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SECTION 328400 - PLANTING IRRIGATION

1. GENERAL
   * + 1. SUMMARY
          1. Section Includes:

Pipes, tubes, and fittings.

Encasement for piping.

Manual valves.

Automatic drain valves.

Miscellaneous piping specialties.

* + - * 1. Related Requirements:

Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.

Section 220500 "Common Work Results for Plumbing" for water metering requirements.

Section 230923.14 "Flow Instruments" for water metering equipment.

* + - 1. DEFINITIONS

Retain terms that remain after this Section has been edited for a project. Include only essential definitions or acronyms not well understood by the affected industry or trade.

* + - * 1. Circuit Piping: Downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.

Retain "Drain Piping" Paragraph below unless drain valves discharge onto grade without downstream piping.

* + - * 1. Drain Piping: Downstream from circuit-piping drain valves. Piping is not under pressure.
        2. ET Controllers: EvapoTranspiration Controllers. Irrigation controllers, which use some method of weather-based adjustment of irrigation. These adjusting methods include use of historical monthly averages of ET, broadcasting of ET measurements, or use of on-site sensors to track ET.
        3. Main Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.
        4. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
      1. ACTION SUBMITTALS

Action submittals are submittals requiring responsive action and return of reviewed documents to Contractor.

* + - * 1. Product Data:

Pipes, tubes, and fittings.

Encasement for piping.

Manual valves.

Pressure-reducing valves.

Automatic control valves.

Automatic drain valves.

Transition fittings.

Dielectric fittings.

Miscellaneous piping specialties.

Sprinklers.

Quick couplers.

Drip irrigation specialties.

Controllers.

Boxes for automatic control valves.

Include rated capacities, operating characteristics,[ **electrical characteristics,**] and furnished specialties and accessories.

Retain "Wiring Diagrams" Paragraph below if equipment includes wiring.

* + - * 1. Wiring Diagrams: For power, signal, and control wiring.

Retain "Delegated Design Submittals" Paragraph below if design services have been delegated to Contractor.

* + - * 1. Delegated Design Submittals: For irrigation systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
      1. INFORMATIONAL SUBMITTALS

Information submittals are submittals that require review by Architect, but they do not require Architect's responsive action and return of reviewed documents to Contractor, provided submittals comply with requirements. If rejected, submittals with responsive action must be returned to Contractor.

Retain "Coordination Drawings" Paragraph below where coordination is required for installation of products and materials by separate installers. Preparation of coordination drawings requires participation of each trade involved; coordinate with other Sections specifying products and materials to be included. See Section 013100 "Project Management and Coordination."

* + - * 1. Coordination Drawings: Irrigation systems, drawn to scale, on which components are indicated and coordinated with each other, using input from Installers of the items involved. Also include adjustments necessary to avoid plantings and obstructions, such as signs and light standards.
        2. Zoning Chart: Indicate each irrigation zone and its control valve.
        3. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.
        4. Field Quality-Control Submittals:

Retain "Field quality-control reports" Subparagraph below if Contractor is responsible for field quality-control testing and inspecting.

Field quality-control reports.

Coordinate "Qualification Statements" Paragraph below with qualification requirements in Section 014000 "Quality Requirements" and as may be supplemented in "Quality Assurance" Article. If inserting additional entities or specialist, add qualifications to "Quality Assurance" Article.

* + - * 1. Qualification Statements: For [**Installer**] <**Insert entity or specialist**>.
        2. Delegated design engineer qualifications.
      1. CLOSEOUT SUBMITTALS
         1. Operation and Maintenance Data: For [**sprinklers**] [**controllers**] [**and**] [**automatic control valves**] to include in operation and maintenance manuals.
      2. MAINTENANCE MATERIAL SUBMITTALS

See Section 017700 "Closeout Procedures" for submission of maintenance material items.

* + - * 1. Extra Stock Material: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Impact Sprinklers: Equal to <**Insert number**> percent of amount installed for each type and size indicated, but no fewer than <**Insert number**> units.

Spray Sprinklers: Equal to <**Insert number**> percent of amount installed for each type and size indicated, but no fewer than <**Insert number**> units.

Bubblers: Equal to <**Insert number**> percent of amount installed for each type indicated, but no fewer than <**Insert number**> units.

Emitters: Equal to <**Insert number**> percent of amount installed for each type indicated, but no fewer than <**Insert number**> units.

Drip-Tube System Tubing: Equal to <**Insert number**> percent of total length installed for each type and size indicated, but not less than [**100 ft.**] [**500 ft.**] <**Insert value**>.

Soaker Tubes: Equal to <**Insert number**> percent of total length installed for each type and size indicated, but not less than [**50 ft.**] [**100 ft.**] <**Insert value**>.

* + - * 1. Schedule of maintenance material items.
      1. QUALITY ASSURANCE
         1. Qualifications:

Installers: Entity that employs a [**Certified Irrigation Designer - Landscape qualified by the Irrigation Association**] [**Professional Class member of the American Society of Irrigation Consultants**] [**Professional Technical Class member of the American Society of Irrigation Consultants**] <**Insert qualifications**>.

* + - * 1. 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. DELIVERY, STORAGE, AND HANDLING
         1. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and entrance of dirt, debris, and moisture.
         2. Store plastic piping protected from direct sunlight. Support piping to prevent sagging and bending.
      2. FIELD CONDITIONS

Retain this article if interruption of existing water service is required.

* + - * 1. 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:

Notify [**Architect**] [**Construction Manager**] [**Owner**] no fewer than [**two**] <**Insert number**> days in advance of proposed interruption of water service.

Do not proceed with interruption of water service without [**Architect's**] [**Construction Manager's**] [**Owner's**] written permission.

1. PRODUCTS
   * + 1. PERFORMANCE REQUIREMENTS

Retain one option from "Irrigation Zone Control" Paragraph below. If retaining first option, retain controller, wiring, and automatic control valves. Manual control requires a gate valve for each zone.

* + - * 1. Irrigation Zone Control: [**Automatic operation with controller and automatic control**] [**Manual operation with manual**] valves.

Retain "Location of Sprinklers and Specialties" Paragraph below if complete system design and calculations are in the Contract Documents or "Delegated Design" Paragraph below and Contractor is required to assume responsibility for design.

* + - * 1. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions, such as signs and light standards. Maintain 100 percent irrigation coverage of areas indicated.
        2. Delegated Design: Design 100 percent coverage irrigation system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

Retain applicable soil conditions in subparagraphs below and coordinate with "Delegated Design" Paragraph above.

Available land records indicate the following soil conditions:

Type: [**Coarse**] [**Medium**] [**Fine**] <**Insert type**>.

Texture:

Sand: <**Insert number**> percent.

Silt: <**Insert number**> percent.

Clay: <**Insert number**> percent.

Particle Size:

Sand: <**Insert number**> mm.

Silt: <**Insert number**> mm.

Clay: <**Insert number**> mm.

Structure: [**Single grained**] [**Granular**] [**Platy**] [**Blocky**] <**Insert structure**>.

Density: <**Insert lb/cu. ft.**>.

Moisture Content: <**Insert number**> percent.

Infiltration Rate: <**Insert gph**>.

* + - * 1. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:

Irrigation Main Piping: [**200 psig**] <**Insert value**>.

Circuit Piping: [**150 psig**] <**Insert value**>.

* + - 1. PIPES, TUBES, AND FITTINGS

See "Writing Guide" Article in the Evaluations for a discussion of how this Section is organized and the most efficient way to edit this Section. See "Piping Materials and Standards" Article in the Evaluations for a discussion of piping materials covered by referenced standards.

* + - * 1. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

Pipe in "Galvanized-Steel Pipe" Paragraph below is available in NPS 1/8 to NPS 26 (DN 6 to DN 650).

* + - * 1. Galvanized-Steel Pipe: ASTM A53/A53M, Standard Weight, Type E, Grade B.

Nipples in "Galvanized-Steel Pipe Nipples" Subparagraph below are available in NPS 1/8 to NPS 12 (DN 6 to DN 300).

Galvanized-Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M or ASTM A106/A106M, Standard Weight, seamless-steel pipe with threaded ends.

Fittings in "Galvanized, Gray-Iron Threaded Fittings" Subparagraph below are available in NPS 1/4 to NPS 12 (DN 8 to DN 300).

Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

Unions in "Malleable-Iron Unions" Subparagraph below are available in NPS 1/8 to NPS 4 (DN 6 to DN 100).

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.

Flanges in "Cast-Iron Flanges" Subparagraph below are available in NPS 1 to NPS 96 (DN 25 to DN 2400).

Cast-Iron Flanges: ASME B16.1, Class 125.

Pipe in "Ductile-Iron Pipe with Mechanical Joints" Paragraph below is available in NPS 3 to NPS 64 (DN 80 to DN 1600).

* + - * 1. Ductile-Iron Pipe with Mechanical Joints: AWWA C151, with mechanical-joint bell and spigot ends.

Fittings in "Mechanical-Joint, Ductile-Iron Fittings" Subparagraph below are available in NPS 3 to NPS 48 (DN 80 to DN 1200).

Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

Pipe in "Ductile-Iron Pipe with Push-on Joint" Paragraph below is available in NPS 3 to NPS 64 (DN 80 to DN 1600).

* + - * 1. Ductile-Iron Pipe with Push-on Joint: AWWA C151, with push-on-joint bell and spigot ends.

Fittings in "Push-on-Joint, Ductile-Iron Fittings" Subparagraph below are available in NPS 3 to NPS 64 (DN 80 to DN 1600).

Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

Gaskets: AWWA C111 rubber.

Tube in "Soft Copper Tube" Paragraph below is available in NPS 1/8 to NPS 12 (DN 6 to DN 300).

* + - * 1. Soft Copper Tube: ASTM B88, Type L, water tube, annealed temper.

Cast-copper-alloy fittings in "Copper Pressure Fittings" Subparagraph below are available in NPS 1/4 to NPS 12 (DN 8 to DN 300); wrought-copper fittings are available in NPS 1/4 to NPS 8 (DN 8 to DN 200).

Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper solder-joint fittings. Furnish wrought-copper fittings if indicated.

Flanges in "Bronze Flanges" Subparagraph below are available in NPS 1/2 to NPS 12 (DN 15 to DN 300).

Bronze Flanges: ASME B16.24, Class 150, with solder-joint end.

Unions in "Copper Unions" Subparagraph below are available in NPS 1/4 to NPS 4 (DN 8 to DN 100).

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.

Tube in "Hard Copper Tube" Paragraph below is available in NPS 1/8 to NPS 12 (DN 6 to DN 300).

* + - * 1. Hard Copper Tube: [**ASTM B88, Type L****,**] [**and**] [**ASTM B88, Type M****,**] water tube, drawn temper.

Fittings in "Copper Pressure Fittings" Subparagraph below are available in NPS 1/4 to NPS 12 (DN 8 to DN 300).

Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper solder-joint fittings. Furnish wrought-copper fittings if indicated.

Flanges in "Bronze Flanges" Subparagraph below are available in NPS 1/2 to NPS 12 (DN 15 to DN 300).

Bronze Flanges: ASME B16.24, Class 150, with solder-joint end.

Unions in "Copper Unions" Subparagraph below are available in NPS 1/2 to NPS 4 (DN 15 to DN 100).

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.

Pipe in "PE Pipe with Controlled ID" Paragraph below is available in NPS 1/2 to NPS 6 (DN 15 to DN 150).

* + - * 1. PE Pipe with Controlled ID: ASTM D2239, PE 3408 compound; [**SIDR 11.5**] [**and**] [**SIDR 15**].

Fittings in "Insert Fittings for PE Pipe" Subparagraph below are available in NPS 1/2 to NPS 4 (DN 15 to DN 100).

Insert Fittings for PE Pipe: ASTM D2609, nylon or propylene plastic with barbed ends. Include bands or other fasteners.

Pipe in "PE Pipe with Controlled OD" Paragraph below is available in NPS 1/2 to NPS 6 (DN 15 to DN 150).

* + - * 1. PE Pipe with Controlled OD: ASTM D3035, PE 3408 compound, SIDR 11.

Fittings in "PE Butt, Heat-Fusion Fittings" Subparagraph below are available in NPS 1/2 to NPS 48 (DN 15 to DN 1200).

PE Butt, Heat-Fusion Fittings: ASTM D3261.

Fittings in "PE Socket-Type Fittings" Subparagraph below are available in NPS 1/2 to NPS 4 (DN 15 to DN 100).

PE Socket-Type Fittings: ASTM D2683.

Pipe in "PE Pressure Pipe" Paragraph below is available in NPS 4 to NPS 63 (DN 100 to DN 1575).

* + - * 1. PE Pressure Pipe: AWWA C906, with DR of 7.3, 9, or 9.3 and PE compound number required to give pressure rating of not less than [**160 psig**] [**200 psig**].

Fittings in "PE Butt, Heat-Fusion Fittings" Subparagraph below are available in NPS 1/2 to NPS 48 (DN 15 to DN 1200).

PE Butt, Heat-Fusion Fittings: ASTM D3261.

Fittings in "PE Socket-Type Fittings" Subparagraph below are available in NPS 1/2 to NPS 4 (DN 15 to DN 100).

PE Socket-Type Fittings: ASTM D2683.

Pipe in "PVC Pipe" Paragraph below is available in NPS 1/8 to NPS 24 (DN 6 to DN 600). Retain last option if retaining both thicknesses in "Piping Schedule" Article.

* + - * 1. PVC Pipe: ASTM D1785, PVC 1120 compound, [**Schedule 40**] [**Schedule 80**] [**Schedules 40 and 80**].

Fittings in "PVC Socket Fittings" Subparagraph below are available in NPS 1/2 to NPS 12 (DN 15 to DN 300). Retain last option if retaining both thicknesses in "Piping Schedule" Article.

PVC Socket Fittings: ASTM D2466, [**Schedule 40**] [**Schedule 80**] [**Schedules 40 and 80**].

Fittings in "PVC Threaded Fittings" Subparagraph below are available in NPS 1/2 to NPS 2 (DN 15 to DN 50).

PVC Threaded Fittings: ASTM D2464, Schedule 80.

Unions in subparagraph below are available in NPS 1/2 to NPS 2 (DN 15 to DN 50).

PVC Socket Unions: Construction similar to that of MSS SP-107, except both headpiece and tailpiece shall be PVC with socket ends.

Pipe in "PVC Pipe, Pressure Rated" Paragraph below is available in NPS 3/4 to NPS 36 (DN 20 to DN 900).

* + - * 1. PVC Pipe, Pressure Rated: ASTM D2241, PVC 1120 compound, [**SDR 21**] [**and**] [**SDR 26**].

Fittings in "PVC Socket Fittings" Subparagraph below are available in NPS 1/8 to NPS 12 (DN 6 to DN 300).

PVC Socket Fittings: ASTM D2467, Schedule 80.

Unions in "PVC Socket Unions" Subparagraph below are available in NPS 1/2 to NPS 2 (DN 15 to DN 50).

PVC Socket Unions: Construction similar to that of MSS SP-107, except both headpiece and tailpiece shall be PVC with socket or threaded ends.

* + - 1. PIPING JOINING MATERIALS
         1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick unless otherwise indicated; full-face or ring type unless otherwise indicated.
         2. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
         3. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
         4. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux in accordance with ASTM B813.
         5. Solvent Cements for Joining PVC Piping: ASTM D2564. Include primer in accordance with ASTM F656.
         6. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.
      2. ENCASEMENT FOR PIPING
         1. Standard: ASTM A674 or AWWA C105.
         2. Form: [**Sheet**] [**Sheet or tube**] [**Tube**].
         3. Material: [**LLDPE film of 0.008-inch**] [**LLDPE film of 0.008-inch** **minimum thickness or high-density, cross-laminated PE film of 0.004-inch**] [**High-density, cross-laminated PE film of 0.004-inch**] minimum thickness.
         4. Color: [**Black**] [**or**] [**Natural**] <**Insert color**>.
      3. MANUAL VALVES

Retain "Curb-Valve Casing" Paragraph below with "Curb Valves" Paragraph above. "Casing" is the AWWA term. Most manufacturers simply call them "valve boxes."

* + - * 1. Curb-Valve Casing:

Standard: Similar to AWWA M44 for cast-iron valve casings.

Top Section: Telescoping, of length required for depth of burial of curb valve.

Barrel: Approximately 3-inch diameter.

Plug: With lettering "WATER."

Bottom Section: With base of size to fit over valve.

Base Support: Concrete collar[ **or wood frame**].

* + - * 1. Shutoff Rods for Curb-Valve Casings: Furnish [**one**] [**two**] <**Insert number**> steel, tee-handle shutoff rod(s) with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve for Project.

Valves in "Bronze Ball Valves" Paragraph below are available in NPS 1/4 to NPS 4 (DN 8 to DN 100).

* + - * 1. Bronze Ball Valves:

Retain "Basis-of-Design Product" Subparagraph and list of manufacturers below to identify a specific product or a comparable product from manufacturers listed.

Basis-of-Design Product: Subject to compliance with requirements, provide **Zurn Industries, LLC; Model 850XL** or comparable product by one of the following:

<**Insert manufacturer's name**>

Description:

Standard: MSS SP-110.

SWP Rating: 150 psig.

CWP Rating: 600 psig.

Body Design: Two piece.

Body Material: Bronze.

Ends: Threaded or solder joint if indicated.

Seats: PTFE or TFE.

Stem: Bronze.

Ball: Chrome-plated brass.

Port: Full[ **or regular, but not reduced**].

Retain "Iron Gate Valve Casings" Paragraph below with "Iron Gate Valves, Resilient Seated" Paragraph above. "Casing" is the AWWA term. Most manufacturers simply call them "valve boxes."

* + - * 1. Iron Gate Valve Casings:

Standard: AWWA M44 for cast-iron valve casings.

Top Section: Adjustable extension of length required for depth of burial of valve.

Barrel: Approximately 5-inch diameter.

Plug: With lettering "WATER."

Bottom Section: With base of size to fit over valve.

Base Support: Concrete collar[ **or wood frame**].

* + - * 1. Operating Wrenches for Iron Gate Valve Casings: Furnish [**one**] [**two**] <**Insert number**> steel, tee-handle operating wrench(es) with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut for Project.
      1. AUTOMATIC DRAIN VALVES
         1. Description: Spring-loaded-ball type of corrosion-resistant construction and designed to open for drainage if line pressure drops below 2-1/2 to 3 psig.
      2. MISCELLANEOUS PIPING SPECIALTIES
         1. Water Hammer Arresters: 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.
         2. Pressure Gages: ASME B40.1. Include 4-1/2-inch- diameter dial, dial range of two times system operating pressure, and bottom outlet.

1. EXECUTION
   * + 1. EARTHWORK
          1. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."
          2. Install warning tape directly above pressure piping, [**12 inches**] <**Insert value**> below finished grades, except 6 inches below subgrade under pavement and slabs.
          3. Drain Pockets: Excavate to sizes indicated. Backfill with cleaned gravel or crushed stone, graded from [**3/4 to 3 inches**] <**Insert value**>, to [**12 inches**] <**Insert value**> below grade. Cover gravel or crushed stone with sheet of asphalt-saturated felt and backfill remainder with excavated material.
          4. Provide minimum cover over top of underground piping according to the following:

Revise cover depths in subparagraphs below to suit Project and to ensure that pipes are below depth of frost penetration. Depth is not critical if system will be drained during freezing conditions.

Irrigation Main Piping: Minimum depth of [**36 inches**] <**Insert value**> below finished grade, or not less than [**18 inches**] <**Insert value**> below average local frost depth, whichever is deeper.

Circuit Piping: [**12 inches**] <**Insert value**>.

Drain Piping: [**12 inches**] <**Insert value**>.

Sleeves: [**24 inches**] <**Insert value**>.

* + - 1. PREPARATION
         1. Set stakes to identify locations of proposed irrigation system. Obtain Architect's approval before excavation.
      2. INSTALLATION OF PIPING
         1. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.
         2. Install piping at minimum uniform slope of 0.5 percent down toward drain valves.
         3. Install piping free of sags and bends.
         4. Install groups of pipes parallel to each other, spaced to permit valve servicing.
         5. Install fittings for changes in direction and branch connections.
         6. Install unions adjacent to valves and to final connections to other components with NPS 2 or smaller pipe connection.
         7. Install flanges adjacent to valves and to final connections to other components with NPS 2-1/2 or larger pipe connection.

Option in first paragraph below may be withdrawn. If retaining option, verify availability.

* + - * 1. Install underground thermoplastic piping in accordance with ASTM D2774[ **and ASTM** ].
        2. Install expansion loops in control-valve boxes for plastic piping.
        3. Lay piping on solid subbase, uniformly sloped without humps or depressions.
        4. Install ductile-iron piping in accordance with AWWA C600.
        5. Install PVC piping in dry weather when temperature is above 40 deg F. Allow joints to cure at least 24 hours at temperatures above 40 deg F before testing.

Revise first two paragraphs below to suit Project; delete if not required.

* + - * 1. 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.
        2. Water Hammer Arresters: Install between connection to building main and circuit valves aboveground or in control-valve boxes.
        3. Install piping in sleeves under parking lots, roadways, and sidewalks.
        4. Install sleeves made of [**Schedule 40**] [**Schedule 80**], PVC pipe and socket fittings, and solvent-cemented joints.
        5. Install transition fittings for plastic-to-metal pipe connections according to the following:

Underground Piping:

NPS 1-1/2 and Smaller: Plastic-to-metal transition fittings.

NPS 2 and Larger: AWWA transition couplings.

Aboveground Piping:

NPS 2 and Smaller: Plastic-to-metal transition [**fittings**] [**unions**].

NPS 2 and Larger: Use dielectric flange kits with one plastic flange.

* + - * 1. Install dielectric fittings for dissimilar-metal pipe connections according to the following:

Underground Piping:

NPS 2 and Smaller: Dielectric coupling or dielectric nipple.

NPS 2-1/2 and Larger: Prohibited except in control-valve box.

Aboveground Piping:

NPS 2 and Smaller: Dielectric union.

NPS 2-1/2 to NPS 4: Dielectric flange.

NPS 5 and Larger: Dielectric flange kit.

Piping in Control-Valve Boxes:

NPS 2 and Smaller: Dielectric union.

NPS 2-1/2 to NPS 4: Dielectric flange.

NPS 5 and Larger: Dielectric flange kit.

* + - 1. JOINT CONSTRUCTION
         1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
         2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
         3. Threaded Joints: Thread pipe with tapered pipe threads in accordance with 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:

Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

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.

* + - * 1. Flanged Joints: Select rubber gasket material of size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
        2. Ductile-Iron Piping Gasketed Joints: Comply with AWWA C600 and AWWA M41.
        3. Copper-Tubing Brazed Joints: Construct joints in accordance with CDA's "Copper Tube Handbook," using copper-phosphorus brazing filler metal.
        4. Copper-Tubing Soldered Joints: Apply ASTM B813 water-flushable flux to tube end unless otherwise indicated. Construct joints in accordance with ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B32.
        5. PE Piping Fastener Joints: Join with insert fittings and bands or fasteners in accordance with piping manufacturer's written instructions.
        6. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join in accordance with ASTM D2657.

Plain-End PE Pipe and Fittings: Use butt fusion.

Plain-End PE Pipe and Socket Fittings: Use socket fusion.

* + - * 1. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:

Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.

PVC Pressure Piping: Join schedule number, ASTM D1785, PVC pipe and PVC socket fittings in accordance with ASTM D2672. Join other-than-schedule-number PVC pipe and socket fittings in accordance with ASTM D2855.

PVC Nonpressure Piping: Join in accordance with ASTM D2855.

* + - 1. INSTALLATION OF VALVES
         1. Underground Curb Valves: Install in curb-valve casings with tops flush with grade.
         2. Underground Iron Gate Valves, Resilient Seat: Comply with AWWA C600 and AWWA M44. Install in valve casing with top flush with grade.

An alternative to restrained joints in subparagraph below is thrust blocks indicated on Drawings.

Install valves and PVC pipe with restrained, gasketed joints.

* + - * 1. Aboveground Valves: Install as components of connected piping system.
        2. Pressure-Reducing Valves: Install in boxes for automatic control valves or aboveground between shutoff valves.[ **Install full-size valved bypass.**]
        3. Throttling Valves: Install in underground piping in boxes for automatic control valves.
        4. Drain Valves: Install in underground piping in boxes for automatic control valves.
      1. INSTALLATION OF SPRINKLERS
         1. Install sprinklers after hydrostatic test is completed.
         2. Install sprinklers at manufacturer's recommended heights.
         3. Locate part-circle sprinklers to maintain a minimum distance of 4 inches from walls and 2 inches from other boundaries unless otherwise indicated.
      2. INSTALLATION OF DRIP IRRIGATION SPECIALTIES

Irrigation specialty type, arrangement, sizes, water-flow data, and mounting heights should be indicated on Drawings; details may be required.

* + - * 1. Install freestanding emitters on pipe riser to mounting height indicated.
        2. Install manifold emitter systems with tubing to emitters. Plug unused manifold outlets. Install emitters on off-ground supports at height indicated.
        3. Install multiple-outlet emitter systems with tubing to outlets. Plug unused emitter outlets. Install outlets on off-ground supports at height indicated.
        4. Install drip tubes with direct-attached emitters on ground.
        5. Install drip tubes with remote discharge on ground with outlets on off-ground supports at height indicated.
        6. Install off-ground supports of length required for indicated mounted height of device.
        7. Install [**application pressure regulators**] [**and**] [**filter units**] in piping near device being protected, and [**aboveground**] [**in control-valve boxes**].
        8. Install [**air relief valves**] [**and**] [**vacuum relief valves**] in piping, and [**aboveground**] [**in control-valve boxes**].
      1. INSTALLATION OF AUTOMATIC IRRIGATION CONTROL SYSTEM

Retain "Equipment Mounting, Interior" or "Equipment Mounting, Exterior" Paragraph below.

* + - * 1. Equipment Mounting, Interior: Install controllers on interior [**floor**] [**concrete bases**] [**wall**].

Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

Install anchor bolts to elevations required for proper attachment to supported equipment.

* + - * 1. Equipment Mounting, Exterior: Install exterior freestanding controllers on precast concrete bases.

Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

Install anchor bolts to elevations required for proper attachment to supported equipment.

* + - * 1. Install control cable in same trench as irrigation piping and at least 2 inches below[ **or beside**] piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.
      1. CONNECTIONS

Coordinate irrigation piping installations and specialty arrangements with schematics on Drawings and with requirements specified. If Drawings are explicit enough, these requirements may be reduced or omitted.

* + - * 1. Comply with requirements for piping specified in Section 331415 "Site Water Distribution 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.
        2. Install piping adjacent to equipment, valves, and devices to allow service and maintenance.
        3. Connect wiring between controllers and automatic control valves.
      1. IDENTIFICATION
         1. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."
         2. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on each automatic controller.

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.

* + - * 1. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tapes over underground piping during backfilling of trenches. See Section 312000 "Earth Moving" for warning tapes.
      1. FIELD QUALITY CONTROL

Retain "Manufacturer's Field Service" Paragraph below to require a factory-authorized service representative to perform inspections, tests, and adjustments.

* + - * 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

Retain first paragraph below to require Contractor to perform tests and inspections.

* + - * 1. Perform tests and inspections.

Retain "Manufacturer's Field Service with Test Assistance" Subparagraph below to require a factory-authorized service representative to assist Contractor with inspections, tests, and adjustments.

Manufacturer's Field Service with Test Assistance: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

Retain "Tests and Inspections" Paragraph below to describe tests and inspections to be performed.

* + - * 1. Tests and Inspections:

See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

Retain "Operational Test" Subparagraph below for controllers and automatic control valves.

Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.

Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

Irrigation system will be considered defective if it does not pass tests and inspections.

* + - * 1. Prepare test and inspection reports.
      1. STARTUP SERVICE
         1. [**Engage a factory-authorized service representative to perform**] [**Perform**] startup service.

Complete installation and startup checks in accordance with manufacturer's written instructions.

Retain both subparagraphs below for controllers and automatic control valves.

Verify that controllers are installed and connected in accordance with the Contract Documents.

Verify that electrical wiring installation complies with manufacturer's submittal.

* + - 1. ADJUSTING

Revise this article to suit Project. Retain first two paragraphs below for controllers and automatic control valves.

* + - * 1. Adjust settings of controllers.
        2. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.
        3. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than [**1/2 inch**] <**Insert value**> above, finish grade.
      1. CLEANING
         1. Flush dirt and debris from piping before installing sprinklers and other devices.
      2. DEMONSTRATION
         1. [**Engage a factory-authorized service representative to train**] [**Train**] Owner's maintenance personnel to adjust, operate, and maintain [**automatic control valves**] [**and**] [**controllers**].
      3. PIPING SCHEDULE

Retain and revise applicable piping applications. Coordinate with materials specified in Part 2.

* + - * 1. Install components having pressure rating equal to or greater than system operating pressure.
        2. Piping in control-valve boxes and aboveground may be joined with flanges or unions instead of joints indicated.
        3. Aboveground Irrigation Main Piping:

NPS 4 and Smaller:

Galvanized-steel pipe and galvanized-steel pipe nipples; galvanized, gray-iron threaded fittings; and threaded joints.

[**Type L**] [**Type M**] hard copper tube, wrought- or cast-copper fittings, and [**brazed**] [**soldered**] joints.

[**Schedule 40**] [**Schedule 80**], PVC pipe; socket-type PVC fittings; and solvent-cemented joints.

Schedule 80, PVC pipe; Schedule 80, threaded PVC fittings; and threaded joints.

NPS 5 and Larger:

Galvanized-steel pipe and galvanized-steel pipe nipples; galvanized, gray-iron threaded fittings; and threaded joints.

[**Schedule 40**] [**Schedule 80**], PVC pipe and socket fittings; and solvent-cemented joints.

Schedule 80, PVC pipe; Schedule 80, threaded PVC fittings; and threaded joints.

* + - * 1. Underground Irrigation Main Piping:

NPS 4 and Smaller:

NPS 3 and NPS 4 ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings, glands, bolts, and nuts; and gasketed joints.

NPS 3 and NPS 4 ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings and gaskets; and gasketed joints.

Type L soft copper tube, wrought-copper fittings, and brazed joints.

Pipe in first subparagraph below is only available in NPS 4 (DN 100) and larger.

NPS 4 PE pressure pipe; PE butt, heat-fusion or socket-type fittings; and heat-fusion joints.

[**Schedule 40**] [**Schedule 80**], PVC pipe and socket fittings, and solvent-cemented joints.

Schedule 80, PVC pipe; Schedule 80, threaded PVC fittings; and threaded joints.

SDR 21, PVC, pressure-rated pipe; Schedule 80, PVC socket fittings; and solvent-cemented joints.

NPS 5 and Larger:

NPS 6 and larger ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings, glands, bolts, and nuts; and gasketed joints.

NPS 6 and larger ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings and gaskets; and gasketed joints.

PE pressure pipe; PE butt, heat-fusion fittings; and heat-fusion joints.

[**Schedule 40**] [**Schedule 80**], PVC pipe and socket fittings; and solvent-cemented joints.

SDR 21, PVC, pressure-rated pipe; Schedule 80, PVC socket fittings; and solvent-cemented joints.

* + - * 1. Circuit Piping:

NPS 2 and Smaller:

[**SIDR 7**] [**SIDR 9**], PE, controlled ID pipe; insert fittings for PE pipe; and fastener joints.

[**DR 9**] [**DR 11**], PE, controlled OD pipe; PE butt, heat-fusion, or PE socket-type fittings; and heat-fusion joints.

Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.

SDR 26, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.

NPS 2-1/2 to NPS 4:

[**SIDR 7**] [**SIDR 9**], PE, controlled ID pipe; insert fittings for PE pipe; and banded or fastener joints.

[**DR 9**] [**DR 11**], PE, controlled OD pipe; PE socket or butt-fusion fittings; and heat-fusion joints. NPS 3 pipe and fittings if NPS 2-1/2 pipe and fittings are not available.

Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.

SDR 26, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.

* + - * 1. Underground Branches and Offsets at Sprinklers and Devices: Schedule 80, PVC pipe; threaded PVC fittings; and threaded joints.

Option: Plastic swing-joint assemblies, with offsets for flexible joints, manufactured for this application.

* + - * 1. Risers to Aboveground Sprinklers and Specialties:

Retain one of two subparagraphs below.

[**Type L**] [**Type M**] hard copper tube, wrought-copper fittings, and [**brazed**] [**soldered**] joints.

Schedule 80, PVC pipe and socket fittings; and solvent-cemented joints.

Retain option in paragraph below to allow Contractor to select piping materials from those retained.

* + - * 1. Drain piping shall be[ **one of**] the following:

SIDR 9, 11.5, or 15; PE, controlled ID pipe; insert fittings for PE pipe; and banded or fastener joints.

Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.

SDR 21, 26, or 32.5; PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.

* + - 1. VALVE SCHEDULE
         1. Underground, Shutoff-Duty Valves: Use the following:

NPS 2 and Smaller: Curb valve, curb-valve casing, and shutoff rod.

NPS 3 and Larger: Iron gate valve, resilient seated; iron gate valve casing; and operating wrench(es).

* + - * 1. Aboveground, Shutoff-Duty Valves:

NPS 2 and Smaller:

Retain one of first two subparagraphs below.

[**Brass**] [**Brass or bronze**] [**Bronze**] [**Plastic**] ball valve.

Bronze gate valve.

NPS 2-1/2 and Larger:

Retain one of two subparagraphs below.

Iron ball valve.

Iron gate valve, [**NRS**] [**OS&Y**].

Valves in "Throttling-Duty Valves" Paragraph below are to be installed in control-valve boxes.

* + - * 1. Throttling-Duty Valves:

NPS 2 and Smaller:

Retain one of first two subparagraphs below.

[**Bronze**] [**Plastic**] automatic control valve.

[**Brass**] [**Brass or bronze**] [**Bronze**] [**Plastic**] ball valve.

NPS 2-1/2 and NPS 3:

Retain one of two subparagraphs below.

[**Bronze**] [**Plastic**] automatic control valve.

Iron ball valve.

* + - * 1. Drain Valves:

NPS 1/2 and NPS 3/4:

Retain one of first three subparagraphs below.

Automatic drain valve.

[**Brass**] [**Brass or bronze**] [**Bronze**] [**Plastic**] ball valve.

Bronze gate valve.

NPS 1 to NPS 2:

Retain one of two subparagraphs below.

[**Brass**] [**Brass or bronze**] [**Bronze**] [**Plastic**] ball valve.

Bronze gate valve.

END OF SECTION 328400