SECTION 328400 - IRRIGATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provision of Contract, including General and Special Conditions, apply to Work of this section.

1. Drawings involving other trades and their respective Specification Sections as they may relate to the irrigation system.

1.2 WORK INCLUDED

A. Provide design and installation of a complete operable underground irrigation system as ordered or directed by, and agreed with, The University of Delaware (UDE) (Owner) or its representative.

B. Refer to para 1.12, SYSTEM DESIGN CRITERIA, below, and Details IR-1 through IR-19 at the end of this Section.

C. Unless directed otherwise, new irrigation equipment shall match and be compatible with existing system components previously installed on this site, including Satellite(s)/Controller(s), valves of all types and sizes, sprinkler heads (except as noted herein), and other equipment, materials, and miscellaneous appurtenances.

D. Point(s) of Connection: Verify location in field (VIF) and, if not previously installed under Division 22 – PLUMBING, coordinate location with UDE and Plumbing Contractor for Building involved. Coordinate also, point(s) of exit to soil from the Building.

E. If not previously installed under Division 22 – PLUMBING, provide interior piping including cross-connection to building domestic water supply, main shut-off valve, City of Newark-approved Sub-meter, pressure reducing valve, if required, backflow prevention device, master valve and flow sensor, if called for, piping to soil, fittings, wall penetrations and waterproof sleeving, and thermal insulation. Interior plumbing work shall be performed under Permit drawn by locally-licensed Master Plumber.

F. Coordinate Satellite location. If not to be installed under Division 26 – ELECTRICAL, provide 120 Vac power from dedicated 20 Amp circuit breaker. Interior electrical work greater than 30 Vac shall be performed under Permit drawn by locally-licensed Master Electrician.

G. Record Documents (“AS-BUILTS”), Central Computer Controller data-base input, Satellite programming, instruction of Owner personnel, Maintenance & Operation Manuals, and Warranties.

1.3 RELATED WORK

A. Examine entire set of Contract Documents for requirements which affect, or may affect, Work of this section.

B. Particular attention is directed to following Sections and Divisions of the related Building Construction Documents which may directly relate to Work of this section:

1. DIVISION 01 – GENERAL REQUIREMENTS
2. DIVISION 03 – CONCRETE
3. DIVISION 07 – THERMAL AND MOISTURE PROTECTION
4. DIVISION 22 – PLUMBING
5. DIVISION 26 – ELECTRICAL
6. DIVISION 31 - EARTHWORK
7. Remainder of DIVISION 32 – EXTERIOR IMPROVEMENTS
8. DIVISION 33 - UTILITIES

1.4 PERMITS AND INSPECTIONS

A. Obtain and, if directed, pay for Permits required for execution of Work under this section. Arrange inspections as required by issuing agency. Tender an Invoice to UDE for Permit expenses.

B. Furnish copies of Permits and approval notices to UDE Representative prior to requesting final payment.

1.5 QUALITY ASSURANCE

A. Visit site prior to beginning design work.

B. Award of a Contract for Work of this section will be contingent on approval of Irrigation Contractor by Owner's Representative following review of Bids and Bidder qualifications. System designer must be Certified Irrigation Designer (CID), Commercial Level and contractor Certified Irrigation Contractor (CIC) by the Irrigation Association (IA), Fairfax, VA.

C. Commissioning: System Check, Test, Start-up, and Adjust shall be performed by a Certified Landscape Irrigation Auditor (CLIA), either in the employ of the Irrigation Contractor or as a Sub-Contractor.

D. Bidders: Minimum three (3) years experience installing systems of this scope and type. Furnish list of three (3) installed projects if requested by Owner's Representative.

E. Ensure competent, English-speaking foreman and lead journeyman are on site at all times irrigation work is in progress. Designate foreman by name, in writing, to Owner's Representative. Provide foreman's telephone pager and mobile phone numbers.

F. Should crew members' dominant primary language be other than English, Foreman and lead journeyman must be fluent in crew's dominant language.

G. Provide two (2) years Winterization and following Spring start-up services.

1.6 QUALITY CONTROL

A. Applicable requirements of accepted Standards and Codes in effect at date of issue of Contract Documents, apply to Work of this section, including, but not necessarily limited to the following:

1. New Castle County Codes and Regulations.
2. American Society for Testing and Materials (ASTM).
3. Uniform Plumbing Code (UPC).
4. National Electrical Code (NEC).
5. National Sanitary Foundation (NSF).
6. American Society of Irrigation Consultants (ASIC).
7. The Irrigation Association (IA)
8. Plastic Pipe and Fittings Association (PPFA).
9. Plastic Pipe Institute (PPI)

1.7 SUBMITTALS

A. Product Data: If part of a larger project, see also Section 011000. Submit electronic copies of Manufacturers' cut sheets, .pdf files preferred. SUBMITTALS must be originals or first-generation copies – faxed sheets and copies of faxed sheets are not acceptable. Information may be downloaded from Manufacturers' websites provided they include pertinent technical data. Mark-up data sheets to be project-specific relating to model, size, configuration, options, pressure ratings, rated capacities, etc., of selected models for the following:

1. Booster Pump and Controls.
2. System Satellite Controller including communication and cabinet type.
3. Backflow Prevention Device (and enclosure if applicable)
4. Flow Sensor.
5. Master Valve.
6. Remote Control Valves (RCV).
7. Manual Valves (gate and ball).
8. Manual Drain Valves
9. Air Vent Vacuum Relief Valves
10. Quick-Coupling Valves (QVC).
11. Sprinkler Heads and Nozzles – all models
12. PVC Pipe and Fittings.
13. Valve and Splice Boxes.
14. Low Voltage Control Wiring.
15. Wire Splice Waterproofing Kits.
16. Trench-marking Tape.
17. Valve Tags and Valve Tag Schedule for interior valves.

B. Shop Drawings (Plans): Include items per para 1.12, SYSTEM DESIGN CRITERIA, below.

C. Mainline hydrostatic test results.

D. Operation and Maintenance Data: See also Section 017700 - Closeout Procedures. Provide two (2) binders titled MAINTENANCE AND OPERATION INSTRUCTIONS FOR UNIVERSITY OF DELAWARE (Project Name) IRRIGATION SYSTEM. Include the following:

1. Cover sheet indicating Irrigation Sub-Contractor name, address, phone no., e-mail address, and dates of Warranties.

2. Warranties.
3. Complete set of APPROVED SUBMITTALS required in para. 1.5, A., above.
4. Half-scale black-line copy of Record Documents (“AS-BUILTS”).
5. Suggested mid-season, no-rain, Controller operating schedule in minutes per day and days per week.
6. Written description of procedures to be followed for winterization and spring start-up.

1.8 TESTS

A. Perform tests in presence of the Owner’s Representative unless directed otherwise.

B. See also applicable paragraphs under PART 3 – EXECUTION, this section.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Procure, pack, ship, deliver, receive, handle, store, and prepare and install materials and equipment in such manner as to protect from damage due to weather, jobsite activities, vandalism, thievery, or other cause.

B. Store plastic piping off of ground and protected from direct sunlight. Support to prevent sagging and bending.

C. Coordinate on-site storage with Owner’s Representative.

1.10 WARRANTEES

A. Guarantee labor and materials for two (2) years from date of final acceptance.

1.11 TOOLS AND MAINTENANCE EQUIPMENT

A. At Close-Out, deliver following items, new and unused, in original containers, to Owner’s Representative with Packing List. Retain copy of signed Packing List for M & O Manuals:

1. Two (2) Controller cabinet keys.
2. Three (3) Q.C.V. keys with swivel hose ells.
3. Three (3) Q.C.V. cover keys.
4. Two (2) formed and welded 1/2” diameter welded-wire “devils-fork” valve keys, 30” long, for operating small in-ground manual valves and automatic valve flow-control, Weather*matic, or equivalent by Buckner

1.12 SYSTEM DESIGN CRITERIA

A. General: The intent of these Documents is to ensure UDE’s interests relating to the overall integrity of the design and installation of all irrigation systems at this site. The designer is to be guided by the following criteria and by Manufacturers’ Recommendations to as great an extent as possible. Should deviations be anticipated, or suggested, the designer shall confer with UDE and its Irrigation Consultant (IC) prior to proceeding with his design and installation.

B. In acceptable AutoCAD digital format, develop and submit for review, irrigation design (Irrigation System Shop Drawing) and materials and equipment list for irrigation system.

C. System shall be capable of applying up to 1.15" of water to tree, shrub, and ornamental planted areas, and up to 1.50" to turf areas per week, operating for not more than six (6) hours per day, on not more than five (5) days per week, i.e., within a 30-hour per week "water window".

D. Coverage of areas to be irrigated: Unless directed otherwise, not less than:

1. Included turf areas: 100 percent head-to-head coverage.
2. Included plant bed areas: 100 percent head-to-head coverage.
3. Included new tree plantings: as directed/agreed, within disturbed area, provide tree watering bubblers whether or not covered by broadcast irrigation sprinklers.

E. Include on Shop Drawing(s): Locations of: Point(s) of Connection; sprinkler heads; valves; controller(s); backflow prevention device(s); pump(s); valve boxes; and other components/features of system including: piping; sleeving; wiring; blow-out(s); and manual drains. Include a Legend indicating symbols for all of the above. Details may be taken directly from this Document.

F. Indicate by symbol, notation, or Legend for each sprinkler head: Type of head, pop-up height, and nozzle.

G. Indicate for each remote control valve (RCV): Zone number, valve size, and zone flow rate (GPM).

H. Size Backflow prevention device so as not to exceed maximum velocity of 7½ feet-per-second (FPS).

I. Size City of Newark-approved Sub-Meter so as to incur pressure loss not greater than 10% of available static pressure (SP), flow rate (GPM) not-to-exceed 75% of rated AWWA flow rate, and not more than one pipe-size smaller than connected piping. Be guided by most-restrictive of these criteria. See also Detail IR-1, this Section.

J. Sprinkler head spacing: Generally, 45% to 50% of diameter of throw but not to exceed 55% of diameter of throw. Sprinkler spacing pattern(s) at Designer's option – square, triangular, rectangular, sliding, or staggered, as best suites landscape layout and provides proper coverage.

K. Size all pipes on the Shop Drawing – mainlines and laterals – so that velocity of flow does not exceed 5 FPS at any point in system. Indicate all pipe and sleeve sizes on the drawings. See also Detail IR-3, this Section.

L. Size control valves so as to incur no more pressure loss than 5% of system static pressure. Valve size shall be either line-size or not than one (1) pipe size smaller than pipe in which installed.

M. Refer to Details IR-1 through IR-19 at back of this Section.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide new materials conforming to applicable standards. Conflicts between or among Standards and Documents will be addressed by Owner's Representative on receipt of written request, otherwise, Documents take precedence provided no code violation involved.

B. Provide most recent model of named manufacturers' products called for unless "or approved substitution" appears in product specification paragraph below, in which case Contractor may submit substitution(s) for consideration.

2.2 IRRIGATION EQUIPMENT

A. Following manufacturers and models are acceptable:

1. Backflow Prevention Device: Watts Regulator, ASSE 1013, or equal by Wilkins-Zurn or Febco, reduced principle type, with wye strainer, manual service valves and air gap fitting.
2. Booster Pump: Prefabricated, VFD unit by Rain Bird, or equal by Watertronics. Provide complete Shop Drawings including electrical schematics. Sized for project flow and pressure requirements.
3. Satellite/Controller: TORO Sentinel Satellite compatible with UDE's Toro Sentinel Central Control software. Provide all necessary appurtenances to accomplish fully-functioning Sentinel system, station capacity as required for project. Coordinate enclosure and communication type(s) with UDE prior to purchase. Manufactured by The TORO Company, Riverside, CA.
4. Remote Control: Model SHHR Hand Held Remote for Sentinel, manufactured by The TORO Company, Riverside, CA.
5. Flow Sensor: Model TFS Series, sized for project flow range, manufactured by The TORO Company, Riverside, CA, or approved substitution.
   a) Flow Sensor Cable: AWG 16, direct burial, shielded cable, P7162D, by Paige Electric Corporation, Union, NJ, or equal.
6. Master Valve: Model 3300 Series, normally open valve with dirty water protection, sized for project flow range, manufactured by Buckner/Superior by Storm Manufacturing Group, Inc., Torrance, CA.
7. Rain Sensor: Model TRS/TWRS, Manufactured by The TORO Company, Riverside, CA.
8. Sprinkler heads:
   a) Large Turf Rotors: 8005 Series manufactured by Rain Bird Sprinkler Corporation, Tucson, AZ. See drawings for nozzle sizes.
   b) Small Turf Rotors: 5000 Series, model 50XX-PL-SAM-PRS, with flow shut-off, pop-up heights as needed, check valve, and pressure regulation (45 PSI), manufactured by Rain Bird Sprinkler Corporation, Tucson, AZ. See drawings for nozzle sizes.
   c) Spray Heads: 1800 Series, model 18XX-SAM-P45 or PRS, pop-up heights as needed, check valve, and 45 PSI, or 30 PSI pressure regulator as needed, manufactured by Rain Bird Sprinkler Corporation, Tucson, AZ. Use with MP Rotator nozzles per drawings, manufactured by Hunter Industries, San Marcos, CA.
9. Tree Watering System: 1804-SAM-PRS Series Spray Heads with Rain Bird 1400 Series Bubblers, or approved equal.
10. Remote Control Valves: PEB Series, 200 psi pressure rated, sizes as indicated, manufactured by Rain Bird Sprinkler Corporation, Tucson, AZ.

11. Quick-Coupling Valves: Model 33-DLRC, 3/4", with #33-DK Keys, SH-0 3/4" Swivel Hose Ell, and #2049 Cover Key, manufactured by Rain Bird Sprinkler Corporation, Tucson, AZ.
12. Manual Valves:
    a) Two and one-half (2 ½") and Three-inch (3"): Class 125 Bronze Gate Valve, NRS, threaded with cross handle, Model T-113-K, manufactured by NIBCO, Inc., Elkhart, IN.
    b) Up to 2": Safety Block, 150 psi working pressure; True Union, PVC Ball Valve, manufactured by DURA Plastic Products, Beaumont, CA, SPEARS, or LASCO.
13. Manual Drain Valves: Brass, 1" manual angle valve, Model VBM-10, manufactured by Buckner by Storm Manufacturing Group, Inc., Torrance, CA.
14. Air Vent/Vacuum Relief Valves: Crispin Model AL-10, 1", manufactured by Crispin Multiplex, Berwick, PA, or approved substitution.
15. Power wire to satellite: THHN or THWN, 12 AWG, or as required by Division 26 – ELECTRICAL.
16. Low Voltage (24Vac) Control Wire: Golf Course Sprinkler Wire, PE insulation suitable for direct burial, solid strand, rated for 600 Volts. Wire manufacturer: Model P7079-D by Paige Electric Corporation, Union, N.J. or Regency Wire & Cable, Inc., Sikeston. MO. Color-code as follows:
    a) Valve power: RED, 14 AWG
    b) Valve common: WHITE, 12 AWG
    c) Spares: BLUE, 14 AWG
17. Electrical Wire Waterproofing: Gel-filled insulator tube, with non-hardening gel and snap-cover, rated at 600 Volts: DBY-6 or DBR-6 manufactured by 3M Company, Electrical Products Division, Austin, TX.
18. Trench-Marking Tape: Width: 2", magnetic/traceable, BLUE, with "IRRIGATION" marking, manufactured by Line Guard Corp., Christy's, Seaton, or approved substitution.
19. PVC pipe, fittings, and primer and solvent. Supply pipe and fittings marked by manufacturer with appropriate ASTM designations and pressure rating, and free from cracks, blisters, dents, or other damage:
    a) Three-inch (3"): Class-200, SDR-21, bell-end, solvent-weld joints, manufactured by Cresline, JM, or SilverLine, with Schedule 40 solvent-weld fittings, ASTM D-1784, ASTM D-2466, manufactured by LASCO, DURA, or approved substitution.
    b) Two and one-half inch (2½") and smaller: Pipe: SCH-40, solvent-weld, ASTM D-1784, ASTM D-1785, manufactured by Cresline, JM, or approved substitution. Fittings: SCH-40, solvent-weld, or threaded to match equipment, ASTM D-1784, ASTM D-2466, manufactured by LASCO, DURA, or approved substitution.
    c) PVC primer and solvent: Primer: F-656, NSF and UPC labeled, manufactured by Nibco/Chemtrol, Christy's, Weld-On, or Hercules. Solvent: ASTM D-2564, NSF and UPC labeled, manufactured by Nibco/Chemtrol, Christy's, Weld-On, or Hercules.
20. PVC nipples: Schedule-80 PVC, ASTM D-1784, ASTM D-2464 TOE or TBE.
21. Copper pipe and fittings:
    a) Interior, above-ground: Type L Copper, ASTM B-88, with wrought or cast fittings, solder or threaded ends, ASTM B-75, ASTM B-584.
    b) Exterior, below-grade: Type "K" soft copper tubing.
22. Valve boxes: HDPE, black with black, bolt-down lids, VB Specification Series, manufactured by Rain Bird Sprinkler Corporation, Tucson, AZ. Provide matching extensions where needed to attain finish grade. Splice and QCV boxes: Nominal 10" diameter.
23. Valve Tags – for interior valves only: Seaton, or approved substitution, engraved or stamped and lacquered Brass, marked "IRR-#(no.) with brass chain to valve stem
24. Sleeves:
    a) Pipe sleeves: Class 200 PVC sized as indicated on the plan. Solvent-weld joints if greater than 20' in length.
    b) Low Voltage wire sleeves: Sch-40 PVC.
25. Wall penetrations, interior-to-exterior: Link-seal.

PART 3 - EXECUTION

3.1 GENERAL

A. Examine Contract Documents. Bring discrepancies to attention of Owner's Representative. Initiate written Request for Information (RFI). Proceed only after receiving clarification.

B. Obtain approval of Irrigation Submittals and Shop Drawings by UDE Representative prior to commencing Work.

C. Install equipment and systems in accordance with Manufacturers' recommendations and attached Details unless otherwise approved/directed.

D. Make field measurements necessary for Work noting relationship of irrigation work to that of other trades. Coordinate with other trades (paving, landscaping, electrical, mechanical, and other site and building trades). Layout project essentially as indicated on APPROVED Irrigation Plan(s), making adjustments for variations in planting bed lines and building conditions, critical root-zone areas, and interference with new and existing utilities.

E. Ensure placement of sleeves as construction progresses.

F. In company of Owner's Representative, stake final locations of major system components in field including sprinkler locations, mainline pipe routing and valve locations. Notify Owner's Representative 48 hours in advance of staking operations.

G. Complete project in stages. Coordinate installation sequencing with Owner's Representative. Do not leave project unmanned unless progress is delayed by job conditions or weather. Backfill and tamp trenches at end of each workday and prior to leaving project unmanned. At end of each workday, broom-clean walks, parking areas, and other hardscape areas soiled by irrigation installation. Owner's Representative will inspect work prior to its being buried or covered.

H. Protect landscaping, drainage systems, site electric, paving, structures, walls, footings, and foundations from damage. Report damage to work of another trade to Owner's Representative immediately. Make or arrange repairs to satisfaction of Owner's Representative.

I. Install equipment and materials in accordance with manufacturers' recommendations and Contract Documents. Report discrepancies to Owner's Representative.

J. Record Drawings: Maintain clean, dry, black-line bond print to serve as field-kept Record Document. See also para 3.12, CLOSE OUT, below.

1. Record daily progress and indicate deviations from diagrammatic layout on Plans.
2. Update on daily basis when work is in progress.
3. Indicate measurements from two permanent points of reference to buried pipe and wire at intervals not-to-exceed 100' for buried pipe and wire not otherwise obvious.
4. Indicate depth of bury at 100' intervals and at changes in direction.
5. Make available to Owner's Representative at all times during construction.
6. Not less than 30 days following completion of Work. Transfer information on field-kept drawing to digital file. Plot Record Drawing on 4-mil Mylar. Deliver to Owner's Representative in protective tube. Do not fold. Provide digital file on CD in AutoCAD in use by University of Delaware.

3.2 INTERIOR MECHANICAL AND ELECTRICAL WORK

A. Perform plumbing work under permit drawn by locally-licensed Master Plumber to point of termination of copper piping in soil area outside building wall.

B. Perform electrical work greater than 30 Vac under permit drawn by locally-licensed Master Electrician.

C. Indicate Point of Connection (POC) piping schematic in detail following generally the schematic indicated on Detail IR-2. Locate and identify existing interior piping at POC.

D. Hangers and supports: Be guided by requirements of Division 22 – PLUMBING. Support piping and equipment from structure above, slab below, or wall, as situation warrants. Provide supports at both ends of Backflow Prevention Device, both ends of Sub-Meter, and at changes in direction. On straight runs of piping, provide hanger/support spacing not-to-exceed pipe manufacturers' recommendations or closer if needed to avoid sagging.

E. Provide thermal insulation in accordance with requirements of Division 22 - PLUMBING. Vapor-seal as required for Domestic Water piping. Size clevis hangers to match outside diameter of thermal insulation. Provide a 16-gauge galvanized saddle at each clevis hanger and ensure saddle diameter matches o.d. of thermal insulation.

F. Set and connect Backflow Prevention Device at Point of Connection in accordance with codes. Support device at both ends from wall, floor, or overhead, depending on conditions.

G. Provide City of Newark-approved Sub-Meter at each Point of Connection in sized accordance with Schedule in Details. Sub-Meter may require calibration by City of Newark prior to installation and shall indicate flows in units required by City of Newark.

H. Master Valve: Install with solenoid and adjusting handle in vertical-up position in accessible location.

I. Flow Sensor: Install with required lengths of straight runs of pipe both upstream and downstream of sensor.

J. Provide sleeving through walls and slabs. Should sleeving be missed during construction, and when otherwise required, smooth core-bore slabs and exterior walls. Provide Link-Seal type waterproof wall sleeves at exterior walls and provide for repair of waterproofing by Waterproofing sub-contractor.

K. If disturbed, restore existing piping, thermal insulation, and vapor-barrier.

L. Apply Valve tags to all irrigation-related valves. Coordinate with project Plumbing Contractor.

3.3 SYSTEM LAYOUT, EXCAVATION, BACKFILL, AND PIPE INSTALLATION

A. Locate, identify, and mark existing and previously-installed below-grade utilities. Contact "Miss Utility" three (3) days prior to commencing excavation work. Engage private utility locator if necessary to locate on-site utilities not addressed by Miss Utility.

B. Existing work to remain may be cut, drilled, bored-beneath, altered, removed, or removed and replaced, as necessary for installation of Work under this Contract at UDE direction. Altered,

replaced, and restored work to match original in all characteristics with exception of acceptable coloration variation.

C. Determine in field locations of driveway and sidewalk crossings. Install sleeving at 24" to 30" cover to top of sleeve. If new construction, ensure sleeving is placed as construction progresses.

D. Install piping using open-trench method. Use of vibratory plow prohibited. Excavate with minimum-width trencher chain to depth of within 1" of pipe invert, provided a suitable base, i.e., no sharp edges or rock, is available. If not, excavate to 2" below invert and provide clean fill or sand base on which to lay pipe. Remove all unacceptable trenching spoils including rock greater than 1" in diameter and other deleterious materials. Accomplish installation using open trenching, boring, and hand-excavation, as situation warrants. Regardless of which method of pipe installation is employed, manually "pot-hole" (dig test pit) at existing utilities to be crossed to determine actual location and depth. Exercise caution to avoid damage to utilities, site lighting, and major tree root systems. Re-routing of piping may be required.

E. Particular attention is indicated relating to crossing utility easements. Such crossings are to be executed in accordance with Utility Company requirements and State and local Codes and Regulations.

F. In tree protection areas: Following staking review, Contractor may be directed to re-route piping or to employ "Air-Spade" trenching or Horizontal Direct Drilling (HDD) method in critical root zone areas.

G. Maintain depths of bury (cover over pipe) as follows:

1. Mainlines: 20" to 24".
2. Laterals: 16" to 18".
3. Under vehicular pavements: 30" to top of sleeve.

H. Pipe and fitting connections:

1. Solvent-weld joints: Cut PVC pipe square and true using saw or pipe-cutting tool. Remove burrs and shavings from cut ends.
   a) Apply solvent and cement in accordance with manufacturer's recommendations, making certain not to employ excess amount of either. Wipe excess cement from each made connection immediately following insertion.
   b) Before moving or disturbing, allow connection to cure in accordance with manufacturer's recommendations relating to temperature, humidity, and cure time.

I. Backfilling operations: Initial fill, to approximately 6" above pipe and wire: shall contain no foreign matter, no frozen materials, and no rock greater than ½" in diameter. Carefully place fill material around pipe and wire and hand-tamp. Remainder of backfill: shall consist of excavated materials less rock larger than ¾" in diameter, frozen materials, or foreign matter: lay-up in maximum 6" lifts and mechanically tamp to compaction to match that of surrounding undisturbed area. Trench settling will not be tolerated. Upper 6" to 8" of backfill: clean fill containing no foreign material or unsuitable trenching spoils. Install trench-marking tape at 6" to 8" depth over mainlines and wire paths. Sod or seed trenches with approved type/mix by Owner's Representative. Record pipe and wire locations daily on field-kept Record Drawings.

3.4 VALVE INSTALLATION

A. See Details.

B. Manual valves:

1. Mainline Isolation Gate Valves: Use Schedule 80 TOE nipples at inlet and outlet.
2. Quick-coupling valves: Install on prefabricated three-ell PVC swing joint in 10” diameter valve box set to finish grade. Stake with re-bar and stainless steel hose clamps
3. In-ground manual drain valves: Drain to daylight or provide gravel sump

C. Remote Control Valves (RCV): Set RCV in valve box with adjusting handle and solenoid vertical-up. Provide line-size Ball valve at inlet of each zone valve. Wire lengths in Valve Box: Sufficient to permit solenoid to be brought to surface. Coil 30” to 36” additional wire around 2” diameter spool piece to serve as surge dampener. Remove spool piece. Provide filter fabric and 4” to 6” washed pea gravel under valve and splice boxes. Bring gravel neatly up to pipe invert. Do not cover system components with gravel. Provide separate power wire “home run” from each RCV to field controller. “Linking” of valves for simultaneous operation if desired/required shall be done at controller.

D. Provide separate valve box for each RCV. Set to finish grade. Compaction surrounding valve and splice boxes: minimum 85%.

E. Provide 12” wide strip of sod all-around each Valve Box if located in turf area.

3.5 SPRINKLER INSTALLATION

A. See Details.

B. Rotors: Connect to lateral line with inlet-size, three-ell, PVC swing joint rated to 315 PSI, with threads matching sprinkler body.

C. Spray heads: Connect to lateral line with ½” flexible swing pipe and spiral barbed fittings. Swing pipe length 10” to 14”.

D. Set sprinkler with cap exactly at, and body perpendicular to, finish grade in turf (set within mulch in planted areas). Ensure adequate compaction around sprinkler. Reset/re-plumb sprinklers during warranty period if necessary.

E. Provide 12” wide strip of sod all-around each sprinkler head in turf.

F. Riser-mounted sprinklers on rigid risers above grade not permitted unless specifically directed.

3.6 TREE WATERING SYSTEM INSTALLATION

A. See Details. The intent is to provide the means to effectively “flood” the soil-mulch saucer formed around each tree to ensure water availability to the root ball.

B. Install 3, or 4 units depending size of root ball, tree caliper, and soil conditions as directed by the Landscape Architect or UDE Representative.

C. Unless otherwise directed by the Landscape Architect or UDE Representative, allow in the Bid the following quantities:

1. Up to 6" caliper: Three (3) bubblers per tree.
2. Over 6" caliper: Four (4) bubblers per tree.

D. Extend Swing Pipe to inside of soil-mulch saucer and mount spray head body plumb with cap within mulch.

3.7 WIRE INSTALLATION

A. See Trench and Remote Control Valve Details.

B. Power wiring: Wiring greater than 30 Vac: Obtain Permit and install under supervision of locally-licensed Electrician or engage project Electrical Contractor to provide.

1. Above-grade: Install in metallic or PVC conduits in accordance with local codes and requirements of Division 26 – ELECTRICAL.
2. Below-grade: Install using open-trench method to depth required by code.

C. Below-grade low-voltage control wiring: Install along with, and at same invert as, irrigation mainline piping. Loosely cinch wires together at 15' intervals with nylon cable cinches or duct tape. Provide additional slack at changes of direction. Wiring shall at no time be installed taut or directly beneath piping. Maintain color scheme throughout installation.

1. SPARES: Install quantities indicated on APPROVED Irrigation Shop Drawing in each direction from Satellite to farthest remote control valve box on each section, or leg, of mainline. Bring spares up into each valve box as they pass through. Loop, cinch, and tag "Spare" in each valve box and in controller cabinet.

D. Each low voltage valve power wire shall "home run" to the Satellite.

E. Underground wire splices: Waterproof and allow only in valve boxes or splice boxes, i.e., no direct-buried splices between boxes.

3.8 SATELLITE / CONTROLLER INSTALLATION

A. See Details.

B. Wall-mount generally where indicated. If interior, mount 4'-6" above finish floor (AFF) to bottom of cabinet. If exterior, mount in stainless steel enclosure. Determine and coordinate final location in field.

C. Set, connect, wire, ground and test in accordance with Manufacturer's Recommendations.

D. Above-ground low-voltage wire and wire to soil: Install in metallic or PVC conduit conforming to local codes and Division 16 requirements. Where wire bundle transitions to direct-bury in soil, provide a waterproof junction box.

E. Test grounds for resistance in accordance with Manufacturer's requirements and ASIC recommendations.

F. Coordinate communication type, and ensure positive communication with the campus-wide Toro Sentinel central control system.

G. If stainless steel enclosure is to be installed, form, pour, level, and finish 2500 pound concrete pad reinforced with 4”x4” welded wire mesh screen (WWMS). Use enclosure pedestal template to ensure conduits fall neatly within pedestal footprint.

3.9 RAIN SENSOR INSTALLATION

A. See Details. Provide wired model if controller is located in a building, provide wireless model if controller located outside and ensure positive communication between sensor and sensor receiver.

B. Coordinate location with UDE Representative.

C. Set, connect, wire, and test in accordance with Manufacturer’s recommendations.

3.10 CHECK, TEST, START-UP, ADJUST AND BALANCE

A. These operations are to be performed by a Certified Landscape Irrigation Auditor (CLIA). CLIA will attest in writing that required check, test, start-up and adjust operations have been performed prior to requesting Punch List site visit and scheduling walk-through and demonstration.

1. Leak Test: Flush, cap, and test mainlines for leaks at 150 PSI for 2 hours. “Allowable leakage”: 11.65 gallons per day, per nominal diameter-inch of installed piping under test, per mile of installed piping. Repair leaks and re-test until results are acceptable. Result of calculations yields quantity of water in gallons required to bring pressure back to within 5 PSI of test pressure. Should 2-hr. loss be 5 PSI or less, section is acceptable. Provide pump and necessary equipment to accomplish testing. Owner’s Representative will witness test. Laterals: Test at normal system operating pressure. Backfilling may be done prior to testing at Contractor option. Repair leaks and retest until results satisfactory.
2. Flushing: After piping, valves, and sprinkler connection piping and risers are in place and connected, but prior to installation of sprinklers, flush piping under full head of water until discharge runs clean and clear. Install sprinklers and proceed to adjust system.
3. Adjustment: Close Manual Drains. Fully open manual and automatic valves. Activate Controller and adjust sprinkler heads for optimum performance and to prevent over-spray onto walks, pavement, and structures. Adjustments may include changes in nozzle sizes, and/or degrees of arc, and/or distance of throw. Overthrow onto walks, parking areas, and buildings is not permissible. Set/adjust sprinkler heads perpendicular to, and at, finish grade.

B. Coverage Test: Perform coverage test in presence of Owner’s Representative Personnel. Coordinate “walk-through” with Owner’s Representative.

3.11 CLEAN-UP

A. Following completion of installation work, recompact and re-dress trenches, and recheck sprinkler settings and adjustments.

B. Remove equipment and leftover materials from site and dispose of in safe and legal manner.

C. Re-tamp disturbed areas and broom-clean and hose-off paved areas.

D. Leave site in at least as neat and clean a condition as when irrigation installation was begun.

3.12 CLOSE-OUT

A. At completion of “walk-through” and instruction of Staff, and prior to application for final payment, ensure that following are accomplished:

1. Permits: Signed-off by appropriate party. Deliver original to UDE representative.
2. Mainline Hydrostatic Pressure Test: Signed-off by UDE Representative.
3. Punch-List: Complete.
4. Record Document Drawings: Completed, approved, and included in Maintenance & Operating Manuals.
5. Maintenance & Operating Manuals: Complete and delivered to Owner’s Representative.

END OF SECTION 328400