERENCE STANDARDS

A. Standards: Comply with botanical names, sizes, and conditions provided in:

1. Botanical Names: American Joint Committee on Horticultural Nomenclature, "Standardized Plant Names."
2. Sizes and Conditions: ANSI Z60.1 "American Standards for Nursery Stock", (latest edition).
3. Trees: “Grades and Standards for Trees” from Division of Plant Industries, Florida Department of Agriculture.
4. Perennials: "Perennial Plant Association Standards."
5. Native Species: Hitchcock, C.L. and A. Cronquist, "Flora of the Pacific Northwest", 1973.

B. Planting Standards: For soil planting depths and required soil volumes for trees, comply with Section 32 90 00 of the Oregon State University Construction Standards.

1. In the event of any conflict between these specifications or drawings and the OSU Construction Standards, the OSU Construction Standards shall prevail. The contractor shall be responsible for all adjustments to material or labor related to compliance with these OSU Construction Standards at no additional cost to the project.

1.4 COORDINATION

A. Provide the following notices to the Owner:

1. In advance of plant material delivery so that plants may be observed upon site delivery: 36 hours.
2. Before time requested for inspection for Substantial Completion: 72 hours. Submit request in writing.

1.5 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of product.
   a. Plant Materials: Include copies of bills of sale, quantities, sizes, quality, and sources for plant materials.
   b. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery. Information may be provided in spreadsheet form. Digital photographs shall be submitted in jpeg format. Multiple photographs of the same plant species shall have a numbered suffix in addition to the botanical name.

2. Samples for Verification: For each of the following:
   a. Plant Material, Trees and Shrubs: Three representative samples of each variety and size delivered to site for review. Maintain approved samples on site as a standard for comparison.
      1) Approved samples may be used in the Work provided they are uniquely tagged and readily identifiable as the approved reference samples.
   b. Organic, Compost Mulch: 1-quart volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each sample shall be typical of the material to be furnished; provide an accurate representation of color, texture, and organic makeup.
   c. Mineral Mulch: 7-8 pounds of each mineral mulch required, in sealed plastic bags labeled with source of mulch. Sample shall be typical of material to be delivered and installed on the site; provide an accurate indication of color, texture, and makeup of the material.

B. Informational Submittals:

1. Qualification Data: For qualified landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
2. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
    a. Manufacturer's certified analysis of standard products.
    b. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
    c. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to the Project.

C. Within 30 days after Contract award, submit:

1. A list of local/regional suppliers for each plant species to be supplied. List to include plant quantities, sizes and root conditions. Certify in writing, confirmed orders for plants in the required quantities, plus allowance for rejected material, by submitting a Bill of Sale for each plant to be supplied. Plants of the various species can be supplied by multiple growers but shall be held at no more than three facilities within fifty miles of the project site.
2. Plant Material Inspection Certificates for all plant material shipped from out of state.

D. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.

E. Closeout Submittals:

1. Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required Establishment Period.
2. Warranty: Sample of special warranty.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of plants.

1. Professional Membership: Installer shall be a member in good standing of the Oregon Landscape Contractors Association, with optional memberships in the Professional Landcare Network or the American Nursery and Landscape Association.
2. Experience: Five years' experience in landscape installation.
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network.
    a. Certified Landscape Technician - Exterior, with specialty area(s), designated CLT-Exterior.
    b. Certified Ornamental Landscape Professional, designated COLP.

B. Plants: Furnish quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

D. Plant Material Observation: Landscape Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Landscape Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Landscape Architect of sources of planting materials ten working days in advance of delivery to site.

E. Plant Material Sourcing: The Landscape Architect has endeavored to complete the design using plants which should be generally available throughout the nursery industry. No unique, proprietary, sole-source, or restrictively grown plants have been specified, although patented plants may be specified. The Landscape Architect expects that the contractor will be able to locate all of the plants in their specified sizes as scheduled on the Drawings. If after a reasonable effort on the part of the contractor, certain species can neither be located nor found in the size specified, the Landscape Architect will endeavor to assist the contractor in their search, or alternatively, revise or modify the planting design to incorporate another species which would be available. To be considered a “reasonable effort” the contractor shall have contacted at least six growers or nursery sources for the plant(s) in question. These contacts shall be documented by date, the name and telephone numbers for the nurseries contacted, the individuals at the various nurseries with whom the contractor spoke, their positions, and alternative plant sizes (if available). This information shall be provided to the Landscape Architect prior to any consideration for size adjustment, plant material substitution, or search assistance. Requests for assistance shall not be submitted incrementally, but rather incorporate all items of the Plant Schedule at one time.

F. Preinstallation Conference: Conduct conference at Project site. Attendees shall include at a minimum the Contractor, the project manager for the Contractor and the Landscape Architect.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver packaged materials in manufacturer’s unopened containers, fully identified by name, brand, type, weight, and analysis.

B. Deliver and store materials to prevent deterioration, damage or intrusion of foreign matter.

C. Deliver trees, shrubs and ground covers after preparations for planting have been completed and the irrigation system is operational. Then plant immediately.

1. Provide freshly dug trees and shrubs.
2. Protect trunks and branches from damage.

3. Protect root systems from drying out.
4. Do not prune prior to delivery.
5. Do not drop balled and burlapped stock during delivery.
6. Handle plants only by the rootballs or containers.
7. Provide shade for plant material if planting is delayed more than 6 hours after delivery to site. Water as required to keep root balls moist.

D. Do not remove container grown stock from containers until planting time.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, drainage conditions, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:

1. Notify Owner's Representative no fewer than three days in advance of proposed interruption of each service or utility.
2. Do not proceed with interruption of services or utilities without Owner's Representative's written permission.

C. Execute work in an orderly and careful manner with due consideration for surrounding areas, plantings or structures which are to remain.

1. Protect adjacent property and improvements from work damage.
2. Repair damage as acceptable to Owner.

D. Excavation: When conditions detrimental to plant growth are encountered, such as adverse drainage conditions, notify Owner and propose remedies before proceeding.

E. Proceed with and complete the landscape work as rapidly as portions of the site become available, working within the seasonal limitations for each type of planting work required.

F. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1. Do not plant on days where:
   a. Temperatures are predicted to exceed 80°F.
   b. Freezing temperatures are expected.
   c. When saturated soils are present (except stormwater basin).
   d. Windy conditions that could damage or desiccate plants and soils; wind speed in excess of 25 miles per hour.

1.9 WARRANTY

A. Remove rejected plant materials immediately from project site and provide satisfactory replacements within 48 hours or other time period mutually agreed upon with Owner's Representative.

B. Remove and replace trees, shrubs and ground cover that die, shown unsatisfactory growth, or are in unhealthy condition. Final replacement decision is at the discretion of the Owner or Owner's Representative.

C. Make repairs and replacements other than plant materials within five days following observation or receipt of Owner's notice.

D. Furnish plant replacements which comply with requirements shown on drawings or specified. A limit of one replacement of each plant will be required.

E. Warrant all materials and workmanship for all causes until Final Acceptance. After Final Acceptance warrant all materials and workmanship for all causes except for defects resulting from neglect, abuse or damage by the Owner, for a period of one year.

F. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following.
   a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.

1.10 MAINTENANCE

A. During period between planting and installation acceptance, provide fertilizer, weeding, spraying, resetting of unstable plants and other maintenance necessary to assure healthy growth. No pruning for shape is to be done by Contractor. Prune only broken or damaged branches.

B. Maintain trees, shrubs and other plants by:

1. Weekly clean-up and weeding.
2. Cultivating.
3. Tighten and repair stakes or guy supports. Reset trees, shrubs and groundcover to proper grades or vertical position as required.
4. Spray as required to keep plant material free of insects and disease.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root

pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots will be rejected.
2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on Drawings.

E. Formal Arrangement: If formal arrangements or consecutive order of plants is shown on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

2.2 FERTILIZERS

A. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: 21-gram or 10-gram tablets.
2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.
3. Application Rates:
   a. 1 - 10-gram tablet per 1 gallon plant.
   b. 2 - 10 gram tablets per 2-3 gallon container.
   c. 2 - 21-gram tablets or 4 10-gram tablets per 5 gallon container.
   d. 4 - 21-gram tablets per 15 gallon container or balled stock equivalent.
   e. 6 - 21-gram tablets per 24 inch box or balled stock equivalent.

2.3 MULCHES

A. Organic Mulch: Free from weed seeds and deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Acceptable Products:

a. McFarlane's Compo-Stuff.
b. Or equal.

B. Mineral Mulch:

1. Type: Basalt.
2. Size and Condition: 3/4”-2” fractured all sides.
3. Color: Charcoal to black.
4. Basis of Design Source: Knife River Watters Quarry, St. Helens, OR.
5. Or equal.

2.4 MYCORRHIZAL FUNGI

A. Mycorrhizal Inoculum:

1. MycoApply All Purpose Granular as produced by Mycorrhizal Applications, Grants Pass, Oregon, Tel.: (866) 476-7800, www.mycorrhizae.com.
2. Or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Landscape Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.

D. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

3.3 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at an angle of 45-60 degrees. Excavations with vertical sides are not acceptable. The excavated soil shall surround a central pedestal of existing soil supporting the root ball. Surrounding excavation of tree pits shall be to a depth of 36". Trim perimeter of bottom leaving center area of bottom raised to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.

1. Excavate approximately three times as wide as ball diameter or 36" minimum, whichever is greater, for balled and burlapped, and container-grown stock.
2. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball at central supporting soil column.
4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
5. Maintain required angles of repose of adjacent materials as shown on the drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
6. Maintain supervision of excavations during working hours.
7. Keep excavations covered or otherwise protected after working hours.

B. Subsoil and topsoil removed from excavations may not be used as planting soil.

C. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

D. Drainage: Notify Landscape Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

3.4 INSTALLATION

A. Planting Trees: Set so trunk is plumb.

1. Place with top of ball at 1 inch to 2 inches above adjacent finished landscape grades.
2. Remove burlap, wire baskets and twine from sides of balls; retain on bottoms.
3. When plants are set, place additional soil mix around base and sides of ball and work each layer to settle soil mix and eliminate voids and air pockets.
4. When excavation is approximately half full, water thoroughly before placing remainder of backfill.
5. Apply mycorrhizal inoculum at the following rates. Sprinkle close to roots.

Plant or Container Size	Application per Planting Hole
24" Box or equivalent fabric bag	6 Tablespoons
1-inch caliper	3-5 Tablespoons
2-inch caliper	4-6 Tablespoons
Larger plants	2-3 Tablespoons per additional caliper inch after the first 3-5 Tablespoons

a. Use the higher application range for stressed environments.

b. For calculation purposes there are approximately 2.5 Tablespoons per ounce and 41 Tablespoons per pound.

6. Thoroughly water each plant again after placing final layer of backfill.
7. Stake as shown on drawings immediately after planting only if soil depth permits.

B. Shrub and Groundcover Planting:

1. Space plants as shown on drawings or as specified.
2. Dig holes within planting beds large enough to allow for spreading of roots.
3. Apply mycorrhizal inoculum at a rate of 2 level teaspoons per "gallon" unit of planting size container, e.g. a #2 container plant would get 4 teaspoons of inoculum, a #3 container plant gets 6 teaspoons. Sprinkle close to roots.

Plant or Container Size	Application per Planting Hole
4-inch (SP4)	1 teaspoon
1-gallon (#1)	2 teaspoons
2-gallon (#2)	4 teaspoons
3-gallon (#3)	1 1/2 Tablespoons
5-gallon (#5)	2-3 Tablespoons
15-gallon (#15)	4-6 Tablespoons

4. Backfill with prepared topsoil free of subsoil or sand.
5. Complete planting by working soil around roots to eliminate air pockets and firm hand taking care not to cover stem flare or root crowns.
6. Water thoroughly after planting.

C. Tree Staking on Grade: As shown on drawing and as specified:

1. Drive stake plum outside root ball and 3-feet deep to furnish necessary support.
2. Secure with tree ties.

3.5 ADJUSTING

A. Remove and replace excessively pruned or stock misshaped as a result of improper pruning.

3.6 CLEANING

A. Keep project site reasonably free from safety hazards, accumulation of debris, soil and other materials.

1. Clean up equipment, excess materials and debris from project site upon work completion of each area of work or sooner, if directed.
2. Leave project site in neat and tidy condition on a daily basis.

B. Remove soil and amendment mixes from walks and paving on a daily basis.

C. Broom and hose down areas daily as necessary to maintain clean pavement.

3.7 ACCEPTANCE OF WORK

A. When inspected landscape work does not comply with drawing or specification requirements replace rejected work and continue specified maintenance until subsequent observance by Landscape Architect and work is found to be acceptable.

B. Upon completion of landscape work, the Owner will inspect the site to determine if Installation Acceptance has been reached.

C. Materials not meeting quality conditions, size or other requirements of these specifications will be rejected and shall be immediately removed from the site.

D. After 90 days, or later following Installation Acceptance, the Owner will inspect the site and determine Final Acceptance.

E. One year following Final Acceptance, the Owner will inspect the site to determine the condition of materials provided under this Contract.

F. Landscape work will be reviewed for the entire project at one time and not on a piecemeal basis.

1. Fees for normal observations and tests will be paid by the Owner.
2. Additional field observations and tests required because of defective work or ill-timed notices will be at the Contractor's expense. The Landscape Architect's standard hourly rates will apply and shall be billed directly to the contractor.

G. Another observation will be conducted at end of all extended warranty periods, to determine acceptance or rejection.

3.8 PROTECTION

A. Protect landscape work and materials from damage due to landscape operations, operations by other contractors and trades, and trespassers.

1. Maintain protection during installation and maintenance periods.
2. Treat, repair, or replace damaged landscape work as directed.

END OF SECTION 32 93 00

SECTION 32 94 00 - PLANTING ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Section includes:

1. Tree Stabilization Materials.
2. Anti-Desiccants and Anti-Transpirants.
3. Slow Release Watering Devices.

1.2 REFERENCES

A. ASTM International, (ASTM).

1. ASTM A641 – Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.

B. OSU Construction Standards, latest edition.

1.3 SUBMITTALS

A. Action Submittals:

1. Product Data: For all items to be used in the Work.
2. Samples:
   a. Root Barrier: Height of panel by 12 inch width.
   b. Proprietary rootball stabilization device: One Unit. (Stakes and chain lock are not proprietary.)
   c. Slow Release Tree Watering Devices: One of each size required.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of plants.

1. Professional Membership: Installer shall be a member in good standing of the Oregon Landscape Contractors Association and may additionally be a member of the Professional Landcare Network or the American Nursery and Landscape Association.
2. Experience: Five years' continuous experience in landscape installation.
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network.
   a. Certified Landscape Technician - Exterior, with specialty area(s), designated CLT-Exterior.

b. Certified Ornamental Landscape Professional, designated COLP.

5. Pesticide Applicator: State of Oregon licensed, commercial.

PART 2 - PRODUCTS

2.1 PESTICIDES

A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.2 TREE STABILIZATION MATERIALS

A. Trunk and Rootball Stabilization Materials:

1. Stakes and Guys:
   a. Upright and Guy Stakes: Rough-sawn, sound, new Douglas-fir, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end. Anchor depth to be a minimum of 12” below bottom of rootball.
   b. Flexible Ties: 1” chain lock tree tie, as manufactured by Prolock™ or equal.
   c. Flags: Standard surveyor's plastic flagging tape, white, 18 inches long tied around any wire guys or cables.

2.3 TREE-WATERING DEVICES

A. Slow Release Watering Bag for Shade/Deciduous Trees:

1. TreeGator® Original, 15-gallon capacity, as manufactured by Spectrum Products, Inc., Tel.: 1-866-873-3428.
2. TreeDiaper®, 36 Round and 48 Round as manufactured by Zynnovation LLC, Ashland, VA 23005, Tel.: (540)-300-1465.
3. Or equal.

B. Slow Release Watering Bag for Conifer Evergreen Trees:

1. TreeGator® Jr. Pro, 15-gallon capacity, as manufactured by Spectrum Products, Inc., Tel.: 1-866-873-3428.
2. TreeDiaper®, 36 Round and 48 Round as manufactured by Zynnovation LLC, Ashland, VA 23005, Tel.: (540)-300-1465.

3. Or equal.

C. When irrigation is not operating or if plant establishment requires additional watering, Contractor shall procure one slow-release watering bag for each tree on the project which may become subject to water-stress conditions.

2.4 ANTI-TRANSPIRANT

A. Anti-Transpirant/Anti-Dessicant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

1. Basis of Design Product: Moisture-Loc™ Foliar Antitranspirant (formerly marketed as Moisturin), as manufactured by Zorro Technologies, Inc., Tel.: 1-707-292-2335, http://conserveawater.
2. No or equal substitution.

2.5 MISCELLANEOUS PRODUCTS

A. Wood Pressure-Preservative Treatment: AWPA C2, with waterborne preservative for soil and freshwater use, acceptable to authorities having jurisdiction, and containing no arsenic; including ammoniacal copper arsenate, ammoniacal copper zinc arsenate, and chromated copper arsenate.

B. Semi-transparent stain for tree stakes, Olympic or equal. Color as selected by Owner’s Representative from manufacturer’s standard color palette.

C. Burlap: Non-synthetic, biodegradable.

D. Filter Fabric: Nonwoven geotextile manufactured for separation applications and made of polypropylene, polyolefin, or polyester fibers or combination of them.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas receiving plants for compliance with requirements and conditions affecting installation and growth performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TREE STABILIZATION

A. Install trunk stabilization as follows unless otherwise indicated:

1. Upright Staking and Guying: Stake trees of 2- through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation

and to extend one-third of trunk height above grade. Set stakes vertically and space to avoid penetrating root balls or root masses. Position stakes on the north and south sides of trees.
a. Use only one stake placed on the north side of tree for tree of less than 2" caliper.

2. Support trees to stakes with bands of flexible chain lock ties at contact points with tree trunk. Position ties 2-1/2'-3' above finish grade or root flare. Allow sufficient slack to avoid rigid restraint of tree and to prevent girdling.

B. At the end of the first year, return to site and remove all stakes and flexible ties.

3.3 PLANTING AREA MULCHING

A. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Trees and Shrubs: Apply organic mulch ring of 2-3 inch average depth, with a radius extending at least 12-inches beyond that of the root ball around trunks or stems. Do not place mulch within 3 inches of trunks or stems. Mulch rings shall extend to full extents of planting pit.
2. Product: McFarlane's Compo-Stuff or equal.

3.4 CLEANUP AND PROTECTION

A. During adjusting, staking and guying, keep adjacent paving and construction areas clean and the work area in an orderly condition.

B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

C. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and project site. Dispose of in a lawful manner.

END OF SECTION 32 94 00

SECTION 33 31 00- SANITARY UTILITY SEWERAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: gravity-flowsanitary sewerage outside the building, with the following components:

1. Pipe and fittings.
2. Couplings.
3. Cleanouts.
4. Manholes.

1.2 PERFORMANCE REQUIREMENTS

A. Gravity-Flow Drainage-Piping Pressure Rating: 10-foot head of water

1.3 SUBMITTALS

A. Product Data: For the following:

1. Cleanouts
2. Pipe material.

B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewer system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

D. Field quality-control reports.

1.4 PROJECT CONDITIONS

A. Site information: Research public utility records and verify existing utility locations prior to ordering any materials. Notify the Architect immediately if any discrepancies are found in the project survey.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. 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.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 “Piping Applications” Article for applications of pipe, fitting, and joining materials.

2.3 DUCTILE-IRON, GRAVITY SEWER PIPE AND FITTINGS

A. Pipe: ASTM A 746, for push-on joints.

B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.

C. Compact fittings: AWWA C153, for push-on joints.

D. Gaskets: AWWA C111, rubber.

2.4 PVC PIPE AND FITTINGS

A. PVC Sewer Piping, NPS 15 and Smaller:

1. Pipe, NPS 15 and Smaller: ASTM D 3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for solvent-cemented or gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

2.5 NONPRESSURE-TYPE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.

2. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Ring-Type, Flexible Couplings: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.6 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Description: Cleanouts: At grade cleanouts shall have an adjustable sleeve-type housing, a threaded brass plug with counter sunk slot, and cast iron frame and cover.
2. Top-Loading Classifications: Medium Duty and Extra-Heavy Duty based on location. Refer to Part 3 “Cleanout Installation.”
3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

2.7 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints rubber gasketed joints.
2. Diameter: 48 inches minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation if site conditions warrant and/or as shown in plans.
4. Base Section: 6-inch minimum thickness for floor slab and 5 inch minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
5. Riser Sections: 5-inch minimum thickness, of length to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with top of cone of size that matches grade rings.
7. Gaskets: ASTM C 443 (ASTM C443M), rubber or preformed plastic.
8. Joint Sealant: ASTM C 990 , bitumen or butyl rubber.
9. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
10. Steps: Individual FRP steps or FRP ladder; wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
11. Adjusting Rings: Interlocking rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.

12. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Ferrous; 23-inch ID by 3- to 7-inch riser, with 3 ¼ -inch- minimum-width flange and 24 ¾-inch-diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
2. Material: ASTM A 536, Grade 60-40-18 ductile iron designed for heavy duty service unless otherwise indicated.

2.8 CONCRETE

A. General: Cast-in-place concrete complying with ACI 318, ACI 350/350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 3000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 3000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.

a. Invert Slope: Uniform slope through manhole to match invert elevations per plans, minimum 2 percent.

2. Benches: Concrete, sloped to drain into channel.

a. Slope: 8 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 31 20 00 "Earth Moving."

3.2 PIPING APPLICATIONS

A. Pipe couplings and fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.

a. Unshielded flexible couplings for same or minor difference OD pipes.
b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

B. Sewer Piping: Use the following pipe materials for each size range.
1. NPS 4 to NPS 15: PVC sewer pipe and fittings gaskets, and gasketed joints.

3.3 PIPING INSTALLATION

A. Install tracer wire directly over piping and at outside edges of underground structures. See Section 31 20 00 "Earth Moving" for tracer wire material requirements.

B. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

D. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

E. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

F. Install sewer piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 2 percent unless otherwise indicated.

2. Install piping with 36-inch minimum cover.
3. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.

3.4 PIPE JOINT CONSTRUCTION

A. Basic piping joint construction is specified in Section 33 05 00 “Common Work Results for Utilities.” Where specific joint construction is not indicated, follow piping manufacturer’s written instructions.

B. Join drainage piping according to the following:
1. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
2. Join dissimilar pipe materials with nonpressure-type, flexible couplings.
3. Join ductile-iron, gravity sewer piping according to AWWA C600 for push-on joints.

C. Pipe couplings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

a. Unshielded flexible couplings for pipes of same or slightly different OD.
b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.5 MANHOLE INSTALLATION

A. General: Install manholes complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Form continuous concrete channels and benches between inlets and outlet.

D. Set tops of frames and covers flush with finished surface for manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

3.6 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.7 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use pipe fittings in sewer pipes at branches for cleanouts, and use PVC pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

B. Set cleanout frames and covers in earth in cast-in-place-concrete block, per the Detail. Set with tops 1 inch above surrounding grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.8 CONNECTIONS

A. Connect drainage piping to building's sanitary building drain. Use transition fitting to join dissimilar piping materials.

B. Make connections to existing piping and underground manholes.

1. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

C. Make connections to existing piping and underground structures so finished Work complies with requirements specified for new Work.

3.9 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate report for each system inspection.
2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.

5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

    a. Fill sewer piping with water. Test with pressure of at least 10-foot head of water, and maintain such pressure without leakage for at least 15 minutes.
    b. Allowable leakage is maximum of 50 gal. /inch of nominal pipe size per mile of pipe, during 24-hour period.
    c. Close openings in system and fill with water.
    d. Purge air and refill with water.
    e. Disconnect water supply.
    f. Test and inspect joints for leaks.
    g. Option: Test concrete gravity sewer piping according to ASTM C 924.

6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

    a. Option: Test plastic gravity sewer piping according to ASTM F 1417.

7. Manholes: Perform hydraulic test according to ASTM C 969.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials and repeat testing until leakage is within allowances specified.

3.10 CLEANING

A. Clean dirt and superfluous material from interior of piping. Flush with potable water.

END OF SECTION 33 31 00

SECTION 33 41 00 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes gravity-flow nonpressure storm drainage, with the following components:

1. Pipe and fittings.
2. Cleanouts.
3. Transition couplings.
4. Catch basins.
5. Stormwater inlets.
6. Area drains.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

1. Cleanouts.
2. Pipe.
3. Fittings.
4. Area Drains.

B. Shop Drawings:

1. Catch basins and stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.

C. Field quality-control reports.

1.3 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Owner's written permission.

B. Site Information: Research public utility records and verify existing utility locations and depths prior to ordering any materials. Notify Engineer immediately if any discrepancies are found in the project Survey.

PART 2 - PRODUCTS

2.1 Refer to Part 3 “Piping Applications” for applications of pipe, fitting, and joining materials.

2.2 DUCTILE-IRON, GRAVITY SEWER PIPE AND FITTINGS

A. Pipe: ASTM A 746, for push-on joints.

B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.

C. Compact Fittings: AWWA C153, for push-on joints.

D. Gaskets: AWWA C111, rubber.

2.3 PVC PIPE AND FITTINGS

A. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35 with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

B. PVC Sewer Pipe and Fittings, NPS 18 and Larger: ASTM F 679, T-1 or T-2 wall thickness, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

2.4 NONPRESSURE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Concrete Pipes: ASTM C 443, rubber.
2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, Flexible Couplings:

1. Description: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, Flexible Couplings:

1. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.5 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Description: Cleanouts: At grade cleanouts shall have an adjustable sleeve-type housing, a threaded brass plug with counter sunk slot, and cast iron frame and cover.
2. Top-Loading Classifications: Medium Duty and Extra-Heavy Duty based on location. Refer to Part 3 “Cleanout Installation.”
3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

2.6 CURB INLETS

A. Per City of Corvallis Standard Detail 209.

2.7 AREA DRAINS

A. Area Drains: 10-Gauge steel plate bituminous coated as manufactured by Lynch, Gratemaster, Gibson Steel Basins, or approved equivalent.

B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for medium-duty loading. Provide flat grate with small, square or short-slotted drainage openings.

1. Size: 15 by 15 inches minimum unless otherwise indicated.
2. Grate Free Area: Approximately 50 percent unless otherwise indicated.

2.8 CONTECH STORMFILTER PROPRIETARY TREATMENT SYSTEM

A. Stormwater treatment system as shown on Plans.

B. Steel Catch Basin Stormfilter as manufactured by Contech Engineered Solutions, or approved equal.

PART 3 - EXECUTION

3.1 EARTHWORK

1. Excavation, trenching, and backfilling are specified in Section 31 20 00 "Earth Moving." Install tracer wire directly over piping and at outside edges of underground structures. See section 31 20 00 “Earth Moving” for tracer wire material requirements.

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

D. Install drainage piping according to the following:

1. Install piping pitched down in direction of flow at a minimum slope of 1 percent, unless otherwise indicated.
2. Install piping with 36-inch minimum cover, unless otherwise indicated.
3. Install ductile-iron piping and special fittings according to AWWA C600 or AWWA M41.
4. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
5. Install piping below frost line.

E. Install corrosion-protection piping encasement over the following underground metal piping according to ASTM A 674 or AWWA C105:

1. Ductile-iron pipe and fittings.

F. Clear interior of piping and manholes of dirt and superfluous material as work progresses.

3.3 PIPE JOINT CONSTRUCTION

A. Follow piping manufacturer’s written instructions for joint construction

B. Join drainage piping according to the following:

1. Join ductile-iron piping and special fittings according to AWWA C600 or AWWA M41.
2. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints.
3. Join dissimilar pipe materials with nonpressure-type flexible couplings.

C. Pipe couplings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use flexible couplings where required to join gravity-flow, sewer piping unless otherwise indicated.

a. Unshielded flexible couplings for pipes of same or slightly different OD.

b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.4 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use PVC fittings in sewer pipes at branches for cleanouts and PVC pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Medium-Duty, top-loading classification cleanouts in non-vehicular areas.
2. Use Extra-Heavy-Duty, top-loading classification cleanouts in vehicular areas.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, as indicated on plans. Set with tops 1 inch above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.5 AREA DRAIN INSTALLATION

A. Set frames and grates to elevations indicated.

3.6 CONTECH STORMFILTER PROPRIETARY TREATMENT SYSTEM

A. Install per manufacturer’s recommendations.

3.7 CONNECTIONS

A. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 4,000 psi.
2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 4,000 psi.
3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

a. Use concrete that will attain a minimum 28-day compressive strength of 4,000 psi unless otherwise indicated.
b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

B. Pipe couplings and expansion joints with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

a. Shielded flexible couplings for same or minor difference OD pipes.
b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.8 IDENTIFICATION

A. Install green tracer wire directly over piping and at outside edges of underground structure. See Section 31 20 00 “Earth Moving” for tracer wire material requirements.

3.9 FIELD QUALITY CONTROL

A. Perform and coordinate inspection and testing for storm drainage installed in the public right-of-way as required by the City of Corvallis Standard Construction Specifications.

B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between structures.
b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
d. Infiltration: Water leakage into piping.
e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

C. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

a. Test plastic piping according to ASTM F 1417.

D. Leaks and loss in test pressure constitute defects that must be repaired.

E. Replace leaking piping using new materials and repeat testing until leakage is within allowances specified.

END OF SECTION 33 41 00

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