

# ADDENDUM

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Project: Billings Sweet Grass Creek

Project No.: 5011850

Addendum No.: One

Project Address: 2620 54<sup>th</sup> Street West, Billings, MT

Date: September 26, 2016

Owner: Corporation of the Presiding Bishop of The Church of Jesus Christ  
of Latter-day Saints, a Utah corporation sole

From (Architect): NBW Architects Idaho Falls, Idaho

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## Instructions to Prospective Bidders:

This Addendum forms a part of the Contract Documents and modifies the original Bidding Documents and/or prior Addenda as noted below. All conditions, requirements, materials and workmanship are to be as described in the Contract Documents unless specifically stated otherwise. This Addendum consists of 1 page(s) and the attached drawing(s), Sheet(s) See below, dated NA.

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## **GENERAL**

1. Add the following Divisions:
  - a. Division 31: Earthwork
  - b. Division 32: Exterior Improvements
  - c. Division 33: Utilities

## **CIVIL**

1. Add the following Civil Drawing Sheets to the Bid Set:
  - a. C101 – Site Plan - Horizontal Control
  - b. C701 – Site Civil Details
  - c. C702 – Site Civil Details
  - d. C703 – Site Civil Details
  - e. C801 – Storage Building & Details
  - f. C1.0 – Existing Topography & Demo Plan
  - g. C2.0 – Overall Site Plan
  - h. C3.0 – Site Plan
  - i. C4.1 – Grading Plan North
  - j. C4.2 – Grading Plan South
  - k. C4.3 – Grading Plan Building, Storm Drain
  - l. C5.0 – Utility Plan
  - m. C6.1 – Details
  - n. C6.2 – Pond Details

## **MECHANICAL**

1. Add the following Section 23 6213 to the Division 23 specifications.
2. Replace existing Bid Set drawings with the following attached plumbing sheets:
  - a. P101 – Main Floor Plumbing Plan
  - b. P401 – Large Scale Plumbing Plans
  - c. P901 – Plumbing Piping Schematics
3. See attached Detail B-P501. Replace existing detail.

End of Addendum

**SECTION 23 6213****PACKAGED AIR-COOLED REFRIGERANT COMPRESSOR  
AND CONDENSER UNITS: Air Conditioning****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Furnish and install compressor units as described in contract documents.
- B. Related Sections:
  - 1. Sections under Heading 07 5000 Membrane Roofing.
  - 2. Section 23 0501: 'Common HVAC Requirements'.
  - 3. Section 23 2300: 'Refrigerant Piping'.
  - 4. Section 23 5417: 'Gas-Fired Furnaces'.

**1.2 REFERENCES**

- A. Definitions:
  - 1. Compressor: Pump that increases vapor (refrigerant or air) pressure from one level to a higher level of pressure.
  - 2. Compressor Unit: Outside section of an air conditioning system which pumps vaporized refrigerant from the evaporator, compresses it, liquefies it in the condenser and returns it to the evaporator coil. The outdoor portion of a split system air conditioner contains the compressor and outdoor coil.
  - 3. Condenser: Device used to condense refrigerant in a cooling system.
  - 4. Condenser Coils: In a compressor unit, the coil dissipates heat from the refrigerant, changing the refrigerant from vapor to liquid.
  - 5. Refrigerant: Absorbs heat by a change of state (evaporation) from liquid to a gas, and releases heat by a change of state (condenses) from gas back to a liquid.
  - 6. SEER (Seasonal Energy Efficiency Ratio): Measure of cooling efficiency for air conditioners and heat pumps. A ratio of total cooling in comparison to electrical energy input in watts per hour. Higher the seer, the more energy efficient the unit. Since 2006, the minimum SEER required by the Department of Energy is 13.00 and 15.00+ SEER is considered high efficiency.
  - 7. Split System: Combination of an outdoor unit (air conditioner or heat pump) with an indoor unit (furnace or air handler). Split systems must be matched for optimum efficiency.
- B. Reference Standards:
  - 1. American National Standards Institute / Air-Conditioning, Heating, and Refrigeration Institute:
    - a. ANSI/AHRI Standard 210/240-2008, 'Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment' (formerly ARI Standard 210/240).

**1.3 SUBMITTALS**

- A. Informational Submittals:
  - 1. Tests and Evaluation Reports:
    - a. Manufacturer Reports: Equipment check-out sheets.
  - 2. Qualification Statements:
    - a. Technician certificate for use in HFC and HCFC refrigerants.

- B. Closeout Submittals:
  - 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
    - a. Warranty Documentation:
      - 1) Final, executed copy of Warranty.
    - b. Record Documentation:
      - 1) Manufacturers Documentation:
        - a) Equipment checkout sheet: Complete and sign all items for each unit.

## 1.4 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
  - 1. Each unit shall be UL / ULC or ETL labeled.
  - 2. Comply with ANSI/AHRI Standard 210/240.
  - 3. Refrigeration compressor, coils, and specialties shall be designed to operate with CFC-free refrigerants.
- B. Qualifications. Section 01 4301 applies, but is not limited to the following:
  - 1. Installer: Refrigerant piping shall be installed by refrigeration contractor licensed by State and by technicians certified in use of HFC and HCFC refrigerants.

## 1.5 WARRANTY

- A. Manufacturer's Warranty:
  - 1. Provide Manufacturer's Special LDS Warranty for the following:
    - a. Provide ten (10) year limited warranty on compressor and five (5) year limited warranty on parts from date of 'start-up'.
    - b. Record 'start-up' date on warranty certificate for each unit.

## PART 2 - PRODUCTS

### 2.1 ASSEMBLIES

- A. Manufacturers:
  - 1. Manufacturer Contact List:
    - a. Air-Rite Manufacturing, Bountiful, UT [www.air-ritemfg.com](http://www.air-ritemfg.com).
      - 1) Blair Halverson (801) 295-2529.
    - b. Carrier Corporation:
      - 1) Carrier National: Bradley Brunner (270) 282-1241 [Bradley.M.Brunner@Carrier.utc.com](mailto:Bradley.M.Brunner@Carrier.utc.com).
      - 2) Carrier Utah: Rich Carpenter (Contractors HVAC Supply) (801) 410-6077 [rcarpent@mtncor.net](mailto:rcarpent@mtncor.net).
    - c. Lennox Industries:
      - 1) For pricing and information call Lennox National Account at (800) 367-6285.
      - 2) Lennox National Contact : Cody Jackson (801) 736-8904 [Cody.Jackson@LennoxInd.com](mailto:Cody.Jackson@LennoxInd.com).
    - d. York International:
      - 1) Brian Michael (405) 419-6230 [brian.k.michael@jci.com](mailto:brian.k.michael@jci.com).
- B. Performance:
  - 1. Capacities: SEER rating as defined by AHRI shall be 13.0 or greater.
- C. Manufactured Units:
  - 1. Compressor Units (5 Tons or Less):
    - a. General:

- 1) Units shall be operable down to 0 deg F (minus 18 deg C) outdoor temperature.
- 2) Use R-410a refrigerant.
- 3) Only one liquid line, one suction line, and one power connection shall be made to each compressor. Provide charging valves.
- b. Condenser Coils:
  - 1) Aluminum plate fins mechanically bonded to seamless copper tubes or 'Spine Fin' trade mark system which has aluminum fins epoxy bonded to aluminum tubes or micro-channel.
  - 2) Provide stamped louver coil guard for unit.
- c. Fans:
  - 1) Direct driven propeller type.
  - 2) Fan motor shall be single or two speed, thermostatically controlled, permanently lubricated, and designed with permanent protection.
  - 3) Motors shall be resiliently mounted.
  - 4) Each fan shall have a safety guard.
- d. Compressor:
  - 1) Each condenser unit shall have only one compressor.
  - 2) Design with following features:
    - a) Externally mounted brass service valves with charging connections.
    - b) Crankcase heater.
    - c) Resilient rubber mounts.
    - d) Compressor motor-overload protection.
    - e) Single speed.
- e. Controls:
  - 1) Factory wired and located in separate enclosure.
  - 2) Following three paragraphs may not be factory installed and will therefore have to be field installed.
  - 3) Safety devices:
    - a) High and low pressure cutout.
    - b) Condenser fan motor-overload devices.
  - 4) Anti-cycle timers to prevent units from starting up again for five minutes after any power interruption.
  - 5) Head pressure type low ambient kit.
- f. Casing:
  - 1) Fully weatherproof for outdoor installation. Finish shall be weather resistant.
- g. Openings shall be provided for power and refrigerant connections.
- h. Panels shall be removable for servicing.
- i. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
  - 1)
    - a) Carrier: 24AAA5.
    - b) Lennox: 14ACX.
    - c) York: YCS.

## 2.2 ACCESSORIES

### A. Vibration Isolators:

1. 4 inches (100 mm) square by 3/4 inch (19 mm) thick minimum neoprene type vibration isolation pads.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

#### A. Verification Of Conditions:



1. Notify Architect of unsuitable conditions in writing
2. Commencement of Work by Installer is considered acceptance of substrate.

### **3.2 INSTALLATION**

- A. General:
1. Set compressor units level on concrete slab on vibration isolation pads located at each corner of unit. This does not apply to compressor units that have composite non-metal bottom.
  2. Do not use capillary tube and piston type refrigerant metering devices.

### **3.3 FIELD QUALITY CONTROL**

- A. Manufacturer Services:
1. Compressor units shall be started up, checked out, and adjusted by compressor unit Installer.
  2. Use equipment checkout sheet provided by Manufacturer:
    - a. Complete and sign all items on sheet.

**END OF SECTION**

# **DIVISION 31: EARTHWORK**

## **31 0500 COMMON WORK RESULTS FOR EARTHWORK**

31 0501 COMMON EARTHWORK REQUIREMENTS

## **31 1000 SITE CLEARING**

31 1100 CLEARING AND GRUBBING

31 1123 AGGREGATE BASE

31 1413 TOPSOIL STRIPPING AND STOCKPILING

## **31 2000 EARTH MOVING**

31 2213 ROUGH GRADING

31 2216 FINE GRADING

31 2316 EXCAVATION

31 2319 DEWATERING

31 2323 FILL

31 2324 FLOWABLE FILL

31 2500 EROSION AND SEDIMENTATION CONTROLS

END OF TABLE OF CONTENTS

**SECTION 31 0501****COMMON EARTHWORK REQUIREMENTS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited to:
  - 1. General procedures and requirements for earthwork.
- B. Related Requirements:
  - 1. Pre-Installation conferences held jointly with Section 31 0501 as described in Administrative Requirements on Part 1 of this specification section:
  - 2. Section 32 9001: 'Common Planting Requirements':
    - a. Pre-installation conference held jointly with other landscape related sections.

**1.2 REFERENCES**

- A. Definitions:
  - 1. Aggregate Base: Layer of granular material immediately below concrete and asphalt paving or miscellaneous site concrete (sidewalks, curbs, etc) and below interior concrete slabs on grade.
  - 2. Base: See aggregate base.
  - 3. Building Grading: sloping of grounds immediately adjacent to building. Proper grading causes water to flow away from a structure. Grading can be accomplished either with machinery or by hand.
  - 4. Compacted Fill: Placement of soils on building site placed and compacted per Contract Documents. Used to replace soils removed during excavation or to fill in low spot on building site.
  - 5. Excavation: Removal of soil from project site or cavity formed by cutting, digging or scooping on project site.
  - 6. Fine Grading (FG): Preparation of subgrade preceding placement of surfacing materials (aggregate base, asphalt or concrete paving, and topsoil) for contour of building site required. Fine Grading is conducted to ensure that earth forms and surfaces have been properly shaped and subgrade has been brought to correct elevations. It is performed after rough grading and placement of compacted fill but before placement of aggregate base or topsoil.
  - 7. Finish Grading: Completed surface elevation of landscaping areas for seeding, sodding, and planting on building site.
  - 8. Natural Grade: Undisturbed natural surface of ground.
  - 9. Rough Grading (RG): Grading, leveling, moving, removal and placement of existing or imported soil to its generally required location and elevation. Cut and fill is part of rough grading.
  - 10. Subgrade (definition varies depending upon stage of construction and context of work being performed):
    - a. Prepared natural soils on which fill, aggregate base, or topsoil is placed.
    - or
    - b. Prepared soils immediately beneath paving or topsoil.
  - 11. Topsoil Placement and Grading: Topsoil placement and finish grading work required to prepare site for installation of landscaping.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Pre-Installation Conference:
  - 1. Participate in pre-installation conference for common earthwork sections:
    - a. Schedule conference after completion of site clearing but before beginning grading work.
    - b. Participate in pre-installation conference held jointly with following sections:
      - 1) Section 03 3111: 'Cast-In-Place Structural Concrete'.

- 2) Section 31 1100: 'Clearing and Grubbing'.
- 3) Section 31 1123: 'Aggregate Base'.
- 4) Section 31 1413: 'Topsoil Stripping and Stockpiling'.
- 5) Section 31 2213: 'Rough Grading'.
- 6) Section 31 2216: 'Fine Grading'.
- 7) Section 31 2316: 'Excavation'.
- 8) Section 31 2323: 'Fill'.
- 9) Section 32 1216: 'Asphalt Paving'.
- 10) Section 33 3313: 'Sanitary Utility Sewerage'.
- c. In addition to agenda items specified in Section 01 3100, review following:
  - 1) Review common earthwork schedule.
  - 2) Review protection requirements.
  - 3) Review cleaning requirements.
  - 4) Review safety issues.
  - 5) Review field tests and inspections requirements.
- d. In addition to agenda items specified above, review following. These are items that will occur before pre-installation conference for landscape sections:
  - 1) Review clearing and grubbing requirements.
  - 2) Review topsoil stripping and stockpiling requirements.
  - 3) Review landscape grading requirements.
  - 4) Review landscape finish grade tolerance requirements.
  - 5) Review landscape and plant tolerances.
  - 6) Review surface preparation of landscape and planting areas.
  - 7) Review additional agenda items as specified in related sections listed above.
2. Participate in pre-installation conference for landscape sections as specified in Section 32 9001:
  - a. Schedule pre-installation conference after completion of Fine Grading specified in Section 31 2216, but one (1) week minimum before beginning landscape work and held jointly with following sections:
    - 1) Section 32 8423: 'Underground Sprinklers'.
    - 2) Section 32 9120: 'Topsoil And Placement'.
    - 3) Section 32 9121: 'Topsoil Physical Preparation' (section included based on Topsoil Testing Report).
    - 4) Section 32 9122: 'Topsoil Grading'.
    - 5) Section 32 9223: 'Sodding'.
    - 6) Section 32 9300: 'Plants'.
  - b. In addition to agenda items specified in Section 01 3100 and Section 32 9001, review following that these items have been installed correctly:
    - 1) Review topsoil placement requirements.
    - 2) Review topsoil surface preparation requirements.
    - 3) Review topsoil depth requirements.
    - 4) Review landscape finish grade tolerance requirements.
    - 5) Review surface preparation of landscape and planting areas.
- B. General Earthwork Sequencing:
  1. Excavation.
  2. Rough Grading.
  3. Compacted Fill.
  4. Fine Grading.
  5. Aggregate Base or Topsoil Grading.

**PART 2 - PRODUCTS: Not Used****PART 3 - EXECUTION****3.1 EXAMINATION****A. Verification Of Conditions:**

1. Forty eight (48) hours minimum before performing any work on site, contact local **Underground Service Alert** to arrange for utility location services.
2. Perform minor, investigative excavations to verify location of various existing underground facilities at sufficient locations to assure that no conflict with the proposed work exists and sufficient clearance is available to avoid damage to existing facilities.
3. Perform investigative excavating ten (10) days minimum in advance of performing any excavation or underground work.
4. Upon discovery of conflicts or problems with existing facilities, notify Architect by phone or fax within twenty four (24) hours. Follow telephone or fax notification with letter and diagrams indicating conflict or problem and sufficient measurements and details to evaluate problem.

**3.2 PREPARATION****A. Protection:**

1. Spillage:
  - a. Avoid spillage by covering and securing loads when hauling on or adjacent to public streets or highways.
  - b. Remove spillage and sweep, wash, or otherwise clean project, streets, and highways.
2. Dust Control:
  - a. Take precautions necessary to prevent dust nuisance, both on-site and adjacent to public and private properties.
  - b. Correct or repair damage caused by dust.

**3.3 FIELD QUALITY CONTROL****A. Field Tests:**

1. Owner reserves right to require additional testing to re-affirm suitability of completed work including compacted soils that have been exposed to adverse weather conditions.

**B. Field Inspections:**

1. Notify Architect forty eight (48) hours before performing excavation or fill work.
2. If weather, scheduling, or any other circumstance has interrupted work, notify Architect twenty four (24) hours minimum before intended resumption of grading or compacting.

**C. Non-Conforming Work:**

1. If specified protection precautions are not taken or corrections and repairs not made promptly, Owner may take such steps as may be deemed necessary and deduct costs of such from monies due to Contractor. Such action or lack of action on Owner's part does not relieve Contractor from responsibility for proper protection of The Work.

**END OF SECTION**

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**SECTION 31 1100****CLEARING AND GRUBBING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Perform clearing and grubbing as necessary to prepare site for rough grading and structure excavation as described in Contract Documents.
- B. Related Requirements:
  - 1. Section 31 0501: Common Earthwork Requirements:
    - a. General procedures and requirements for earthwork.
    - b. Pre-installation conference held jointly with other common earthwork related sections.
    - c. Pre-installation conference held jointly with other landscape related sections.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- A. Pre-Installation Conference:
  - 1. Participate in pre-installation conferences as specified in Section 31 0501.

**PART 2 - PRODUCTS: Not Used****PART 3 - EXECUTION****3.1 PERFORMANCE**

- A. Tree And Brush Removal:
  - 1. Cut off trees, shrubs, brush, and vegetative growth **12 inches (300 mm)** maximum above ground.
  - 2. Cut roots **6 inches (150 mm)** or larger in diameter only with Architect's written permission.
- B. Grubbing:
  - 1. Grub out stumps and roots **12 inches (300 mm)** minimum below original ground surface, except as follows:
    - a. Under buildings, remove roots one inch and larger entirely.
    - b. Entirely remove roots of plants that normally sprout from roots, as identified by Architect.

**3.2 CLEANING**

- A. Remove from site trees, shrubs, uprooted stumps, vegetative layer, and surface debris and dispose of legally.
- B. Do not bury cuttings, stumps, roots, and other vegetative matter or burnt waste material on site.

**END OF SECTION**

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**SECTION 31 1123****AGGREGATE BASE****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Install the following as described in Contract Documents:
    - a. Aggregate SubBase (Stockpile of material currently being used for surcharge load):
      - 1) Interior slabs-on-grade concrete.
- B. Products Installed But Not Furnished Under This Section:
  - 1. Vapor Retarder:
    - a. Interior slabs on grade:
      - 1) Under-slab vapor retarder and seam tape.
  - b. Aggregate Base:
    - 1) Interior slabs-on-grade concrete.
    - 2) Miscellaneous cast-in-place concrete and equipment pads.
    - 3) Asphalt paving.
- C. Related Requirements:
  - 1. Section 01 1200: 'Multiple Contract Summary' for multiple contracts.
  - 2. Section 01 3100: 'Project Management and Coordination' for pre-installation conference.
  - 3. Section 01 4000: 'Quality Requirements' for administrative and procedural requirements for quality assurance and quality control.
  - 4. Section 01 4301: 'Quality Assurance – Qualifications' establishes minimum qualification levels required.
  - 5. Section 01 4523: 'Testing and Inspecting Services' for testing and inspection, and testing laboratory services for materials, products, and construction methods.
  - 6. Section 01 6200: Administrative and procedural requirements for product options.
  - 7. Section 01 7800: 'Closeout Submittals'.
  - 8. Section 03 3111: 'Cast-In-Place Structural Concrete'.
  - 9. Section 07 2616: 'Below-Grade Vapor Retarders' for:
    - a. Furnishing of vapor retarder and seam tape.
  - 10. Section 31 0501: 'Common Earthwork Requirements' for:
    - a. General procedures and requirements for earthwork.
    - b. Pre-installation conference held jointly with other common earthwork related sections.
  - 11. Section 31 2213: 'Rough Grading'.
  - 12. Section 31 2216: Subgrade procedures.
  - 13. Section 31 2323: Compaction procedures and tolerances.
  - 14. Section 32 1216: Asphalt paving.

**1.2 REFERENCES**

- A. Association Publications:
  - 1. Council of American Structural Engineers. CASE Form 101: *Statement of Special Inspections*. Washington, DC: CASE, 2001. (c/o American Council of Engineering Companies, 1015 15<sup>th</sup> St., NW, Washington, DC 20005; 202-347-7474; [www.acec.org](http://www.acec.org)).
- B. Definitions:
  - 1. AASHTO: The American Association of State Highway and Transportation Officials. Organization of highway engineers from the 50 states that develops guides and standards.
  - 2. Aggregate (Asphalt Paving):
    - a. Aggregate: A hard inert mineral material, such as gravel, crushed rock, slag, or sand.

- b. Coarse Aggregate: Aggregate retained on No. 8 (2.36 mm) sieve.
  - c. Dense-Graded Aggregate: Aggregate that is graded from maximum size down through filler with object of obtaining an asphalt mix with controlled void content and high stability.
  - d. Fine Aggregate: Aggregate passing No. 8 (2.36 mm) sieve.
  - e. Reclaimed Asphalt Pavement (RAP): Existing asphalt mixture that has been pulverized, usually by milling, and is used like an aggregate in recycling of asphalt pavements.
- C. Definitions (Following are specifically referenced for testing):
- 1. Accreditation: Process in which certification of competency, authority, or credibility is presented. Verify that laboratories have an appropriate quality management system and can properly perform certain test methods (e.g., ANSI, ASTM, and ISO test methods) and calibration parameters according to their scopes of accreditation.
  - 2. Approved: To authorize, endorse, validate, confirm, or agree to.
  - 3. Field Quality Control: Testing, Inspections, Special Testing and Special Inspections to assure compliance to Contract Documents.
  - 4. Inspection/Special Inspection: Inspection of materials, installation, fabrication, erection or placement of components and connections requiring special expertise to ensure compliance with approved construction documents and referenced standards:
    - a. Inspection: Not required by code provisions but may be required by Contract Documents.
    - b. Special Inspection: Required by code provisions and by Contract Documents.
    - c. Inspection-Continuous: Full-time observation of the Work requiring inspection by approved inspector who is present in area where the Work is being performed.
    - d. Inspection-Periodic: Part-time or intermittent observation of the Work requiring inspection by approved inspector who is present in area where the Work has been or is being performed and at completion of the Work.
  - 5. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform particular construction operation, including installation, erection, application, and similar operations.
  - 6. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation. They are not samples. Approved mockups establish standard by which the Work will be judged.
  - 7. Observation: Visual observation of building / site elements or structural system by registered design professional for general conformance to approved construction documents at significant construction stages and at completion. Observation does not include or waive responsibility for performing inspections or special inspections.
  - 8. Owner's Representative: Owner's Designated Representative (Project Manager or Facilities Manager) who will have express authority to bind Owner with respect to all matters requiring Owner's approval or authorization.
  - 9. Preconstruction Testing: Tests and inspections that are performed specifically for Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
  - 10. Product Testing: Tests and inspections that are performed by testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards..
  - 11. Relative Compaction: Ratio of field dry density as determined by ASTM D6938 or ASTM D2216, and laboratory maximum dry density as determined by ASTM D698.
  - 12. Quality Assurance: Testing, Inspections, Special Testing and Special Inspections provided for by Owner.
  - 13. Quality Control: Testing, Inspections, Special Testing and Special Inspections provided for by Contractor.
  - 14. Service Provider: Agency or firm qualified to perform required tests and inspections.
  - 15. Source Quality Control Testing: Tests and inspections that are performed at source, i.e., plant, mill, factory, or shop.
  - 16. Special Inspection: See Inspection.
  - 17. Special Inspector: Certified individual or firm that implements special inspection program for project.
  - 18. Special Test: See Test.

19. Test/Special Test: Field or laboratory tests to determine characteristics and quality of building materials and workmanship.
  - a. Test: Not required by code provisions but may be required by Contract Documents.
  - b. Special Test: Required by code provisions and by Contract Documents.
20. Testing Agency: Entity engaged to perform specific tests, inspections, or both.
21. Testing Agency Laboratory: Agency or firm qualified to perform field and laboratory tests to determine characteristics and quality of materials and workmanship.
22. Verification: Act of reviewing, inspecting, testing, etc. to establish and document that product, service, or system meets regulatory, standard, or specification requirements.

D. Reference Standards:

1. ASTM International:
  - a. ASTM C29/C29M-09, 'Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate'.
  - b. ASTM C117-13, 'Standard Test Method for Materials Finer than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing'.
  - c. ASTM C131/C131M-14, 'Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine'.
  - d. ASTM C136-06, 'Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates'.
  - e. ASTM C1077-14, 'Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation'.
  - f. ASTM D698-12, 'Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>))'.
  - g. ASTM D1556-07, 'Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method'.
  - h. ASTM D1557-12, 'Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>))'.
  - i. ASTM D1883-07, 'Standard Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils'.
  - j. ASTM D2216-10, 'Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass'.
  - k. ASTM D2419-14, 'Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate'.
  - l. ASTM D2487-11, 'Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)'.
  - m. ASTM D3666-13, 'Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials'.
  - n. ASTM D3740-12a, 'Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction'.
  - o. ASTM D4318-10, 'Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils'.
  - p. ASTM D6938-10, 'Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)'.
  - q. ASTM E11-13, 'Standard Specification for Wire Cloth and Sieves for Testing Purposes'.
  - r. ASTM E329-14a, 'Standard Specification for Agencies Engaged in Construction Inspection and/or Testing'.
  - s. ASTM E543-13, 'Standard Specification for Agencies Performing Nondestructive Testing'.
  - t. ASTM E1212-12, 'Standard Practice for Quality Management Systems for Nondestructive Testing Agencies'.
  - u. ASTM E1643-11, 'Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs'.
2. International Building Code (IBC):
  - a. Chapter 17, 'Structural Tests and Special Inspections' (2012 or latest edition available).

### 1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conferences:

1. Participate in pre-installation conference as specified in Section 31 0501.

2. In addition to agenda items specified in Section 01 3100 and Section 31 0501, review following:
  - a. Review aggregate base installation requirements.
  - b. Review vapor retarder installation requirements.
  - c. Review proposed miscellaneous exterior concrete schedule.
  - d. Review proposed asphalt paving schedule.
  - e. Review Section 01 4523 for Testing and Inspection administrative requirements and responsibilities and Field Quality Control tests and inspections required of this section.
    - 1) Review frequency of testing and inspections.
- B. Sequencing:
  1. Compaction as described in Section 31 2216 'Fine Grading'.
  2. Exterior Footings and Foundations are installed.
  3. Vapor Retarder:
    - a. Install below-grade vapor retarder on top of soil base or aggregate base.
  4. Aggregate Base:
    - a. Install aggregate base at location shown in Contract Drawings.
  5. Concrete Slab is installed.
- C. Scheduling:
  1. Interior slab-on-grade concrete:
    - a. Notify Architect twenty four (24) hours minimum before installation of concrete to allow inspection of vapor retarder installation.
    - b. Notify Testing Agency and Architect twenty four (24) hours minimum before installation of interior concrete slabs to allow inspection of aggregate base.
    - c. Allow special inspector to review all sub grades and excavations to determine if building pad has been prepared in accordance with geotechnical report prior to placing any aggregate base.
  2. Miscellaneous exterior concrete:
    - a. Notify Testing Agency and Architect twenty four (24) hours minimum before placing concrete for exterior site work concrete (sidewalks, curbs, gutters, etc.), footings, foundation walls, and building slabs to allow inspection of aggregate base.
  3. Asphalt Paving:
    - a. Notify Testing Agency and Architect twenty four (24) hours minimum before placing aggregate base to allow inspection of aggregate base.

#### 1.4 SUBMITTALS

- A. Closeout Submittals:
  1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
    - a. Record Documentation:
      - 1) Testing and Inspection Reports:
        - a) Testing Agency Testing and Inspecting Reports of aggregate base.

#### 1.5 QUALITY ASSURANCE

- A. Testing and Inspection:
  1. Owner will provide Testing and Inspection for aggregate base:
    - a. Owner will employ testing agencies to perform testing and inspection for aggregate base as specified in Field Quality Control in Part 3 of this specification.
      - 1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform the Work in strict accordance with requirements of Contract Documents and perform contractor testing and inspection.
      - 2) See Section 01 1200: 'Multiple Contract Summary'.
    - b. Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform testing and inspection as part of his Quality Control.
      - 1) Testing and inspections, if performed by Contractor, will be responsibility of Contractor to be performed by an independent entity.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery And Acceptance Requirements:
1. Materials shall be delivered in original, unopened packages with labels intact.

## 1.7 FIELD CONDITIONS

- A. Ambient Conditions:
1. Do not perform work during unfavorable conditions as specified below:
    - a. Aggregate Base:
      - 1) Presence of free surface water.
      - 2) Over-saturated sub base materials.
    - b. Vapor Retarder:
      - 1) Unacceptable conditions for installation include presence of high winds which would tear or damage vapor retarder.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Aggregate Base:
1. Interior slab-on-grade concrete:
    - a. New Aggregate Base:
      - 1) Gravel: **3/4 inch** minus well-graded, clean gravel or crushed rock.
      - 2) Base type gravel or crushed rock, graded by weight as follows (three-quarter to one-inch clean gap-graded gravel):
        - a) Road Base type gravel or crushed stone (slag not allowed), graded as follows:
 

(1) Sieve		Percent of Weight Passing
(a) 1 inch	(25.4 mm)	100
(b) 3/4 inch	(19.0 mm)	90 - 80
(c) 1/2 inch	(12.7 mm)	20 - 40
(d) 3/8 inch	(9.5 mm)	5 - 10
(e) No. 4	(4.750 mm)	0 - 5
  2. Miscellaneous exterior concrete (Section 03 3053):
    - a. New Aggregate Base:
      - 1) Road Base to conform to State DOT Specifications.
  3. Asphalt paving (Section 32 1216):
    - a. New Aggregate Base:
      - 1) Road Base to conform to **1-1/2 inches (38 mm)** minus State DOT Specifications and Gradations.
      - 2) Aggregate base shall be nonplastic.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Stockpiles:
1. Provide area for each stockpile of adequate size, reasonably uniform in cross-section, well drained, and cleared of foreign materials.
  2. Locate piles so that there is no contamination by foreign material and no intermingling of aggregates from adjacent piles. Do not use steel-tracked equipment on stockpiles.
  3. Do not store aggregates from different sources, geological classifications, or of different gradings in stockpiles near each other unless bulkhead is placed between different materials.

4. Do not use washed aggregates sooner than twenty four (24) hours after washing or until surplus water has drained out and material has uniform moisture content.
  5. Do not stockpile higher than **15 feet (4.57 m)**. Cover or otherwise protect stockpiles for use in HMA to prevent buildup of moisture.
- B. Surface Preparation (Miscellaneous Exterior Concrete):
1. Subgrade:
    - a. Finish grade to grades required by Contract Documents.
    - b. Compact subgrade as specified in Section 31 2323.
- C. Surface Preparation (Asphalt Paving):
1. Subgrade:
    - a. Finish grade parking surface area to grades required by Contract Documents.
    - b. Aggregate base and paving must be placed before any moisture or seasonal changes occur to subgrade that would cause compaction tests previously performed to be erroneous. Recompact and retest subgrade soils that have been left exposed to weather.
- D. Surface Preparation (Interior Slab-On-Grade Concrete):
1. Vapor retarder:
    - a. Install vapor retarder in accordance with ASTM E1643 except where Contract Documents indicate otherwise and following instructions:
      - 1) Install vapor retarder over aggregate base over compacted subgrade so entire area under slab is covered.
      - 2) Install vapor retarder in accordance with ASTM E1643 at interior stem walls.
      - 3) Lap joints **6 inches (150 mm)** minimum and seal with specified seam tape.
      - 4) Seal vapor retarder around pipes, conduits, and other utility items that penetrate vapor retarder using factory-fabricated boot installed as recommended by Manufacturer.
      - 5) Except for punctures required for reinforcing and anchor bolts at top of stem walls, seal tears and punctures.

## 3.2 INSTALLATION

- A. Aggregate Base:
1. General:
    - a. Do not place aggregate base material when subgrade is frozen or unstable.
    - b. Spread aggregate base material with equipment except in limited or restricted areas where use of hand spreading is allowed.
    - c. Spread aggregate base material in manner that does not break down material and eliminates segregation, ruts, and ridges.
    - d. Correct damage to aggregate base caused by construction activities, and maintain corrected aggregate base until subsequent course is placed.
    - e. Do not allow traffic on aggregate base.
    - f. Remove all standing storm water.
  2. Interior concrete slab-on-grade aggregate base:
    - a. Place **4 inches (100 mm)** minimum of  $\frac{3}{4}$  inch crushed gravel base under vapor retarder, level, and compact with vibratory plate compactor.
  3. Miscellaneous exterior concrete aggregate base:
    - a. Except under mow strips, place **4 inches (100 mm)** minimum of aggregate base, level, and compact as specified in Section 31 2323.
  4. Asphalt paving aggregate base:
    - a. **13 inches** thick under parking and **14 inches** thick under drive aisles minimum after compaction in accordance with Contract Drawings.
    - b. Install in **8 inch** lifts maximum.
    - c. If roller is smaller than **8 ton (7260 kg)**, lay aggregate base and compact in four courses.
    - d. Compact as specified in Section 31 2323.
    - e. Priming: Prime aggregate base with application of **0.2 to 0.5 gallons (2 to 5 liters)** of asphalt cement primer per square **yard (meter)** if pavement will be laid more than three days after compaction of aggregate base, or if precipitation is anticipated between completion of compaction of aggregate base and laying of asphalt paving.

- f. Recompact unprimed aggregate base if it receives precipitation before pavement is laid.
  - g. Remove or repair improperly prepared areas as directed by Architect.
- B. Tolerances:
- 1. Asphalt Paving areas:
    - a. Aggregate Base:
      - 1) 13 inches high under parking area and 14 inches under drive aisles.
      - 2) Measure using string line from curb to curb, gutter, flat drainage structure, or grade break.
      - 3) Finished base course shall be true to line and grade within plus or minus 1/4 inch in 10 feet (6 mm in 3 meters).
      - 4) Maximum variation from required grades shall be 1/10 of one foot (28 mm).

### 3.3 FIELD QUALITY CONTROL

- A. Field Tests and Inspections:
- 1. Aggregate Base:
    - a. General:
      - 1) Owner is responsible for Quality Assurance. Quality assurance performed by Owner will be used to validate Quality Control performed by Contractor.
      - 2) Quality Control is sole responsibility of Contractor as specified in Section 01 4523 'Testing And Inspection Services'.
    - b. Interior slab-on-grade concrete areas:
      - 1) Testing Agency shall provide testing and inspection for interior aggregate base.
      - 2) Number of tests may vary at discretion of Architect.
      - 3) Testing Agency will test compaction of base in place according to ASTM D1556, ASTM D2167, and ASTM D6938, as applicable. Tests will be performed at following frequency:
        - a) Building Slab Areas: One test for every 2,500 sq. ft. (232 sq. m) or less of building slab area but no fewer than three tests.
    - c. Miscellaneous exterior concrete areas:
      - 1) Testing Agency shall provide testing and inspection for exterior aggregate base.
      - 2) Number of tests may vary at discretion of Architect.
      - 3) Testing Agency will test compaction of base in place according to ASTM D1556, ASTM D2167, and ASTM D6938, as applicable. Tests will be performed at following frequency:
        - a) Sitework Areas: One test for every 10,000 sq. ft. (930 sq. m) or less of exterior pads area but no fewer than three tests.
    - d. Asphalt paving area:
      - 1) Testing Agency shall provide testing and inspection for exterior aggregate base.
      - 2) Number of tests may vary at discretion of Architect.
      - 3) Testing Agency will test compaction of base in place according to ASTM D1556, ASTM D2167, and ASTM D6938, as applicable. Tests will be performed at following frequency:
        - a) Sitework Areas: One test for every 10,000 sq. ft. (930 sq. m) or less of exterior pads area but no fewer than three tests.

### 3.4 PROTECTION

- A. Interior Slab-On-Grade Concrete:
- 1. Vapor Retarder:
    - a. Do not allow water onto vapor retarder or aggregate base before placing concrete.
    - b. Protect membrane from possible punctures caused by reinforcing bar supports before placing concrete.

END OF SECTION

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**SECTION 31 1413****TOPSOIL STRIPPING AND STOCKPILING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Strip and stockpile acceptable topsoil as described in Contract Documents.
- B. Related Requirements:
  - 1. Section 31 0501: 'Common Earthwork Requirements':
    - a. General procedures and requirements for earthwork.
    - b. Pre-installation conference held jointly with other common earthwork related sections.
    - c. Pre-installation conference held jointly with other landscape related sections.
  - 2. Section 31 1100: 'Clearing and Grubbing'.
  - 3. Section 31 2213: 'Rough Grading'.
  - 4. Section 31 2316: 'Excavation'.
  - 5. Section 32 9001: 'Common Planting Requirements'.
  - 6. Section 32 9120: 'Topsoil And Placement' for topsoil evaluation and placement required for topsoil grading.
  - 7. Section 32 9121: 'Topsoil Physical Preparation' for physical preparation of topsoil (section included based on Topsoil Testing Report).
  - 8. Section 32 9122: 'Topsoil Grading' for preparation of topsoil and addition of amendments prior to landscaping.

**1.2 REFERENCES**

- A. Definitions:
  - 1. Existing topsoil: Defined as total amount of soil stripped and stored for reuse, less vegetation layer stripped and disposed of as specified in Paragraphs below.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Pre-Installation Conference:
  - 1. Participate in pre-installation conferences as specified in Section 31 0501.

**PART 2 - PRODUCTS: Not Used****PART 3 - EXECUTION****3.1 PERFORMANCE**

- A. Strip existing vegetation layer **1 to 3 inches (mm)** deep minimum from areas of site to receive buildings, landscaping, and paving and remove from site before stripping topsoil for storage and reuse.
- B. After stripping vegetation layer, strip existing topsoil additional **1 ½ to 4 inches** deep minimum from areas of site to receive buildings and paving and store on site for later use.
  - 1. Existing topsoil is property of Contractor with restriction that topsoil is to be used first for Project landscape topsoil requirements and second for non-structural fill and backfill.

2. After Project fill, backfill, and landscape topsoil requirements are satisfied, remove excess existing topsoil from site. Do not remove existing topsoil from site without Architect's written approval.
- C. Screen existing topsoil to meet standards established as specified in Section 32 9120 'Topsoil And Placement'.

**END OF SECTION**

**SECTION 31 2213****ROUGH GRADING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Perform rough grading work required to prepare site for construction as described in Contract Documents.
- B. Related Requirements:
  - 1. Section 01 3100: 'Project Management and Coordination' for pre-installation conference.
  - 2. Section 03 3053: Miscellaneous Exterior Cast-In-Place Concrete.
  - 3. Section 31 0501: 'Common Earthwork Requirements' for:
    - a. General procedures and requirements for earthwork.
    - b. Pre-installation conference held jointly with other common earthwork related sections.
  - 4. Section 31 1123: 'Aggregate Base' for aggregate base requirements.
  - 5. Section 31 1413: 'Topsoil Stripping And Stockpiling' for stripping and storing of existing topsoil.
  - 6. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.
  - 7. Section 31 2316: 'Excavation'.
  - 8. Section 31 2323: 'Fill' for compaction procedures and tolerances for base.
  - 9. Section 32 1216: 'Asphalt Paving'.
  - 10. Section 32 9122: 'Topsoil Grading' for preparation of topsoil and addition of amendments prior to landscaping.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- A. Pre-Installation Conference:
  - 1. Participate in pre-installation conference as specified in Section 31 0501:
  - 2. In addition to agenda items specified in Section 01 3100 and Section 31 0501, review following:
    - a. Identify benchmark to be used in establishing grades and review Contract Document requirements for grades, fill materials, and topsoil.
    - b. Examine site to pre-plan procedures for making cuts, placing fills, and other necessary work.

**PART 2 - PRODUCTS****2.1 MATERIALS**

- A. Materials used for fill shall be as specified for backfill in Section 31 2323 'Fill'.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Verification Of Conditions:
  - 1. Verify elevations of rough grading are correct before compacted fill, fine grading, aggregate base or landscape grading are placed.

### 3.2 PREPARATION

- A. Surface Preparation:
  - 1. Before making cuts, remove topsoil over areas to be cut and filled that were not previously removed by stripping specified in Section 31 1413 'Topsoil Stripping And Stockpiling'. Stockpile this additional topsoil with previously stripped topsoil.

### 3.3 PERFORMANCE

- A. Subgrade (Natural Soils):
  - 1. Subgrade beneath compacted fill or aggregate base under asphalt or concrete paving shall be constructed smooth and even.
- B. Special Techniques:
  - 1. Compact fills as specified in Section 31 2323 'Fill'.
  - 2. If soft spots, water, or other unusual and unforeseen conditions affecting grading requirements are encountered, stop work and notify Architect.
- C. Tolerances:
  - 1. Maximum variation from required grades shall be 1/10 of one foot (28 mm).

**END OF SECTION**

**SECTION 31 2216****FINE GRADING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Perform fine grading of subgrade work required to prepare site for paving finish grading and for placement of topsoil as described in Contract Documents.
  - 2. Prepare natural soil subgrade as described in Section 31 2213 'Rough Grading' or prepare fill subgrade as described in this specification section for asphalt paving.
- B. Related Requirements:
  - 1. Section 01 1200: 'Multiple Contract Summary' for multiple contracts.
  - 2. Section 01 3100: 'Project Management and Coordination' for pre-installation conference.
  - 3. Section 01 4000: 'Quality Requirements' for administrative and procedural requirements for quality assurance and quality control.
  - 4. Section 01 4301: 'Quality Assurance – Qualifications' establishes minimum qualification levels required.
  - 5. Section 01 4523: 'Testing and Inspecting Services' for testing and inspection, and testing laboratory services for materials, products, and construction methods.
  - 6. Section 01 7800: 'Closeout Submittals'.
  - 7. Section 31 0501: 'Common Earthwork Requirements' for:
    - a. General procedures and requirements for earthwork.
    - b. Pre-installation conference held jointly with other common earthwork related sections.
  - 8. Section 31 1123: 'Aggregate Base' for aggregate base requirements.
  - 9. Section 31 1413: 'Topsoil Stripping And Stockpiling' for stripping and storing of existing topsoil.
  - 10. Section 31 2213: 'Rough Grading' for grading and preparation of natural soil subgrades below fill and aggregate base materials.
  - 11. Section 31 2316: 'Excavation'.
  - 12. Section 31 2323: 'Fill' for compaction procedures and tolerances for base.
  - 13. Section 32 1216: 'Asphalt Paving' for finish grading for asphalt paving.
  - 14. Section 32 9001: 'Common Planting Requirements'.
    - a. Pre-installation conference held jointly with other common planting related sections.
  - 15. Section 32 9120: 'Topsoil And Placement' for topsoil evaluation and placement required for topsoil grading.
  - 16. Section 32 9121: 'Topsoil Physical Preparation' for physical preparation of topsoil (section included based on Topsoil Testing Report).
  - 17. Section 32 9122: 'Topsoil Grading' for preparation of topsoil and addition of amendments prior to landscaping.

**1.2 REFERENCES**

- A. Association Publications:
  - 1. American Concrete Institute, Farmington Hills, MI [www.concrete.org](http://www.concrete.org). Abstracts of ACI Periodicals and Publications:
    - a. ACI 229R-13, 'Report on Controlled Low-Strength Materials'.
  - 2. Council of American Structural Engineers. CASE Form 101: *Statement of Special Inspections*. Washington, DC: CASE, 2001. (c/o American Council of Engineering Companies, 1015 15<sup>th</sup> St., NW, Washington, DC 20005; 202-347-7474; [www.acec.org](http://www.acec.org)).
- B. Definitions (Following are specifically referenced for testing):
  - 1. AASHTO: The American Association of State Highway and Transportation Officials. Organization of highway engineers from the 50 states that develops guides and standards.

2. Accreditation: Process in which certification of competency, authority, or credibility is presented. Verify that laboratories have an appropriate quality management system and can properly perform certain test methods (e.g., ANSI, ASTM, and ISO test methods) and calibration parameters according to their scopes of accreditation.
3. Approved: To authorize, endorse, validate, confirm, or agree to.
4. Field Quality Control: Testing, Inspections, Special Testing and Special Inspections to assure compliance to Contract Documents.
5. Inspection/Special Inspection: Inspection of materials, installation, fabrication, erection or placement of components and connections requiring special expertise to ensure compliance with approved construction documents and referenced standards:
  - a. Inspection: Not required by code provisions but may be required by Contract Documents.
  - b. Special Inspection: Required by code provisions and by Contract Documents.
  - c. Inspection-Continuous: Full-time observation of the Work requiring inspection by approved inspector who is present in area where the Work is being performed.
  - d. Inspection-Periodic: Part-time or intermittent observation of the Work requiring inspection by approved inspector who is present in area where the Work has been or is being performed and at completion of the Work.
6. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform particular construction operation, including installation, erection, application, and similar operations.
7. Observation: Visual observation of building / site elements or structural system by registered design professional for general conformance to approved construction documents at significant construction stages and at completion. Observation does not include or waive responsibility for performing inspections or special inspections.
8. Owner's Representative: Owner's Designated Representative (Project Manager or Facilities Manager) who will have express authority to bind Owner with respect to all matters requiring Owner's approval or authorization.
9. Preconstruction Testing: Tests and inspections that are performed specifically for Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
10. Product Testing: Tests and inspections that are performed by testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
11. Relative Compaction: Ratio of field dry density as determined by ASTM D6938 or ASTM D2216, and laboratory maximum dry density as determined by ASTM D698.
12. Quality Assurance: Testing, Inspections, Special Testing and Special Inspections provided for by Owner.
13. Quality Control: Testing, Inspections, Special Testing and Special Inspections provided for by Contractor.
14. Service Provider: Agency or firm qualified to perform required tests and inspections.
15. Source Quality Control Testing: Tests and inspections that are performed at source, i.e., plant, mill, factory, or shop.
16. Special Inspection: See Inspection.
17. Special Inspector: Certified individual or firm that implements special inspection program for project.
18. Special Test: See Test.
19. Test/Special Test: Field or laboratory tests to determine characteristics and quality of building materials and workmanship.
  - a. Test: Not required by code provisions but may be required by Contract Documents.
  - b. Special Test: Required by code provisions and by Contract Documents.
20. Testing Agency: Entity engaged to perform specific tests, inspections, or both.
21. Testing Agency Laboratory: Agency or firm qualified to perform field and laboratory tests to determine characteristics and quality of materials and workmanship.
22. Verification: Act of reviewing, inspecting, testing, etc. to establish and document that product, service, or system meets regulatory, standard, or specification requirements.

C. Reference Standards:

1. ASTM International (Following are specifically referenced for fill and aggregate base testing):
  - a. ASTM D698-12, 'Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>))'.

- b. ASTM D1556-07, 'Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method'.
  - c. ASTM D1557-12, 'Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>))'.
  - d. ASTM D2167-08, 'Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method'.
  - e. ASTM D2216-10, 'Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass'.
  - f. ASTM D2487-11, 'Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)'.
  - g. ASTM D3666-13, 'Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials'.
  - h. ASTM D3740-12a, 'Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction'.
  - i. ASTM D6938-10, 'Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)'.
  - j. ASTM E329-14a, 'Standard Specification for Agencies Engaged in Construction Inspection and/or Testing'.
  - k. ASTM E543-13, 'Standard Specification for Agencies Performing Nondestructive Testing'.
  - l. ASTM E1212-12, 'Standard Practice for Quality Management Systems for Nondestructive Testing Agencies'.
- 2. International Building Code (IBC):
    - a. Chapter 17, 'Structural Tests and Special Inspections' (2012 or latest edition available).

### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Conference:
  - 1. Participate in pre-installation conference as specified in Section 31 0501 and Section 32 9001.
  - 2. In addition to agenda items specified in Section 01 3100 and Section 31 0501, review following:
    - a. Review backfill requirements.
    - b. Review geotechnical report.
    - c. Review Section 01 4523 for Testing and Inspection administrative requirements and responsibilities and Field Quality Control tests and inspections required of this section.
      - 1) Review frequency of testing and inspections.
- B. Scheduling:
  - 1. Notify Testing Agency and Architect twenty four (24) hours minimum before installation of fill / engineered fill to allow inspection.
  - 2. Allow special inspector to review all subgrades and excavations to determine if site has been prepared in accordance with geotechnical report prior to placing any fill, aggregate base or concrete.
  - 3. Allow inspection and testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after inspections and test results for previously compacted work comply with requirements.
    - a. ).

### 1.4 SUBMITTALS

- A. Closeout Submittals:
  - 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
    - a. Record Documentation:
      - 1) Testing and Inspection Reports:
        - a) Testing Agency Testing and Inspecting Reports of fill / engineered fill.

## 1.5 QUALITY ASSURANCE

### A. Testing and Inspection:

1. Owner will provide Testing and Inspection for fill / engineering fill:
  - a. Owner will employ testing agencies to perform testing and inspection for fill / engineering fill as specified in Field Quality Control in Part 3 of this specification.
    - 1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform the Work in strict accordance with requirements of Contract Documents and perform contractor testing and inspection.
    - 2) See Section 01 1200: 'Multiple Contract Summary'.
  - b. Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform testing and inspection as part of his Quality Control.
    - 1) Testing and inspections, if performed by Contractor, will be responsibility of Contractor to be performed by an independent entity.

## PART 2 - PRODUCTS: Not Used

## PART 3 - EXECUTION

### 3.1 PREPARATION

#### A. Protection Of In-Place Conditions: Protect utilities and site elements from damage.

#### B. Surface Preparation:

1. Landscaping and Planting Areas:
  - a. Before grading, dig out weeds from planting areas by their roots and remove from site. Remove rocks larger than **1-1/2 inches (38 mm)** in size and foreign matter such as building rubble, wire, cans, sticks, concrete, etc.
  - b. Remove imported paving base material present in planting areas down to natural subgrade or other material acceptable to Architect.
2. Asphalt Paving:
  - a. Survey and stake parking surfaces to show grading required by Contract Documents.
  - b. Subgrade (material immediately below aggregate base):
    - 1) Fine grade parking surface area to grades required by Contract Documents.
    - 2) Compact subgrade as specified in Section 31 2213 (natural soils) and Section 31 2323 (fill).
    - 3) Subgrade to be constructed smooth and even.

### 3.2 PERFORMANCE

#### A. Interface With Other Work: Do not commence work of this Section until grading tolerances specified in Section 31 2213 are met.

#### B. General:

1. Do not expose or damage existing shrub or tree roots.

#### C. Tolerances:

1. Site Tolerances:
  - a. Subgrade (material immediately below aggregate base):
    - 1) **0.00 inches (0.00 mm)** high.
    - 2) Measure using string line from curb to curb, gutter, flat drainage structure, or grade break.
  - b. Maximum variation from required grades shall be **1/10 of one foot (28 mm)**.
2. Aggregate Base (Asphalt paving) Tolerances:



- a. Aggregate base shall be **13 inches** thick under parking areas and **14 inches** thick under drive aisles minimum after compaction, except where shown otherwise on Drawings.
  - b. Measure using string line from curb to curb, gutter, flat drainage structure, or grade break.
3. Landscaping and Planting Tolerances:
  - a. Maximum variation from required grades shall be **1/10 of one foot (28 mm)**.
  - b. To allow for final finish grades as specified in Section 32 9121 of planting areas, fine grade elevations before placing topsoil and mulch are:
    - 1) Sod Areas: **7 inches (175 mm)** below top of walk or curb.
    - 2) Seeded Areas: **6 inches (150 mm)** below top of walk or curb.
    - 3) Ground Cover Areas: **7 inches (180 mm)** below top of walk or curb.
    - 4) Tree And Shrub Areas: **4 inches (100 mm)** below top of walk or curb.
4. Slope grade away from building as specified in Section 32 9120.

### 3.3 FIELD QUALITY CONTROL

- A. Field Tests and Inspections:
  1. General:
    - a. Owner is responsible for Quality Assurance. Quality assurance performed by Owner will be used to validate Quality Control performed by Contractor.
    - b. Quality Control is sole responsibility of Contractor as specified in Section 01 4523 'Testing And Inspection Services'.
  2. Site Preparation:
    - a. Prior to placement of fill / engineered fill, inspector shall determine that site has been prepared in accordance with geotechnical report.
    - b. Footing subgrade: At footing subgrades, Certified Inspector is to verify that soils conform to geotechnical report.
  3. Fill / Engineered Fill:
    - a. Testing Agency shall provide testing and inspection for fine grading.
    - b. Number of tests may vary at discretion of Architect.
    - c. Testing Agency is to provide one (1) moisture-maximum density relationship test for each type of fill material.

**END OF SECTION**

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**SECTION 31 2316****EXCAVATION****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Perform Project excavating and trenching as described in Contract Documents, except as specified below.
  - 2. Procedure and quality for excavating and trenching performed on Project under other Sections unless specifically specified otherwise.
- B. Related Requirements:
  - 1. Section 31 0501: 'Common Earthwork Requirements' for:
    - a. General procedures and requirements for earthwork.
    - b. Pre-installation conference held jointly with other common earthwork related sections.
  - 2. Section 31 1100: Clearing and Grubbing.
  - 3. Section 31 1123: 'Aggregate Base'.
  - 4. Section 31 1413: 'Topsoil Stripping and Stockpiling'.
  - 5. Section 31 2213: 'Rough Grading' for rough grading and preparation of natural soil subgrades below fill and aggregate base materials.
  - 6. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.
  - 7. Section 31 2323: 'Fill' for compaction procedures and tolerances for base.
  - 8. Performance of excavating inside and outside of building required for electrical and mechanical work is responsibility of respective Section doing work unless arranged differently by Contractor.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- A. Pre-Installation Conference:
  - 1. Participate in pre-installation conference as specified in Section 31 0501:
  - 2. In addition to agenda items specified in Section 01 3100 and Section 31 0501, review following:
    - a. Review protection of existing utilities requirements.

**PART 2 - PRODUCTS: Not Used****PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Verification Of Conditions:
  - 1. Carefully examine site and available information to determine type soil to be encountered.
  - 2. Discuss problems with Architect before proceeding with work.

**3.2 PREPARATION**

- A. Protection of Existing Utilities:
  - 1. Protect existing utilities identified in Contract Documents during excavation.
  - 2. If existing utility lines not identified in Contract Documents are encountered, contact Architect before proceeding.

### 3.3 PERFORMANCE

- A. Interface With Other Work:
  - 1. Section 31 2213: 'Rough Grading' for rough grading and preparation of natural soil subgrades below fill and aggregate base materials.
  - 2. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.
- B. Excavation:
  - 1. Building Footings And Foundations:
    - a. Under Building:
      - 1) Excavate at least 6 feet below existing surcharge grade and **5 feet (1.50 m)** beyond perimeter of buildings and structures and as necessary for proper placement and forming of footings and foundations so that final grade allows for 4 inches of select fill below slab.
    - b. Under Paving:
      - 1) Excavate at least 12 inches below existing grade so final grade allows for 25 inches of compacted fill below paving in parking areas and 26 inches under drive aisles.
    - c. Bottom of excavations to receive footings shall be undisturbed soil.
    - d. Excavation Carried Deeper Than Required:
      - 1) Under Footings: Fill with concrete specified for footings.
      - 2) Under Slabs: Use specified compacted backfill material.
  - 2. Pavement And Miscellaneous Cast-In-Place Concrete:
    - a. Excavate as necessary for proper placement and forming of concrete site elements and pavement structure. Remove vegetation and deleterious material and remove from site.
    - b. Backfill over-excavated areas with compacted base material specified in Section 31 1123.
    - c. Remove and replace exposed material that becomes soft or unstable.
  - 3. Utility Trenches:
    - a. Unless otherwise indicated, excavation shall be open cut. Short sections of trench may be tunneled if pipe or duct can be safely and properly installed and backfill can be properly tamped in tunnel sections and if approved by Architect.
    - b. Excavate to proper alignment, depth, and grade. Excavate to sufficient width to allow adequate space for proper installation and inspection of utility piping.
    - c. If trenches are excavated deeper than required, backfill until trench bottom is proper depth with properly compacted native material.
    - d. Pipe **4 Inches (100 mm)** In Diameter Or Larger:
      - 1) Grade bottom of trenches to provide uniform bearing and support for each section of pipe on undisturbed soil at every point along its length.
      - 2) Except where rock is encountered, take care not to excavate below depths indicated.
        - a) Where rock excavations are required, excavate rock with minimum over-depth of **4 inches (100 mm)** below required trench depths.
        - b) Backfill over-depths in rock excavation and unauthorized over-depths with loose, granular, moist earth, thoroughly compacted.
      - 3) Whenever wet or unstable soil incapable of properly supporting pipe, as determined by Architect, occurs in bottom of trench, remove soil to depth required and backfill trench to proper grade with coarse sand, fine gravel, or other suitable material acceptable to Architect.
  - 4. If unusual excavating conditions are encountered, stop work and notify Architect.

### 3.4 REPAIR / RESTORATION

- A. Repair damage to other portions of the Work resulting from work of this Section at no additional cost to Owner. On new work, arrange for damage to be repaired by original installer.

**3.5 CLEANING**

- A. Debris and material not necessary for Project are property of Contractor and are to be removed before completion of Project. However, if material necessary for Project is hauled away, replace with specified fill / backfill material.

**END OF SECTION**

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**SECTION 31 2319****DEWATERING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Furnish and install work of this Section as described in Contract Documents including:
    - a. Labor, materials, equipment and all else necessary for full compliance with contract requirements, or as directed by Owner for removal of water from trench and foundation excavations.
- B. Related Requirements:
  - 1. Section 31 0501: 'Common Earthwork Requirements'.
  - 2. Section 31 2323: 'Fill'.
  - 3. Section 31 2500: 'Erosion and Sedimentation Control'.

**1.2 QUALITY ASSURANCE**

- A. Regulatory Agency Sustainability Approvals:
  - 1. Comply with provisions all applicable building codes and local regulations except where more stringent requirements are shown or specified.
    - a. In case of conflict, strictest interpretation shall govern.

**PART 2 - PRODUCTS****2.1 SYSTEMS**

- A. Design Criteria:
  - 1. Water level in trenches and other excavations shall be maintained **3 inch (76 mm)** minimum of below bottom of excavation.
  - 2. If well point dewater system is required, system to be designed by licensed Professional Civil Engineer and submitted to Architect/Engineer for review and approval prior to installation.
- B. Equipment:
  - 1. Pumps:
    - a. Provide minimum of two (2) **3 inch (76 mm)** pumps required on construction site during construction along with sufficient length of hose for proper disposal of pumped water.

**PART 3 - EXECUTION****3.1 DEWATERING**

- A. Provide and maintain pumping equipment, dams, drains, ditches, flumes, wells, well points and other acceptable means for excluding and removing water from trenches and other excavations until such time that backfilling is complete.
- B. Discharge water in such manner that mud and silt are not discharged directly into existing drainage systems and remove from such drainage facilities any mud, silt and/or debris which has accumulated and leave all drainage facilities in condition similar to that which existed prior to dewatering operations.

**END OF SECTION**



**SECTION 31 2323****FILL****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
1. Perform Project backfilling and compacting as described in Contract Documents, except as specified below.
  2. Procedure and quality for backfilling and compacting performed on Project under other Sections unless specifically specified otherwise.
- B. Related Requirements:
1. Section 01 1200: 'Multiple Contract Summary' for multiple contracts.
  2. Section 01 3100: 'Project Management and Coordination' for pre-installation conference.
  3. Section 01 4000: 'Quality Requirements' for administrative and procedural requirements for quality assurance and quality control.
  4. Section 01 4301: 'Quality Assurance – Qualifications' establishes minimum qualification levels required.
  5. Section 01 4523: 'Testing and Inspecting Services' for testing and inspection, and testing laboratory services for materials, products, and construction methods.
  6. Section 01 7800: 'Closeout Submittals'.
  7. Section 31 0501: 'Common Earthwork Requirements' for:
    - a. General procedures and requirements for earthwork.
    - b. Pre-installation conference held jointly with other common earthwork related sections.
  8. Section 31 1100: 'Clearing and Grubbing'.
  9. Section 31 1123: 'Aggregate Base' for aggregate base requirements.
  10. Section 31 1413: 'Topsoil Stripping And Stockpiling' for stripping and storing of existing topsoil.
  11. Section 31 2213: 'Rough Grading' for grading and preparation of natural soil subgrades below fill and aggregate base materials.
  12. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.
  13. Section 31 2316: 'Excavation'.
  14. Section 31 2324: 'Flowable Fill'.
  15. Section 32 9120: 'Topsoil And Placement' for topsoil evaluation and placement required for topsoil grading.
  16. Section 32 9121: 'Topsoil Physical Preparation' for physical preparation of topsoil (section included based on Topsoil Testing Report).
  17. Section 32 9122: 'Topsoil Grading' for preparation of topsoil and addition of amendments prior to landscaping.
  18. Division 32: Compaction of subgrade under walks and paving.
  19. Performance of backfilling and compacting inside and outside of building required for electrical and mechanical work is responsibility of respective Section doing work unless arranged differently by Contractor.

**1.2 REFERENCES**

- A. Association Publications:
1. American Concrete Institute, Farmington Hills, MI [www.concrete.org](http://www.concrete.org). Abstracts of ACI Periodicals and Publications.
    - a. ACI 229R-99, *Controlled Low-Strength Materials* (Reapproved 2005).
  2. Council of American Structural Engineers. CASE Form 101: *Statement of Special Inspections*. Washington, DC: CASE, 2001. (c/o American Council of Engineering Companies, 1015 15<sup>th</sup> St., NW, Washington, DC 20005; 202-347-7474; [www.acec.org](http://www.acec.org)).

B. Definitions (Following are specifically referenced for testing):

1. Accreditation: Process in which certification of competency, authority, or credibility is presented. Verify that laboratories have an appropriate quality management system and can properly perform certain test methods (e.g., ANSI, ASTM, and ISO test methods) and calibration parameters according to their scopes of accreditation.
2. Approved: To authorize, endorse, validate, confirm, or agree to.
3. Field Quality Control: Testing, Inspections, Special Testing and Special Inspections to assure compliance to Contract Documents.
4. Inspection/Special Inspection: Inspection of materials, installation, fabrication, erection or placement of components and connections requiring special expertise to ensure compliance with approved construction documents and referenced standards:
  - a. Inspection: Not required by code provisions but may be required by Contract Documents.
  - b. Special Inspection: Required by code provisions and by Contract Documents.
  - c. Inspection-Continuous: Full-time observation of the Work requiring inspection by approved inspector who is present in area where the Work is being performed.
  - d. Inspection-Periodic: Part-time or intermittent observation of the Work requiring inspection by approved inspector who is present in area where the Work has been or is being performed and at completion of the Work.
5. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform particular construction operation, including installation, erection, application, and similar operations.
6. Observation: Visual observation of building / site elements or structural system by registered design professional for general conformance to approved construction documents at significant construction stages and at completion. Observation does not include or waive responsibility for performing inspections or special inspections.
7. Owner's Representative: Owner's Designated Representative (Project Manager or Facilities Manager) who will have express authority to bind Owner with respect to all matters requiring Owner's approval or authorization.
8. Preconstruction Testing: Tests and inspections that are performed specifically for Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
9. Product Testing: Tests and inspections that are performed by testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
10. Relative Compaction: Ratio of field dry density as determined by ASTM D6938 or ASTM D2216, and laboratory maximum dry density as determined by ASTM D698 or ASTM D1557.
11. Quality Assurance: Testing, Inspections, Special Testing and Special Inspections provided for by Owner.
12. Quality Control: Testing, Inspections, Special Testing and Special Inspections provided for by Contractor.
13. Service Provider: Agency or firm qualified to perform required tests and inspections.
14. Source Quality Control Testing: Tests and inspections that are performed at source, i.e., plant, mill, factory, or shop.
15. Special Inspection: See Inspection.
16. Special Inspector: Certified individual or firm that implements special inspection program for project.
17. Special Test: See Test.
18. Test/Special Test: Field or laboratory tests to determine characteristics and quality of building materials and workmanship.
  - a. Test: Not required by code provisions but may be required by Contract Documents.
  - b. Special Test: Required by code provisions and by Contract Documents.
19. Testing Agency: Entity engaged to perform specific tests, inspections, or both.
20. Testing Agency Laboratory: Agency or firm qualified to perform field and laboratory tests to determine characteristics and quality of materials and workmanship.
21. Verification: Act of reviewing, inspecting, testing, etc. to establish and document that product, service, or system meets regulatory, standard, or specification requirements.

C. Reference Standards:

1. ASTM International (Following are specifically referenced for fill and aggregate base testing):

- a. ASTM D698-12, 'Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>))'.
- b. ASTM D1556-07, 'Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method'.
- c. ASTM D1557-12, 'Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>))'.
- d. ASTM D2167-08, 'Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method'.
- e. ASTM D2216-10, 'Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass'.
- f. ASTM D2487-11, 'Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)'.
- g. ASTM D3666-13, 'Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials'.
- h. ASTM D3740-12a, 'Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction'.
- i. ASTM D6938-10, 'Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)'.
- j. ASTM E329-14a, 'Standard Specification for Agencies Engaged in Construction Inspection and/or Testing'.
- k. ASTM E543-13, 'Standard Specification for Agencies Performing Nondestructive Testing'.
- l. ASTM E1212-12, 'Standard Practice for Quality Management Systems for Nondestructive Testing Agencies'.
2. International Code Council (IBC) (2012):
  - a. IBC Chapter 17, 'Special Inspections And Tests'.
    - 1) Section 1704, 'Soils'.
    - 2) Section 1705, 'Statement Of Special Inspections'.

### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Conferences:
  1. Participate in pre-installation conference as specified in Section 31 0501.
  2. In addition to agenda items specified in Section 01 3100, Section 31 0501, and Section 31 2324 if Flowable Fill is included, review following:
    - a. Review backfill requirements.
    - b. Review Geotechnical Evaluation Report.
    - c. Review Section 01 4523 for Testing and Inspection administrative requirements and responsibilities and Field Quality Control tests and inspections required of this section.
      - 1) Review frequency of testing and inspections.
- B. Sequencing:
  1. Do not backfill against bituminous dampproofing for twenty four (24) hours after application of dampproofing.
  2. Before backfilling, show utility and service lines being covered on record set of Drawings. Do not backfill until utilities involved have been tested and approved by Architect and until instructed by Architect.
- C. Scheduling:
  1. Notify Testing Agency and Architect seventy two (72) hours minimum before installation of fill / engineered fill to perform proctor and plasticity index tests on proposed fill or subgrade.
  2. Notify Testing Agency and Architect twenty four (24) hours minimum before installation of fill / engineered fill to allow inspection.
  3. Allow special inspector to review all subgrades and excavations to determine if site has been prepared in accordance with geotechnical report prior to placing any fill (or concrete).
  4. Allow inspection and testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after inspections and test results for previously compacted work comply with requirements.

## 1.4 SUBMITTALS

- A. Closeout Submittals:
  - 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
    - a. Record Documentation:
      - 1) Testing and Inspection Reports:
        - a) Testing Agency Testing and Inspecting Reports of fill / engineered fill.

## 1.5 QUALITY ASSURANCE

- A. Testing and Inspection:
  - 1. Owner will provide Testing and Inspection for fill / engineering fill:
    - a. Owner will employ testing agencies to perform testing and inspection for fill / engineering fill as specified in Field Quality Control in Part 3 of this specification.
      - 1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform the Work in strict accordance with requirements of Contract Documents and perform contractor testing and inspection.
      - 2) See Section 01 1200: 'Multiple Contract Summary'.
    - b. Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform testing and inspection as part of his Quality Control.
      - 1) Testing and inspections, if performed by Contractor, will be responsibility of Contractor to be performed by an independent entity.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Site Material:
  - 1. Existing excavated material on site is suitable for use as fill and backfill to meet Project requirements.
- B. Imported Fill / Backfill:
  - 1. Well graded material conforming to ASTM D2487 free from debris, organic material, frozen materials, brick, lime, concrete, and other material which would prevent adequate performance of backfill.
    - a. Under Building Footprint And Paved Areas: Fill shall comply with soil classification groups GW, CL, GP, GM, SW, SP, or SM. Fill may not contain stones over 6 inches (150 mm) diameter and ninety five (95) percent minimum of fill shall be smaller than 1-1/2 inch (38 mm) in any direction.
    - b. Under Landscaped Areas:
      - 1) Fill more than 36 inches (900 mm) below finish grade shall comply with soil classification groups GW, CL, GP, GM, SW, SP, or SM. Fill may not contain stones over 6 inches (150 mm) diameter and ninety (90) percent minimum of fill shall be smaller than 1-1/2 inch (38 mm) in any direction.
      - 2) Fill less than 36 inches (900 mm) below finish grade shall comply with soil classification groups SW, SP, SM, or SC. Fill may not contain stones larger than 1-1/2 inches (38 mm) in any direction and ninety (90) percent minimum of fill shall be smaller than 3/8 inch (4.7 mm) in any direction.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Before placing fill, aggregate base, or finish work, prepare existing subgrade as follows:

1. Prepare subgrade in accordance with Section 31 2216.
  - a. Prior to placing aggregate base proof roll using loaded tandem axle dump truck. If deflection is greater than 7 ½ inches, scarify and re-compact. If this cannot be done or does not work sub-excavate and use fabric.
2. Do not place fill or aggregate base over frozen subgrade.
3. Under Building Slab and Equipment Pad Areas:
  - a. Scarify subgrade 6 inches (150 mm) deep, moisture condition to uniform moisture content of between optimum and four (4) percent over optimum, and mechanically tamp 6 inches (150 mm) deep to ninety five (95) percent minimum of relative compaction.
4. Under Driveways And Parking Areas:
  - a. Scarify subgrade 6 inches (150 mm) deep, moisture condition to uniform moisture content between optimum and four (4) percent over optimum, and mechanically tamp to ninety five (95) percent minimum of relative compaction.
5. Under Miscellaneous Concrete Site Elements And Outside Face of Foundation Walls
  - a. Scarify subgrade 6 inches (150 mm) deep, moisture condition to uniform moisture content between optimum and four (4) percent over optimum, and mechanically tamp to ninety five (95) percent minimum of relative compaction.
6. Landscape Areas:
  - a. Compact subgrade to eighty five (85) percent relative compaction.

### 3.2 PERFORMANCE

- A. Interface With Other Work:
  1. Section 31 2213: 'Rough Grading' for rough grading and preparation of natural soil subgrades below fill and aggregate base materials.
  2. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.
  3. Section 31 2324: 'Flowable Fill' for backfilling of piping systems and other utilities under paving'.
- B. Fill / Backfill:
  1. General:
    - a. Around Buildings And Structures: Slope grade away from building as specified in Section 31 2216. Hand backfill when close to building or where damage to building might result.
    - b. Site Utilities:
      - 1) In Landscape Areas: Use backfill consisting of on-site soil.
      - 2) Under Pavement and Concrete Site Elements: Extend excavatable flowable fill / backfill to elevation of subgrade. Do not place aggregate base material until excavatable flowable fill / backfill has cured seventy two (72) hours.
    - c. Do not use puddling or jetting to consolidate fill areas.
  2. Compacting:
    - a. Fill / Backfill And Aggregate Base:
      - 1) All fill material shall be well-graded granular material with maximum size less than 3 inch (76 mm) and with not more than fifteen (15) percent passing No. 200 sieve.
      - 2) Under Building Slab and Equipment Pad Areas:
        - a) Place in 8 inch (200 mm) maximum layers, moisture condition to plus or minus two (2) percent of optimum moisture content, and mechanically tamp to ninety five (95) percent minimum of maximum laboratory density as established by ASTM D698.
      - 3) Under Driveways And Parking Areas:
        - a) Place in 8 inch (200 mm) maximum layers, dampen but do not soak, and mechanically tamp to ninety five (95) percent minimum of maximum laboratory density as established by ASTM D698.
      - 4) Under Miscellaneous Concrete Site Elements And Outside Face of Foundation Walls:
        - a) Place in 8 inch (200 mm) maximum layers, dampen but do not soak, and mechanically tamp to ninety five (95) percent minimum of maximum laboratory density as established by ASTM D698.
      - 5) Utility Trenches:
        - a) Site:
          - 1) Place fill in 12 inch (300 mm) layers and moisture condition to plus or minus two (2) percent of optimum moisture content.

- (2) Compact fill to ninety five (95) percent minimum relative compaction to within **12 inches (300 mm)** of finish grade.
- (3) Compact fill above **12 inches (300 mm)** to eighty five (85) percent relative compaction.
- b) Under Slabs:
  - (1) Under Slabs: Place fill in **6 inch (150 mm)** layers, moisture condition to plus or minus two (2) percent of optimum moisture content, and compact to ninety five (95) percent minimum relative compaction to within **4 inches (100 mm)** of finish grade.
  - (2) Final **4 inches (100 mm)** of fill shall be aggregate base as specified in Section 31 1123.
- 6) Fill Slopes: Compact by rolling or using sheepsfoot roller.
- 7) Backfill Under Footings: Not allowed.
- 8) Landscape Areas:
  - a) Compact fill to eighty five (85) percent minimum relative compaction.
- 9) Other Backfills: Place other fills in **12 inch (300 mm)** layers and compact to ninety five (95) percent relative compaction.
- 10) Loose material from compacted subgrade surface shall be immediately removed before placing compacted fill or aggregate base course.

### 3.3 REPAIR / RESTORATION

- A. Repair damage to other portions of the Work resulting from work of this Section at no additional cost to Owner. On new work, arrange for damage to be repaired by original installer.

### 3.4 FIELD QUALITY CONTROL

- A. Field Tests and Inspections:
  - 1. General:
    - a. Owner is responsible for Quality Assurance. Quality assurance performed by Owner will be used to validate Quality Control performed by Contractor.
    - b. Quality Control is sole responsibility of Contractor as specified in Section 01 4523 'Testing And Inspection Services'.
  - 2. Fill / Engineered Fill:
    - a. Testing Agency shall provide testing and inspection for fill.
    - b. Number of tests may vary at discretion of Architect.
    - c. Testing Agency is to provide one (1) moisture-maximum density relationship test for each type of fill material.
    - d. Prior to placement of engineered fill, inspector shall determine that site has been prepared in accordance with geotechnical report.
    - e. Footing subgrade: At footing subgrades Certified Inspector is to verify that soils conform to geotechnical report.
    - f. Testing Agency will test compaction of soils according to ASTM D1556, ASTM D2167, and ASTM D6938, as applicable. Lift thicknesses shall comply with geotechnical report. Inspector shall determine that in-place dry density of engineered fill material complies with geotechnical report. Tests will be performed at following locations and frequencies:
      - 1) Paved Areas: At each compacted fill and backfill layer, at least one (1) test for every **10,000 sq. ft. (930 sq. m)** or less of paved area but in no case less than three (3) tests.
      - 2) Building Slab Areas: At each compacted fill and backfill layer, at least on test for every **2,500 sq. ft. (232 sq. m)** or less of building slab area but in no case less than three (3) tests.
      - 3) Foundation Wall/Continuous Footing Backfill: At each compacted backfill layer, at least one (1) test for each **40 linear feet (12 linear m)** or less of wall length, but no fewer than two (2) tests.
      - 4) Trench Backfill: At each **12 inch (305 mm)** compacted lift for each **100 linear feet (30.5 linear m)** or less of trench length but no fewer than two (2) tests.

- 5) Sidewalks, Curbs, Gutters, Exterior Pads: Minimum of one (1) test for each lift for each 40 lineal feet (12 linear m) or one (1) test for every 5,000 sq. ft. (465 sq. m) or less of pad area but no fewer than three (3) tests.
- g. Required verification and inspection of soils as referenced in 2012 IBC Table 1704.7 'Required Verification And Inspection Of Soils'. Periodic and continuous inspections include:
  - 1) Verify materials below footings are adequate to achieve design bearing capacity (periodic).
  - 2) Verify excavations are extended to proper depth and have reached proper material (periodic).
  - 3) Perform classification and testing of compacted fill materials (periodic).
  - 4) Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill (continuous).
  - 5) Prior to placement of compacted fill, observe subgrade and verify that site has been prepared properly (periodic).

### 3.5 CLEANING

- A. Debris and material not necessary for Project are property of Contractor and are to be removed before completion of Project. However, if material necessary for Project is hauled away, replace with specified fill / backfill material.

**END OF SECTION**

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**SECTION 31 2324****FLOWABLE FILL****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Furnish and install cement stabilized sand as described in Contract Documents.
- B. Related Requirements:
  - 1. Section 01 3100: 'Project Management and Coordination' for pre-installation conference.
  - 2. Section 01 4000: 'Quality Requirements' for administrative and procedural requirements for quality assurance and quality control.
  - 3. Section 01 4301: 'Quality Assurance – Qualifications' establishes minimum qualification levels required.
  - 4. Section 01 4523: 'Testing and Inspecting Services' for testing and inspection, and testing laboratory services for materials, products, and construction methods.
  - 5. Section 01 7800: 'Closeout Submittals'.
  - 6. Section 31 0501: 'Common Earthwork Requirements' for:
    - a. General procedures and requirements for earthwork.
    - b. Pre-installation conference held jointly with other common earthwork related sections.
  - 7. Section 31 1123: 'Aggregate Base' for aggregate base requirements.
  - 8. Section 31 2213: 'Rough Grading' for grading and preparation of natural soil subgrades below fill and aggregate base materials.
  - 9. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.
  - 10. Section 31 2316: 'Excavation'.
  - 11. Performance of backfilling and compacting inside and outside of building required for electrical and mechanical work is responsibility of respective Section doing work unless arranged differently by Contractor.

**1.2 REFERENCES**

- A. Association Publications:
  - 1. American Concrete Institute, Farmington Hills, MI [www.concrete.org](http://www.concrete.org). Abstracts of ACI Periodicals and Publications.
    - a. ACI 229R-99, *Controlled Low-Strength Materials* (Reapproved 2005).
- B. Definitions:
  - 1. Controlled Low Strength Material, (CLSM): Self-leveling and selfcompacting, cementitious material.
  - 2. Excavatable Flowable Fill: Unconfined compressive strength of **150 psi (1.03 MPa)** or less. Strengths exceeding this limit can be excavated using mechanical equipment, depending on mix composition and equipment. Due to continued strength-gaining characteristics of component materials such as fly ash and slag, excavatability of mixtures exceeding **150 psi (1.03 MPa)** should be proven prior to final placement.
  - 3. Excavatability: Material property which relates to ease at which material may be removed.
  - 4. Flowability: Material property which relates to rheology of material.
  - 5. Flowable fill: Cementitious slurry consisting of mixture of fine aggregate or filler, water, and cementitious material(s), which is used as fill or backfill in lieu of compacted earth. This mixture is capable of filling all voids in irregular excavations and hard to reach places (such as under undercuts of existing slabs), is self-leveling, and hardens in matter of few hours without need for compaction in layers. Flowable fill is sometimes referred to as excavatable flowable fill, controlled density fill (CDF), controlled low strength material (CLSM), lean concrete slurry, and unshrinkable

fill. Flowable fill is not concrete nor used to replace concrete. It is intended to contain low cementitious content for reduced strength development.

C. Reference Standards:

1. ASTM International (Following are specifically referenced for fill and aggregate base testing):
  - a. ASTM C33/C33M-13, 'Standard Specification for Concrete Aggregates'.
  - b. ASTM C40/C40M-11, 'Standard Test Method for Organic Impurities in Fine Aggregates for Concrete'.
  - c. ASTM C42/C42M-13, 'Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete'.
  - d. ASTM C94/C94M-13b, 'Standard Specification for Ready-Mixed Concrete'.
  - e. ASTM C123/C123M-12, 'Standard Test Method for Lightweight Particles in Aggregate'.
  - f. ASTM C142/C142M-10, 'Standard Test Method for Clay Lumps and Friable Particles in Aggregates'.
  - g. ASTM C150/C150M-12, 'Standard Specification for Portland Cement'.
  - h. ASTM D558-11, 'Standard Test Methods for Moisture-Density (Unit Weight) Relations of Soil-Cement Mixtures'.
  - i. ASTM D1632-07, 'Standard Practice for Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory'.
  - j. ASTM D1633-00(2007), 'Standard Test Methods for Compressive Strength of Molded Soil-Cement Cylinders'.
  - k. ASTM D2487-11, 'Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)'.
  - l. ASTM D3665-12, 'Standard Practice for Random Sampling of Construction Materials'.
  - m. ASTM D4318-10, 'Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils'.
  - n. ASTM D6938-10, 'Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)'.

### 1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conferences:

1. Participate in pre-installation conference in conjunction with Section 31 2323.
2. In addition to agenda items specified in Section 01 3100, Section 31 2323, and Section 31 0501, review following:
  - a. Review backfill requirements.

### 1.4 SUBMITTALS

A. Informational Submittals:

1. Design Data:
  - a. Submit mix designs to meet following requirements:
    - 1) Excavatable Fill (Flowable/Controlled Low Strength Materials CLSM):
      - a) Provide mix designs for review.
2. Design Data:
  - a. Submit mix designs to meet following requirements:
    - 1) Excavatable Fill (Flowable/Controlled Low Strength Materials CLSM):
      - a) Provide target cement content and production data for sand-cement mixture in accordance with requirements as specified in Part 2 of this specification.
    - 2) Cement Stabilized Sand:
      - a) Design will be based on strength specimens molded in accordance with ASTM D558 at moisture content within 3 percent of optimum and within four (4) hours of batching.
        - (1) Design will be based on strength specimens molded in accordance with ASTM D558 at moisture content within three (3) percent of optimum and four (4) hours of batching.

- (2) Determine minimum cement content from production data and statistical history. Provide no less than 1.1 sacks of cement per ton of dry sand.

## 1.5 DELIVERY, STORAGE, AND HANDLING

### A. Storage And Handling Requirements:

1. Dosage capsules have storage tolerance in temperature range of 0 deg F to 55 deg F (minus 18 deg C to plus 12.8 deg C).

## PART 2 - PRODUCTS

### 2.1 MATERIALS

#### A. Cement Stabilized Sand:

1. Cement: Type I Portland cement conforming to ASTM C150/C150M.
2. Sand:
  - a. Clean, durable sand meeting grading requirements for fine aggregates of ASTM C33/C33M, and the following requirements:
    - 1) Classified as SW, SP, SW-SM, SP-SM, or SM by Unified Soil Classification System of ASTM D2487.
    - 2) Maximum compressive strength of 125 psi (862 kPa) maximum at 28 days.
    - 3) Minimum compressive strength of 65 psi (448 kPa) maximum at 28 days.
    - 4) Deleterious Materials:
      - a) Clay lumps, ASTM C142/C142M less than 0.5 percent.
      - b) Lightweight pieces, ASTM C123/C123M less than 5 percent.
      - c) Organic impurities, ASTM C40/C40M color no darker than standard color.
    - 5) Plasticity index of 4 or less when tested in accordance with ASTM D4318.
3. Water: Potable water, free of oils, acids, alkalies, organic matter or other deleterious substances, meeting requirements of ASTM C94/C94M.

#### B. Excavatable Flowable Fill /Controlled Low Strength Materials CLSM:

1. Excavatable application:
2. Follow recommendations of ACI 229R.
3. Contain maximum of 50 lbs to 100 lbs of cement per yard (30 kg to 59 kg of cement per cu m) of flowable fill / backfill
4. Air content:
  - a. General:
    - 1) Stable air content of fifteen (15) to thirty five (35) percent.
  - b. Darafill:
    - 1) Stable air content of twenty (20) percent, Darafill dosage as necessary.
5. Fly ash:
  - a. Fly ash between 0 to 900 lbs per cu yd (0 to 533.95 kg per cu m).
  - b. When using less than 75 lbs per cu yd (44.5 kg per cu m) of Portland cement, combined quantity of Portland cement and fly ash must be at least 100 lbs per cu yd (59.33 kg per cu m).
6. Water content:
  - a. Select water content as necessary to produce consistency that will result in flowable, self-leveling product at time of placement.
  - b. Maximum water content of 36 gallons per yard (225 L per cu m) of backfill.
7. Slump: 7 inch (180 mm) minimum.
8. Type Two Acceptable Products:
  - a. Darafill by W R Grace & Co, Cambridge, MA [www.na.graceconstruction.com](http://www.na.graceconstruction.com).
  - b. Equal as approved by Architect before use. See Section 01 6200.

## 2.2 MIXING MATERIALS

- A. Cement Stabilized Sand:
  - 1. Add required amount of water and mix thoroughly in pug mill-type mixer.
  - 2. Stamp batch ticket at plant with time of loading. Reject material not placed and compacted within four (4) hours after mixing.

## 2.3 MIXING QUALIFICATION

- A. Cement Stabilized Sand:
  - 1. Determine target cement content of material as follows:
    - a. Obtain samples of sand-cement mixtures at production facility representing range of cement content consisting of at least three (3) points.
    - b. Complete molding of samples within four (4) hours after addition of water.
    - c. Perform strength tests (average of two (2) specimens) at forty eight (48) hours and seventy (7) days.
    - d. Perform cement content tests on each sample.
    - e. Perform moisture content tests on each sample.
    - f. Plot average forty eight (48) hour strength vs. cement content.
    - g. Record scale calibration date, sample date, sample time, molding time, cement feed dial settings, and silo pressure (if applicable).
  - 2. Test raw sand for following properties at point of entry into pug-mill:
    - a. Gradation.
    - b. Plasticity index.
    - c. Organic impurities.
    - d. Clay lumps and friable particles.
    - e. Lightweight pieces.
    - f. Moisture content.
    - g. Classification.
  - 3. Present data obtained in format similar to that provided in sample data form attached to this Section.
  - 4. Target content may be adjusted when statistical history so indicates. For determination of minimum product performance use formula:
    - a.  $f c\% \frac{1}{2} \text{ standard deviation.}$

## PART 3 - EXECUTION

### 3.1 PERFORMANCE

- A. Interface With Other Work:
  - 1. Section 31 2323: 'Fill'.
- B. Fill / Backfill:
  - a. Site Utilities:
    - 1) In Landscape Areas: Use backfill consisting of on-site soil.
    - 2) Under Pavement and Concrete Site Elements: Extend excavatable flowable fill / backfill to elevation of subgrade. Do not place aggregate base material until excavatable flowable fill / backfill has cured seventy two (72) hours.
  - b. Do not use puddling or jetting to consolidate fill areas.

### 3.2 PLACING

- A. Cement Stabilized Sand:

1. Place sand-cement mixture in maximum **12 inch (305 mm)** thick loose lifts and compact to ninety five (95) percent of maximum density as determined in accordance with ASTM D558, unless otherwise specified:
  - a. Refer to related specifications for thickness of lifts in other applications.
  - b. Target moisture content during compaction is +3 percent of optimum.
  - c. Perform and complete compaction of sand-cement mixture within four (4) hours after addition of water to mix at plant.
2. Do not place or compact sand-cement mixture in standing or free of water.

### 3.3 FIELD QUALITY CONTROL

#### A. Testing:

1. Testing will be performed under provisions of Section 01 4523 'Testing Laboratory Services':
  - a. One (1) sample of cement stabilized sand shall be obtained for each **150 tons (153 metric ton)** of material placed per day with no less than one (1) sample per day of production.
  - b. Random samples of delivered cement stabilized sand shall be taken in field at point of delivery in accordance with ASTM D3665.
  - c. Obtain three (3) individual samples of approximately **12 lb (5.4 kg) to 15 lbs (6.8 kg)** each from first, middle, and last truck and composite them into one (1) sample for testing purposes.
2. Prepare and mold four (4) specimens (for each sample obtained) in accordance with ASTM D558, Method A, without adjusting moisture content. Samples will be molded at approximately same time material is being used, but no later than four (4) hours after water is added to mix.
3. After molding, specimens will be removed from molds and cured in accordance with ASTM D1632.
4. Specimens will be tested for compressive strength in accordance with ASTM D1633, Method A. Two (2) specimens will be tested at forty eight (48) hours, plus or minus two (2) hours and two (2) specimens will be tested at seven (7) days, plus or minus four (4) hours.
5. Strength test will be average of strengths of two (2) specimens molded from same sample of material and tested at same age. Average daily strength will be average of strengths of all specimens molded during one (1) day's production and tested at same age.
6. Precision and Bias: Test results shall meet recommended guideline for precision in ASTM D1633 Section 9.
7. Reporting: Test reports shall contain, as a minimum, following information:
  - a. Supplier and plant number.
  - b. Time material was batched.
  - c. Time material was sampled.
  - d. Specification section number.
  - e. Indication of compliance / non-compliance.
  - f. Mixture identification.
  - g. Required strength.
  - h. Compressive strength data as required by ASTM D1633.
  - i. Supplier mixture identification.
  - j. Specimen diameter and height, **in. (mm)**.
  - k. Specimen cross-sectional area, **sq in (sq cm)**.

### 3.4 ACCEPTANCE

- #### A. Strength level of material will be considered satisfactory if:
1. Maximum compressive strength of **125 psi (862 kPa)** maximum at twenty eight (28) days.
  2. Minimum compressive strength of **65 psi (448 kPa)** maximum at twenty eight (28) days.
- #### B. Testing laboratory shall notify Architect/Engineer of tests indicating results falling below specified strength requirements within twenty four (24) hours.
- #### C. If any strength test of laboratory cured specimens falls below the specified strength, Contractor may, at his own expense, request test of cores drilled from the area in question in accordance with ASTM

C42/C42M. In such cases, three (3) cores shall be taken for each strength test that falls below values given in paragraph A above.

- D. Cement stabilized sand in an area represented by core tests shall be considered satisfactory if the average of three (3) cores is equal to at least 100 psi (690 kPA) and if no single core is less than 70 psi (480 kPA). Additional testing of cores extracted from locations represented by erratic core strength results will be permitted.

**END OF SECTION**

**SECTION 31 2500****EROSION AND SEDIMENTATION CONTROLS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Provide permanent erosion and sedimentation controls as described in Contract Documents.
  - 2. Submit Notice Of Intent (NOI).
  - 3. Submit and maintain an appropriate Storm Water Pollution Prevention Plan (SWPPP).
- B. Related Requirements:
  - 1. Section 01 5700: Temporary Erosion and Sedimentation Control.
  - 2. Section 02 4113: Selective Site Demolition.
  - 3. Section 31 0501: Common Earthwork Requirements.
  - 4. Section 31 1100: Clearing and Grubbing.
  - 5. Section 31 1413: Topsoil Stripping And Stockpiling.
  - 6. Section 32 9300: Sections under heading.

**1.2 REFERENCES**

- A. References:
  - 1. United States Environmental Protection Agency:
    - a. EPA Document 832/R-92-005 (Sep 1992), 'Storm Water Management for Construction Activities.'

**1.3 SUBMITTALS**

- A. Informational Submittals:
  - 1. Delegated Design Submittals:
    - a. Sediment and erosion control plan, specific to site, meeting following objectives:
      - 1) Prevent loss of soil, including soil stockpiled for reuse, by storm water runoff and wind erosion.
      - 2) Prevent sedimentation of storm sewers and receiving streams.
      - 3) Prevent air pollution by dust and particulate matter.

**1.4 QUALITY ASSURANCE**

- A. Regulatory Agency Sustainability Approvals:
  - 1. Sediment and erosion control shall conform to EPA Document 832/R-92-005, Chapter 3, or local erosion and sedimentation control standards, whichever is more stringent.
- B. Qualifications:
  - 1. Supervisor of erosion control operations shall be thoroughly familiar with types of erosion control materials being installed and best methods for their installation. Supervisor shall be present when work of this Section is being performed and shall direct work performed under this Section.

## PART 2 - PRODUCTS

### 2.1 SYSTEM

#### A. Design Criteria:

1. Protect and maintain areas disturbed by the Work, so erosion is adequately controlled and silt and sediments are not allowed to flow into any watercourse, onto adjacent properties, or into storm drains.

#### B. Materials:

##### 1. Hay And Straw Mulch:

###### a. General:

- 1) Reasonably free from swamp grass, weeds, twigs, debris and other deleterious materials, and free from rot, mold, primary noxious weed seeds, and rough or woody materials.
- 2) Mulches containing mature seed of species which would volunteer and be detrimental to permanent seeding, or would result in over-seeding, or would produce growth which is aesthetically unpleasing, is not permitted.

###### b. Hay Mulch:

- 1) Properly aired native hay, Sudan grass hay, broom sedge hay, legume hay, or similar hay or grass mowings.
- 2) Apply at **2 to 3 tons (2.03 to 3.05 metric tons)** per acre unnetted or stabilized, or at **1.5 tons (1.52 metric ton)** per acre when net or mulch stabilizer is used. When air-dried and in loose state, contents of representative bale shall lose not more than 15 percent of resulting air-dry weight of bale.

###### c. Straw Mulch:

- 1) Threshed plant residue of oats, wheat, barley, rye, or rice from which grain has been removed.
- 2) Apply at **2 to 3 tons (2.03 to 3.05 metric tons)** per acre unnetted or stabilized, or at **1.5 tons (1.52 metric ton)** per **acre (4 047 cu m)** when net or mulch stabilizer is used.

###### d. Matting:

###### 1) Jute Matting:

- a) Undyed and unbleached jute yarn woven into uniform open, plain weave mesh and furnished in rolled strips. Matting shall conform to following physical requirements:
- b) **48 inch (1 200 mm)** wide, plus or minus **one inch (25 mm)**.
- c) 78 warp ends per width of cloth.
- d) 41 weft ends per yard.
- e) **1.22 lbs to 1.80 lbs (0.55 kg to 0.82 kg)** per lineal yard, plus or minus 5 percent.

###### e. Excelsior Matting:

- 1) Uniform web of interlocking wood excelsior fibers with a backing of mulch net fabric on one side only and furnished in rolled strips. Mulch net shall be woven of either twisted paper or cotton cord. Matting shall conform to following physical requirements:
  - a) **36 inches (900 mm)** wide, plus or minus **one inch (25 mm)**.
  - b) **0.8 lbs (0.36 kg)** per sq yd, plus or minus 5 percent.

###### f. Soil Erosion Matting:

- 1) Type Two Acceptable Products.
  - a) 'Enkamat Type 7020' by American Enka Company.
  - b) Equal as approved by Architect before use. See Section 01 6200.

###### g. Erosion Control Mulching Blanket:

- 1) Type Two Acceptable Products.
  - a) 'Hold/Gro' by Gulf States Paper Corp.
  - b) Equal as approved by Architect before use. See Section 01 6200.

##### 2. Seed And Sod For Erosion Control:

- a. For Temporary Control: Annual or perennial ryegrass.
- b. For Permanent Control: See Sections under 32 9300 heading.

##### 3. Hay Bales For Erosion Control:

- a. Rectangular shaped bales of hay or straw, weighing at least **40 lbs (18 kg)** per bale, free from primary noxious weed seeds and rough or woody materials.



4. Silt Fences:
  - a. Type Two Acceptable Products
    - 1) 'Geofab Silt Fence' by Mercantile Development Inc.
    - 2) 'Mirafi 100X' by Celanese Fibers Marketing Co.
    - 3) Equal as approved by Architect before use. See Section 01 6200.

## 2.2 ACCESSORIES

- A. For Mulch:
  1. Mulch Stabilizers:
    - a. Type Two Acceptable Products
      - 1) 'Curasol' applied at 40 gallons (152 liters) per acre (4 047 cu m).
      - 2) Dow 'Mulch Binder' applied at 45 gallons (170 liters) per acre (4 047 cu m).
      - 3) Asphalt binder meeting requirements of AASHTO M140, Type SS-1 or RS-1 as applicable and applied at 400 gallons (1 514 liters) per acre (4 047 cu m).
      - 4) Equal as approved by Architect before use. See Section 01 6200.
  2. Temporary Type Mulch Nets: Paper yarn, approximately 0.05 inches (1.27 mm) in diameter, woven into net with openings of approximately 7/8 inch (22 mm) by 1/2 inch (12.7 mm) and weight of approximately 0.2 lbs (0.091 kg) per sq yd (0.84 cu m).
  3. Permanent Type Mulch Nets:
    - a. Type Two Acceptable Products:
      - 1) 'Vexar' or 'Erosion-Net' plastic or nylon mesh netting with openings of approximately 3/8 inch to 3/4 inch (9.5 mm to 19 mm).
      - 2) Equal as approved by Architect before use. See Section 01 6200.
- B. For Matting / Blankets:
  1. Staples: 11 ga (3.05 mm) minimum plain iron wire, made from 12 inch (305 mm) minimum lengths of wire bent to form 'U' of 1-1/2 inches to 2 inches (38 mm to 50 mm) in width with equal legs of 5 inch to 5-1/4 inches (125 mm to 133 mm). Use longer staples for loose soils or where otherwise required.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General:
  1. Take every reasonable precaution to avoid erosion and to prevent silting of rivers, streams, lakes, reservoirs, impoundments, and drainage ditches and swales.
  2. Keep exposure of uncompleted cut slopes, embankments, trench excavations, and site graded areas as short as possible. Initiate seeding and other erosion control measures on each segment as soon as reasonably possible.
  3. Should it become necessary to suspend construction for any length of time, shape excavated and graded areas so runoff will be intercepted and diverted to points where minimal erosion will occur. Provide and maintain temporary erosion and sediment control measures, such as berms, dikes, slope drains, silt stops, and sedimentation basins, until permanent drainage facilities or erosion control features have been completed and are operative.
  4. Handle and treat fine material placed or exposed during The Work so as to minimize possibility of it reaching surface waters. Use diversion channels, dikes, sediment traps, or other effective control measures.
  5. Provide silt stops wherever erosion control measures may not be totally capable of controlling erosion, such as in drainage channels and where steep slopes may exist.
  6. Before water is allowed to flow in any ditch, swale, or channel, install permanent erosion control measures in waterway so waterway will be safe against erosion.
  7. Take precautions in using construction equipment to minimize erosion. Do not leave wheel tracks where erosion might begin.

8. Unless specifically required in Contract Documents, operation of mechanized equipment in watercourses is not permitted. Where work is required in watercourses, minimize movement of equipment in the water and remove false work, pilings, debris, and other temporary work as soon as construction will allow.
  9. Wherever crossings of live streams are necessary, provide temporary culverts or bridges to allow equipment to cross them without fording. Disturbance of lands and waters outside limits of construction is prohibited, except as may be found necessary and approved in writing by Architect.
  10. Mulching shall follow seeding operations by no more than 24 hours.
  11. Continue erosion control measures until permanent measures have been sufficiently established and are capable of controlling erosion on their own.
- B. Hay And Straw Mulching:
1. Install hay or straw mulch immediately after areas have been properly prepared.
    - a. When permanent seed or seed for temporary erosion control is sown prior to placing mulch, place mulch on seeded areas within 24 hours after seeding.
    - b. Architect may authorize blowing of chopped mulch provided that 95 percent of mulch fibers will be **6 inches (150 mm)** or more in length and that mulch can be applied in so there will be a minimum amount of matting that would retard plant growth.
    - c. Hay mulch should cover ground enough to shade it, but should not be so thick that a person standing cannot see ground through mulch.
    - d. Remove matted mulch or branches.
  2. Where mild winds that may blow mulch are probable, when ground slopes exceed 15 percent, or when otherwise required to maintain mulch firmly in place, apply a system of pegs and strings, a chemical stabilizer, or temporary type netting to mulch. Unless otherwise directed, remove strings and netting prior to acceptance of the Work.
  3. Where high winds or heavy rainstorms are likely, where ground surfaces are steeper than 15 percent, or where other conditions require, apply temporary type netting over mulch and take whatever other measures are necessary to maintain mulch firmly in place.
  4. Unless otherwise specified, use of permanent type netting is not permitted without prior written approval of Architect.
- C. Matting:
1. General:
    - a. Use of mulch with matting is not permitted. However, **4 to 6 inch (100 to 150 mm)** overlap of mulch over edge of matting is allowed.
    - b. Prepare surfaces of ditches and slopes to conform to grades, contours, and cross sections shown on Drawings. Finish to smooth, even condition with debris, roots, stone, and lumps raked out and removed. Loosen soil surface sufficient to permit bedding of matting. Unless otherwise noted, place seed prior to placement of matting.
    - c. Unroll matting parallel to direction of water flow and loosely drape, without folds or stretching, so continuous ground contact is maintained.
    - d. In ditches and swales and on slopes, place each upslope and each downslope end of each piece of matting in 6 inch trench, stapled at **12 inches (300 mm)** on center, backfilled, and tamped. Similarly, bury edges of matting along edges of catch basins and other structures. Architect may require that other edges exposed to more than normal flow of water be buried in similar fashion.
    - e. Tightly secure matting to soil with staples driven approximately vertically into ground, flush with matting surface. Do not form depressions or bulges in matting surface with staples.
    - f. Increase specified spacing of staples when factors such as season of year or amount of water encountered or anticipated require additional anchoring.
  2. Jute Matting:
    - a. Where strips are laid parallel or meet, as in a tee, overlap **4 inches (100 mm)** minimum. Overlap ends **6 inches (150 mm)** minimum, shingle fashion.
    - b. Space check slots built at right angles to direction of water flow so one check slot or one end occurs within each **50 feet (15 meters)** of slope length. Construct check slots by placing tight fold of matting **6 inches (150 mm)** minimum vertically into ground. Tamp these same as upslope ends.
    - c. Press jute matting onto ground with light lawn roller or other satisfactory means.

- d. On slopes flatter than 4:1, place staples **36 inches (900 mm)** apart maximum in three rows for each strip, with one row along each edge and one row alternately spaced down center. On grades 4:1 or steeper, place staples in the same three rows, but spaced **24 inches (600 mm)** apart. On lapping edges, reduce spacing of staples by half. At ends of matting and at required check slots, space staples **12 inches (300 mm)** apart. Staple matting placed adjacent to boulders or other obstructions with no spaces between staples.
  - e. Spread additional seed over jute matting, particularly those locations disturbed by building of slots.
3. Excelsior Matting:
    - a. Where strips of excelsior matting are laid end-to-end, butt adjoining ends.
    - b. When adjoining rolls of excelsior matting are laid parallel to one another, butt matting snugly.
    - c. On slopes flatter than 4:1, place staples **36 inches (900 mm)** maximum apart in three rows for each strip, with one row along each edge and one row alternately spaced down center. On grades 4:1 or steeper, place staples in same three rows, but spaced **24 inches (600 mm)** apart. Space staples in ends of matting **12 inches (300 mm)** apart. Staple matting placed adjacent to boulders or other obstructions with no spaces between staples.
  4. Erosion Control Mulching Blanket:
    - a. Where one roll ends and second roll begins, bring end of upslope piece over end of downslope roll so there is **12 inch (300 mm)** overlap. Place overlap in **4 inch (100 mm)** deep trench, staple at **12 inches (300 mm)** on center, and backfill and tamp.
    - b. On slopes where two or more widths of blanket are applied, overlap edges **4 inches (100 mm)** and staple at **12 inch (300 mm)** intervals along exposed edge of lap joint.
    - c. Staple body of blanket in grid pattern with staples **36 inches (900 mm)** on center, each way.
- D. Seed For Erosion Control:
1. Seeding for permanent erosion control shall be carried out in accordance with appropriate Section under 32 9300 heading.
  2. Areas that will be regraded or otherwise disturbed later during construction may be seeded with rye grass to obtain temporary control. Sow seed at **one lb (0.45 kg)** per **1,000 sq ft (93 sq m)**, on pure live seed basis.
- E. Hay Bales And Silt Fences:
1. Provide hay bales or silt fences, as required, for temporary control of erosion and to stop silt and sediment from reaching surface waters, adjacent properties, or entering catch basins, or damaging the Work.
  2. Stake hay bales firmly in place. Use sufficient number of bales to accommodate runoff without causing flooding and to adequately store any silt, sediment, and debris reaching them.
  3. Erect silt fences and bury bottom edge in accordance with Manufacturer's recommended installation instructions. Provide sufficient length of fence to accommodate runoff without causing flooding and to adequately store any silt, sediment, and debris reaching it.

### 3.2 REPAIR / RESTORATION

- A. If any staple becomes loosened or raised, if any matting becomes loose, torn, or undermined, or if any temporary erosion and sediment control measures are disturbed, repair them immediately.
- B. If seed is washed out before germination, repair damage, refertilize, and reseed.
- C. Maintain mulched and matted areas, silt stops, and other temporary control measures until permanent control measures are established and no further erosion is likely.

### END OF SECTION

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## **DIVISION 32: EXTERIOR IMPROVEMENTS**

### **32 1000 BASES, BALLASTS, AND PAVING**

32 1216 ASPHALT PAVING - SUPERPAVE  
32 1723 PAVEMENT MARKINGS

### **32 3000 SITE IMPROVEMENTS**

32 3113 CHAIN LINK FENCES AND GATES

### **32 8000 IRRIGATION**

32 8423 UNDERGROUND SPRINKLERS

### **32 9000 PLANTING**

32 9001 COMMON PLANTING REQUIREMENTS  
32 9120 TOPSOIL AND PLACEMENT  
32 9122 TOPSOIL GRADING  
32 9223 SODDING  
32 9300 PLANTS  
32 9413 LANDSCAPE EDGING

END OF TABLE OF CONTENTS

**SECTION 32 1216****ASPHALT PAVING: Superpave Method****PART 1 - GENERAL****1.1 SUMMARY****A. Includes But Not Limited To:**

1. Furnish and install asphalt concrete paving in driveways and parking areas as described in Contract Documents including the following, but not limited to:
  - a. Asphalt Mix Design Criteria Summary:
 

1) Asphalt Binder:	PG 64-22
2) Nominal maximum size aggregate (Nmas):	9.5 mm (3/8 inch)
3) Maximum size aggregate:	12.5 mm (1/2 inch)
4) Mix Designator (compaction effort); Ndesign:	50
5) Antistrip Agent:	If required by supplier's mix design (use 1 percent or greater lime slurry when required)
6) Asphalt Fibers:	No
7) Reclaimed Asphalt Pavement (RAP):	Allowed up to 25 percent. Asphalt binder shall be one grade softer when more than 15 percent RAP is used
8) ROSP	Not allowed.
9) Warm Mix Additive	If required by supplier's mix design
10) Recycle Agent:	If required by supplier's mix design
  - b. Tack coat: Application of asphaltic material to existing asphalt concrete or portland concrete surfaces before asphalt concrete pavement.
  - c. Blotter materials and procedures for absorbing excess asphalt as required.
  - d. An "approved as equal" mix may be used if approved prior to bidding.

**B. Related Requirements:**

1. Section 01 1200: 'Multiple Contract Summary' for multiple contracts.
2. Section 01 3100: 'Project Management and Coordination' for pre-installation conference.
3. Section 01 4301: 'Quality Assurance – Qualifications' establishes minimum qualification levels required.
4. Section 01 4523: 'Testing and Inspecting Services' for testing and inspection, and testing laboratory services for materials, products, and construction methods.
5. Section 01 7800: 'Closeout Submittals'.
6. Section 31 0501: 'Common Earthwork Requirements' for:
  - a. General procedures and requirements for earthwork.
  - b. Pre-installation conference held jointly with other common earthwork related sections.
7. Section 31 1123: 'Aggregate Base' for compaction of aggregate base.
8. Section 31 2213: 'Rough Grading' for rough grading and preparation of natural soil subgrades below fill and aggregate base materials.
9. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.
10. Section 31 2323: 'Fill' for compaction procedures and tolerances for base.

**1.2 REFERENCES****A. Association Publications:**

1. Asphalt Institute, 2696 Research Park Dr., Lexington, KY [www.asphaltinstitute.org](http://www.asphaltinstitute.org):
  - a. MS-2, 'Mix Design Methods' (7<sup>th</sup> Edition 2015).

**B. Definitions:**

1. Aggregate: Hard inert mineral material, such as gravel, crushed rock, slag, or sand.
    - a. Coarse Aggregate: Aggregate retained on or above No. 4 (4.75 mm) sieve.
    - b. Coarse-Graded Aggregate: Aggregate having predominance of coarse sizes.
    - c. Dense-Graded Aggregate: Aggregate that is graded from maximum size down through filler with object of obtaining an asphalt mix with controlled void content and high stability.
    - d. Fine Aggregate: Aggregate passing No. 4 (4.75 mm) sieve.
    - e. Fine-Graded Aggregate: Aggregate having predominance of fine sizes.
    - f. Mineral Filler: Fine mineral product at least 70 percent of which passes a No. 200 (75µm) sieve.
  2. Air Voids: Total volume of small air pockets between coated aggregate particles in asphalt cement concrete (ACC); expressed as percentage of bulk volume of compacted paving mixture.
  3. Anti-Stripping Agent: Chemicals added to bitumen to improve the adhesion of the bitumen to hydrophilic aggregates
  4. Asphalt Binder: Asphalt cement or modified asphalt cement that binds aggregate particles into dense mass.
    - a. Asphalt Cement used in paving applications that has been classified according to the Standard Specification for Performance Graded Asphalt Binder, AASHTO Designation MP 320. It can be either unmodified or modified Asphalt Cement, as long as it complies with specifications.
  5. Asphalt-Aggregate Designator: Alpha-numeric code that indicates nominal maximum size of aggregate, and type and grade of asphalt in aggregate-asphalt mix.
    - a. Example: "12.5 PG70-28" means aggregate asphalt mix shall be composed of aggregate gradation with 12.5 mm (1/2 inch) nominal maximum size and performance grade asphalt binder designed to perform between temperatures of 70 deg C and -28 deg C (158 deg F and -18.4 deg F).
  6. Equivalent Single Axle Load (ESAL): Effect on pavement performance of any combination of axle loads of varying magnitude equated to number of 18,000-lb. (80-kN) single-axle loads that are required to produce an equivalent effect.
  7. Maximum Size (Superpave): One sieve larger than the nominal maximum size.
  8. Ndesign (Superpave): Design number of gyrations used for design of Hot Mix Asphalt (HMA).
  9. Nominal Maximum Size: One sieve size larger than first sieve size retaining more than 10 percent of Sample. Nominal maximum size sieve will retain minimum of 0 and maximum of 10 percent of sample. Maximum size is one sieve size larger than nominal maximum size.
  10. Performance Graded Asphalt Binder (PGAB): Asphalt binder designed to produce HMA that meets certain performance standards. Designations for performance-graded asphalt binders are prefixed with PG. Each grade designation also includes two sets of numbers that denote temperature range. This is a range of climate temperatures to which road may be exposed and still be expected to give superior performance. PG numbers do not indicate viscosity as in conventional liquid asphalt designations.
  11. Pre-emergent Herbicide: Chemical that is applied before weeds emerge. It acts by killing weed seedlings and /or establishing layer of chemical on or near soil surface that is toxic to germinating seeds and young seedlings.
  12. Reclaimed Asphalt Pavement (RAP): Existing asphalt mixture that has been pulverized, usually by milling, and is used like aggregate in recycling of asphalt pavements.
  13. Subgrade (definition varies depending upon stage of construction and context of work being performed):
    - a. Prepared natural soils on which fill, aggregate base, or topsoil is placed.
    - or
    - b. Prepared soils immediately beneath paving.
  14. Tack Coat: Very light application of liquid asphalt, or asphalt emulsion diluted with water.
- C. Reference Standards:
1. American Association of State and Highway Transportation Officials:
    - a. AASHTO T 304-11: 'Standard Method of Test for Uncompacted Void Content of Fine Aggregate'.
    - b. AASHTO T 322-07(2011), 'Standard Method of Test for Determining the Creep Compliance and Strength of Hot-Mix Asphalt (HMA) Using the Indirect Tensile Test Device.
  2. ASTM International:

- a. ASTM C29/C29M-16, 'Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate'.
- b. ASTM C88-13, 'Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate'.
- c. ASTM C117-13, 'Standard Test Method for Materials Finer than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing'.
- d. ASTM C131/C131M-14, 'Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine'.
- e. ASTM C142/C142M-10, 'Standard Test Method for Clay Lumps and Friable Particles in Aggregates'.
- f. ASTM D242/D242M-09(2014), 'Standard Specification for Mineral Filler For Bituminous Paving Mixtures'.
- g. ASTM D977-13, 'Standard Specification for Emulsified Asphalt'.
- h. ASTM D979/D979M-15, 'Practice for Sampling Bituminous Paving Mixtures'.
- i. ASTM D2041/D2041M-11, 'Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures'.
- j. ASTM D2172/D2172M-11, 'Standard Test Methods for Quantitative Extraction of Bitumen From Bituminous Paving Mixtures'.
- k. ASTM D2256/ D2256M-10, 'Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method'.
- l. ASTM D2397/D2397M, 'Standard Specification for Cationic-Emulsified Asphalt'.
- m. ASTM D2419-14, 'Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate'.
- n. ASTM D2950/D2950M-14, 'Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods'.
- o. ASTM D3203/D3203M-11, 'Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures'.
- p. ASTM D3549/D3549M-11, 'Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens'.
- q. ASTM D3665-12, 'Standard Practice for Random Sampling of Construction Materials'.
- r. ASTM D4318-10, 'Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils'.
- s. ASTM D4552/D4552M-10, 'Standard Practice for Classifying Hot-Mix Recycling Agents'.
- t. ASTM D4759-11, 'Standard Practice for Determining the Specification Conformance of Geosynthetics'.
- u. ASTM D4791-10, 'Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate'.
- v. ASTM D5444-15, 'Standard Method for Mechanical Size Analysis of Extracted Aggregate'.
- w. ASTM D5821-13, 'Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate'.
- x. ASTM D6307-10, 'Standard Test Method for Asphalt Content of Hot-Mix Asphalt by Ignition Method'.
- y. ASTM D6932/D6932M-08(2013), 'Standard Guide for Materials and Construction of Open-Graded Friction Course Plant Mixtures'.

### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Conferences:
  - 1. Participate in pre-installation conference as specified in Section 31 0501 'Common Earthwork Requirements':
  - 2. In addition to agenda items specified in Section 01 3100 'Project Management and Coordination' and Section 31 0501 'Common Earthwork Requirements', review following:
    - a. Review surveying and staking of parking areas and installation of sleeves.
    - b. Review proposed aggregate base schedule.
    - c. Review rough grading elevations before placing paving fill.
    - d. Review fine grading elevations of subgrade fine grading operations before placing aggregate base and paving.
    - e. Review proposed asphalt paving schedule.



- f. Review asphalt paving mix design.
  - g. Review pre-emergent herbicide protection of adjoining property and planting area on site requirements, schedule and application requirements.
  - h. Review schedule of mandatory asphalt paving surface treatment to be applied after placement of asphalt paving.
  - i. Review schedule of paint stripes to be applied after asphalt paving surface treatment.
  - j. Review safety issues.
  - k. Review Section 01 4523 'Testing and Inspecting Services' for administrative requirements and responsibilities and Field Quality Control tests and inspections required of this section.
    - 1) Review requirements and frequency of testing and inspections.
- B. Scheduling: Notify Testing Agency and Architect twenty four (24) hours minimum before placing asphalt paving.

#### 1.4 SUBMITTALS

- A. Action Submittals:
- 1. Product Data:
    - a. Pre-Emergent Herbicide:
      - 1) Manufacturer's published product data on pre-emergent herbicide.
- B. Informational Submittals:
- 1. Certificates:
    - a. Require mix plant to furnish delivery/load tickets for each batch of asphalt. Keep delivery tickets at job-site for use of Owner's Representative. Tickets shall show following:
      - 1) Name of mix plant.
      - 2) Date.
      - 3) Name of contractor.
      - 4) Name and location of Project.
      - 5) Serial number of ticket.
      - 6) Asphalt mix type.
      - 7) Time loaded.
      - 8) Identity of truck.
    - b. Installer to provide Manufacturer's Certificate of Compliance stating material authenticity and properties for review and acceptance by Architect before product use.
  - 2. Design Data:
    - a. Hot Mix Asphalt:
      - 1) Design Criteria:
        - a) Develop mix design according to current Asphalt Institute MS-2 'Asphalt Mix Design Methods' for Superpave Method.
        - b) Submittal format:
          - (1) Design mix submittal shall follow format as indicated in current Asphalt Institute MS-2, '*Mix Design Methods*'.
      - 2) Mix design of asphalt paving must meet Design Criteria minimum requirements and show conformance to the following:
        - a) Location and name of hot mix asphalt concrete production facility.
        - b) Date of mix design. If older than two (2) years, recertify mix design.
        - c) Asphalt mix type.
        - d) Mix design method used.
        - e) Mix density.
        - f) Design air voids (three and one half (3.5) percent).
        - g) Asphalt content in percent.
        - h) Performance grade of asphalt binder.
        - i) Nominal maximum size of aggregate.
        - j) Maximum size of aggregate.
        - k) Aggregate source and gradation.
        - l) Mix properties and design parameters.
        - m) Temperature of mix at plant and in the field for optimum field compaction.

- n) Amount of recycled asphalt pavement (RAP).
    - o) Mineral fillers, antistrip, and recycle agent percentages.
    - p) Identify if warm mix technologies will be used and how much warm mix additive will be used.
  - 3) Within thirty (30) days prior to asphalt construction, submit actual design mix to Architect, Civil Engineering Consultant of Record and Independent Testing Laboratory for review and approval.
- 3. Test And Evaluation Reports:
  - a. Hot Mix Asphalt:
    - 1) Copies of test results from tests conducted to assure compliance to Contract Document requirements.
- 4. Manufacturer Instructions:
  - a. Pre-Emergent Herbicide:
    - 1) Application instructions for pre-emergent herbicide.
- 5. Qualification Statement:
  - a. Installer:
    - 1) Provide Qualification documentation if requested by Owner's Representative.
- C. Closeout Submittals:
  - 1. Include following in Operations And Maintenance Manual specified in Section 01 7800 'Closeout Submittals':
    - a. Record Documentation:
      - 1) Manufacturer's documentation:
        - a) Pre-emergent herbicide documentation.
        - b) Asphalt paving design.
        - c) Test reports.
        - d) Certificates from mix plant of delivery/load tickets.
        - e) Manufacturer's Certificate of Compliance.
      - 2) Testing and Inspection Reports:
        - a) Testing Agency Testing and Inspecting Reports of asphalt paving.

## 1.5 QUALITY ASSURANCE

- A. Qualifications. Requirements of Section 01 4301 'Quality Assurance - Qualifications' applies but not limited to following:
  - 1. Asphalt Paving:
    - a. Foreman of asphalt paving crew has completed at least three (3) projects of similar size and nature.
    - b. Upon request, submit documentation.
  - 2. Pre-emergent herbicide:
    - a. Applicator:
      - 1) Pre-emergent herbicide shall be applied by applicator certified by State in which Project is located as an applicator of agricultural chemicals.
- B. Testing and Inspection:
  - 1. Owner is responsible for Quality Assurance. Quality assurance performed by Owner will be used to validate Quality Control performed by Contractor.
  - 2. Owner will provide Testing and Inspection for asphalt paving:
    - a. Owner will employ testing agencies to perform testing and inspection for asphalt paving as specified in Field Quality Control in Part 3 of this specification.
      - 1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform the Work in strict accordance with requirements of Contract Documents and perform contractor testing and inspection.
      - 2) See Section 01 1200: 'Multiple Contract Summary'.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery And Acceptance Requirements:
  - 1. Asphalt Material:
    - a. Each shipment must:
      - 1) Be uniform in appearance and consistency.
      - 2) Show no foaming when heated to specified loading temperature.
    - b. Do not supply shipments contaminated with other asphalt types or grades than those specified:
      - 1) Do not use petroleum distillate as a release agent.
  - 2. Pre-emergent herbicide:
    - a. Materials shall be delivered in original, unopened packages with labels intact.
- B. Storage And Handling Requirements:
  - 1. Pre-emergent herbicide:
    - a. Do not freeze. Store in at temperatures above 41 deg F (5 deg C).
    - b. Follow Manufacturer's storage and handling requirements.

## 1.7 FIELD CONDITIONS

- A. Ambient Conditions:
  - 1. Pre-emergent herbicide:
    - a. Follow printed Manufacturers instruction for environmental hazards:
    - b. Follow printed Manufacturers instruction ambient conditions for application of product.
  - 2. Tack Coat:
    - a. Apply only when air and roadbed temperatures in shade are greater than 40 deg F (4.4 deg C). Temperature restrictions may be waived only upon written authorization from Architect or Civil Engineer.
    - b. Do not apply to wet surfaces.
    - c. Do not apply when weather conditions prevent tack coat from adhering properly.
  - 3. Asphalt paving:
    - a. Do not perform work during following conditions:
      - 1) Ambient temperature is below 45 deg F (7.2 deg C) or will fall below 45 deg F (7.2 deg C) during placement.
      - 2) Temperature of aggregate base below 50 deg F (10 deg C).
      - 3) Cold Weather Asphalt Paving Plan: If asphalt pavement is placed outside of these temperature limits or those identified in MINIMUM Temperature Degrees, a plan is required which includes:
        - a) Haul times.
        - b) Placement details.
        - c) Compaction aids used in production.
        - d) Owner does not assume responsibility for asphalt when placed outside temperature limits.
      - 4) Presence of free surface water or weather is unsuitable.
      - 5) Wind or ground cools mix material before compaction.

## PART 2 - PRODUCTS

### 2.1 DESIGN CRITERIA

- A. General:
  - 1. Follow current Asphalt Institute MS-2 'Asphalt Mix Design Methods' for Superpave Method.
- B. Asphalt Mix:
  - 1. Asphalt Binder:
    - a. Performance Graded Asphalt Binder:

- 1) Use performance graded asphalt binder identified under Asphalt Mix Design Criteria.
2. Aggregates:
  - a. Use clean, hard, durable, angular, sound, consisting of crushed stone, crushed gravel, slag, sand, or combination.
  - b. Use nominal maximum size aggregate and maximum size aggregate per Asphalt Mix Design Criteria. Aggregate gradation to meet **Table 1 - MASTER GRADING BANDS** requirements:

<b>Table 1 - MASTER GRADING BANDS</b>			
Sieve (mm)		Nominal Maximum Aggregate Size	
		12.5 mm	9.5 mm
Control Sieves	19	100	-
	12.5	100	100
	9.5	< 90	90 – 100
	4.75	--	< 90
	2.36	28 – 58	32 – 60
	0.075	2 – 10	2 – 10
Restricted Zone	2.36	39.1	47.2
	1.18	25.6 – 31.6	31.6 – 37.6
	0.6	19.1 – 23.1	23.5 – 27.5
	0.3	15.5	18.7
NOTES: 1. It is assumed fine and coarse aggregate have same bulk specific gravity. 2. Gradation is expressed in percent passing by weight, ASTM C136. Percentage of fines passing 0.075 mm control sieve determined by washing, ASTM C117.			

- c. Provide aggregate material properties to meet **Table 2 – AGGREGATE PHYSICAL PROPERTIES** requirements:

**Table 2 –AGGREGATE PHYSICAL PROPERTIES**

Property	ASTM	ESAL	Min	Max
<b>Coarse Aggregate (does not pass No. 4 sieve)</b>				
Angularity (fractured faces), percent	D5821	less than 0.3	55	--
		0.3 to 3.0	75	--
		greater than 3.0	85/80	--
Wear (hardness or toughness), percent	C131/C131M	less than 0.3	--	40
		0.3 to 3.0	--	35
		greater than 3.0	--	35
Flats or elongates (3:1 length to width), percent, maximum	D4791	--	--	20
<b>Fine Aggregate (passing No. 4 sieve)</b>				
Angularity (uncompacted void content), percent (AASHTO T304)	--	less than 0.3	--	--
		0.3 to 3.0	40	--
		greater than 3.0	45	--
Sand equivalent, percent	D2419	less than 0.3	40	--
		0.3 to 3.0	40	--
		greater than 3.0	45	--
Friable particles, percent	C142	--	--	2
Plastic limit, maximum	Liquid limit	D4318	--	25
	Plastic limit	D4318	--	6

**Notes:**

1. ESAL in millions.
2. Angularity by weight retained above 9 mm sieve, with at least one fractured face. 85/80 denotes 85 percent coarse aggregate has one fractured face and 80 percent has two or more fractured faces.
3. Wear of aggregate retained above 2.36 mm sieve unless specific aggregates have higher values are known to be satisfactory.
4. Flats or elongates retained above 4.75 mm sieve.
5. Friable particles passing No. 4.75 mm sieve.
6. Plasticity, passing No. 4.75 sieve. Aggregate is no-plastic even when filler material is added to aggregate.

**Blended Physical Properties**

Dry-rodded unit weight, lb/ft <sup>3</sup> , minimum	C29/C29M	-	75	--
Weight loss (soundness), percent, maximum	C88		--	16
Clay content or cleanliness (sand equivalent), percent	D2419	less than 0.3	45	--
		more than 0.3	60	--

**Notes:**

1. Weight loss using sodium sulfate.
2. Sand equivalent value is after going through dryer or before drum mixer. The sand equivalent requirement is waived for RAP aggregate but applies to remainder of aggregate blend.
3. Friable particles of clay lumps, shale, wood, mica, and coal passing 4.75 sieve.

3. **Admixture:**

- a. Antistrip: Heat stable, cement slurry, lime slurry, dry lime, or liquid antistrip:
  - 1) Add if mix is moisture sensitive as determined by 'Moisture Susceptibility' paragraph below.
- b. Mineral Filler: Comply with requirements of ASTM D242/D242M.
- c. Recycle Agent: Comply with requirements of ASTM D4552/D4552M.

## 2.2 MATERIAL

- A. Aggregate Base: Conform to applicable requirements as specified in Section 31 1123: 'Aggregate Base'.
- B. Asphalt Paving Surface Treatment:
  - 1. Include mandatory Asphalt Paving Surface Treatment to be applied no sooner than thirty (30) days or no later than eighteen (18) months of placing Asphalt Paving to be included with this project:
- C. Pre-Emergent Herbicide:
  - 1. Design Criteria:
    - a. Selective type pre-emergence control chemical containing forty (40) percent Trifluralin minimum for control of annual grasses and broadleaf weeds.
    - b. Non-oil based sterilant.
    - c. Labeled for under-pavement use.
  - 2. Type Two Acceptable Products:
    - a. Treflan E.C. by Monterey AgResources, Fresno, CA [www.montereyagresources.com](http://www.montereyagresources.com) (available in western United States).
    - b. Trust 4EC by WinField Solutions LLC (Agrilsolutions), St Paul, MN [www.agrilsolutionsinfo.com](http://www.agrilsolutionsinfo.com) (available in United States).
    - c. Equal as approved by Architect before installation. See Section 01 6200.
- D. Reclaimed Asphalt Pavement (RAP). Aggregate: Restrictions include:
  - 1. Allowed up to 25 percent. Asphalt binder shall be one grade softer when more than 15 percent RAP is used.
- E. Tack Coat:
  - 1. Emulsified asphalt meeting requirements of ASTM D977, Grade SS-1H, CQS-1H, or ASTM D2397/D2397M, Grade CSS-1H.

## PART 3 - EXECUTION

### 3.1 INSTALLERS

- A. Approved Applicators. See Section 01 4301 'Quality Assurance - Qualifications':

### 3.2 PREPARATION

- A. General:
  - 1. Aggregate base and paving must be placed before any moisture or seasonal changes occur to subgrade that would cause compaction tests previously performed to be erroneous. Re-compact and retest subgrade soils that have been left exposed to weather.
- B. Protection Of In-Place Conditions:
  - 1. Pre-emergent herbicide:
    - a. Take necessary precautions to protect adjoining property and areas designated for planting on building site.
    - b. Do not contaminate any body of water by direct application, cleaning of equipment or disposal of wastes.
  - 2. Asphalt Paving:
    - a. Protect all structures, including curb, gutter, sidewalks, guard rails and guide posts.
    - b. Protect neighborhood, storm drains and down-stream fish habitat.
- C. Surface Preparation:
  - 1. Survey and stake parking surfaces to show grading required by Contract Documents.
  - 2. Subgrade (soil below aggregate base):

- a. Prepare natural soil subgrade as specified in Section 31 2213 'Rough Grading' or prepare fill subgrade as described in Section 31 2216 'Fine Grading'.
3. Aggregate base:
  - a. Finish grade parking surface area to grades required by Contract Documents.
  - b. Compact aggregate base as specified in Section 31 1123 'Aggregate Base'.
  - c. Tolerances:
    - 1) Elevation of aggregate base shall be 0.00 inches (0.00 mm) high and no more than 1/2 inch (12.7 mm) low.
    - 2) Measure using string line from curb to curb, gutter, flat drainage structure, or grade break.
4. Tack coat:
  - a. Clean surface of all materials such as mud, dirt, leaves, etc. that prevent tack from bonding to existing surfaces.
    - 1) If flushed, allow surface to dry.
5. Asphalt paving:
  - a. Area shall be clean and tack coat applied before placing of asphalt paving.
    - 1) Remove all moisture, dirt, sand, leaves, and other objectionable material from prepared surface before placing asphalt.
    - 2) Locate, reference, and protect all utility covers, monuments, curb, and gutter and other components affected by asphalt paving operations.
    - 3) Allow sufficient cure time for tack coat before placing asphalt.

### 3.3 APPLICATION

- A. Interface With Other Work:
  1. Section 31 1123: 'Aggregate Base' for compaction of aggregate base.
  2. Section 31 2213: 'Rough Grading' for rough grading and preparation of natural soil subgrades below fill and aggregate base materials.
  3. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.
  4. Section 31 2323: 'Fill' for compaction procedures and tolerances.
- B. Pre-Emergent Herbicide:
  1. Asphalt paving areas:
    - a. Follow Manufacturer's printed application requirements:
    - b. Apply to prepared subgrade dispersed in liquid. Concentrate shall be such that Manufacturer's full recommended amount of chemical will be applied to every 1000 sq ft (93 sq m) and liquid will penetrate minimum of 2 inches (50 mm).
    - c. Application shall be no more than one (1) day before installation of aggregate base.
- C. Tack Coat:
  1. General:
    - a. Tack coat vertical surfaces or existing asphalt cement concrete or portland cement concrete that will be in contact with asphalt paving.
    - b. Use tack coat diluted to a 2:1 (concentrate water) ratio.
    - c. Use pressure distributor to apply in uniform, continuous spread.
    - d. Cover all tacked surface areas with surfacing materials same day of application.
  2. Application rate. Typically as follows:
    - a. Emulsions, 0.08 to 0.15 gallons per sq yd (0.303 to 0.679 L per sq m) of diluted material:
      - 1) Apply sufficient to achieve ninety five (95) percent or better coverage of existing surfaces.
      - 2) Above application rates may vary according to field conditions. Obtain approval from Civil Engineer for quantities, rate of application, temperatures, and areas to be treated before any application.
- D. Asphalt Paving:
  1. General:
    - a. Paving adjacent to cast-in-place concrete site elements shall be between 1/4 inch (6 mm) higher than concrete.

- b. Surface texture of hand worked areas shall match texture of machine-laid areas.
- c. Surface shall be uniform with no 'birdbaths'. Leave finished surfaces clean and smooth. Variations from specified grades shall not exceed **1/2 inch (12.7 mm)**.
- d. Cross Slope: **1/4 inch (6 mm)** in **10 feet (3.0 m)** perpendicular to centerline except at cross section grade breaks.
- e. Grade: **1/8 inch (3 mm)** in **10 feet (3.0 m)** parallel to centerline.
- f. Do not place on frozen aggregate base or during adverse climatic conditions such as precipitation or when roadway surface is icy or wet.
- g. Uniformly mix materials so aggregate is thoroughly coated with asphalt.
- h. Place at temperatures established by the mix design with self-propelled laydown machine.
- i. Use **Table 3 – MINIMUM TEMPERATURE, DEGREES** as guide:

Table 3 – MINIMUM TEMPERATURE, DEGREES							
Ambient Air Temperature Deg F.	Ambient Air Temperature Deg C.	Compacted Paving Mat Thickness					
		3/4" (19 mm)	1" (25 mm)	1 1/2" (38 mm)	2" (50 mm)	3" (75 mm)	4" + (100 mm) +
45 – 50	7 – 10	---	---	---	---	280	265
50 – 59	10 – 15	---	---	---	280	270	255
60 – 69	16 – 20	---	---	285	275	265	250
70 – 79	21 – 29	285	285	280	270	265	250
80 - 89	27 - 31	280	275	270	265	260	250
90+	32+	275	270	265	260	250	250

- j. Longitudinal bituminous joints shall be vertical and properly tack coated if cold. Transverse joints shall always be tack coated.
- 2. Compaction:
  - a. Compact asphalt paving to ninety four (94) percent plus or minus two (2) percent of theoretical maximum specific gravity, ASTM D2041/D2041M (Rice Method - maximum theoretical density).
  - b. Roll with powered equipment capable of obtaining specified density while providing required smoothness.
  - c. Begin breakdown rolling immediately after asphalt is placed when asphalt temperature is at maximum.
  - d. Complete handwork compaction concurrently with breakdown rolling.
  - e. Execute compaction so visibility of joints is minimized:
  - f. Complete finish rolling to improve asphalt surface as soon as possible after intermediate rolling and while asphalt paving is still warm.
  - g. Do not use vibration for finish rolling.
- 3. Lift Thickness:
  - a. Preferred Method:
    - 1) For pavements **3-1/2 inch (89 mm)** or thinner apply asphalt paving in single lift.
    - 2) For pavements greater than **3-1/2 inch (89 mm)**, use alternate method below.
  - b. Alternate Method:
    - 1) Asphalt paving may be applied in two (2) lifts, first **2 inches (50 mm)** thick minimum and second **1 1/2 inches (38 mm)** thick minimum following temperature recommendations of following paragraph.
    - 2) Surface of first lift shall be clean and provide tack coat between first and second lifts.
    - 3) Provide not less than two (2) times maximum aggregate size in compacted asphalt concrete mixes.
- E. Asphalt Paving Surface Treatments:
  - 1. Apply mandatory Asphalt Paving Surface Treatment no sooner than thirty (30) days or no later than eighteen (18) months of placing Asphalt Paving to be included with this project. Do not apply prior to asphalt curing (refer to 'Asphalt, Concrete and Pervious Concrete Maintenance Guidelines'):



- F. Paint Stripes:
1. Apply paint stripes after asphalt paving surface treatment has been applied to asphalt paving.

### 3.4 FIELD QUALITY CONTROL

- A. Field Tests And Inspections:
1. Civil and structural field tests, laboratory testing, and inspections are provided by Owner's independent Testing Agency as specified in Section 01 4523 'Testing And Inspection Services':
    - a. Quality Control is sole responsibility of Contractor:
      - 1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform testing and inspection as part of his Quality Control:
        - a) Testing and inspections, if performed by Contractor, will be responsibility of Contractor to be performed by an independent entity.
      - 2) Contractor bears full responsible for compliance with all contract requirements and quality control on project and will be responsible for quality of asphalt mixture and asphalt installation.
- B. Field Tests (Provided by Contractor):
1. General:
    - a. Contractor bears full responsibility for compliance with all contract requirements and quality control on project and will be responsible for quality of asphalt mixture and asphalt installation.
    - b. Testing and Inspection Reports to be distributed as specified in Section 01 4523 'Testing And Inspection Services'.
  2. Compaction Tests:
    - a. Contractor to provide compaction tests of asphalt being placed to establish rolling patterns and installation procedures.
    - b. Compaction tests by Contractor are independent of compaction tests being provided by Owner. See Section 01 4523 'Testing And Inspection Services'.
    - c. Asphalt paving shall be compacted to ninety four (94) percent of Theoretical Maximum Specific Gravity (Rice) plus three (3) percent or minus two (2) percent. Determine percent compaction by ASTM D2041/D2041M.
  3. Thickness Tests:
    - a. Determine thickness of paving being placed, no less than one (1) test per 10,000 sq. ft. (930 sq. m) of paving or portion thereof, three (3) tests minimum.
- C. Field Tests And Inspections (Provided by Owner):
1. General:
    - a. Compaction tests provided by Owner will be used to validate or determine discrepancies with testing by Contractor.
    - b. Civil engineer applies pay factor for Gradation/Asphalt Content, In-Place Density. Civil engineer computes pay factor for each lot.
    - c. Opening paved surface to traffic does not constitute acceptance.
    - d. Asphalt-aggregate mix sampling as per ASTM D979/D979M.
      - 1) Test for:
        - a) Air voids as per ASTM D3203/D3203M.
        - b) Asphalt binder content as per ASTM D6307.
        - c) Aggregate gradation as per ASTM D5444.
    - e. Lot size: 10,000 sq. ft. (930 sq. m) or part thereof.
    - f. Sub lot size: 5,000 sq. ft. (465 sq. m) or part thereof.
  2. At Site Testing and Inspection:
    - a. General:
      - 1) Sampling: One (1) random sample per sample per 10,000 sq. ft. (930 sq. m): Locations as follows:
        - a) Behind paver before compaction.
        - or
        - b) Where sub-lot exhibits non-uniform appearance.
    - b. Asphalt Paving:

- 1) Testing Agency shall provide full time nuclear density testing and inspection for asphalt paving during asphalt paving operations (nuclear density testing is informational testing only and does not constitute acceptance by Owner).
- 2) Inspection to include:
  - a) Aggregate coating.
  - b) Compaction control and effort required.
  - c) Suitability of spreading and asphalt paving equipment.
  - d) Temperature of mix as delivered and placed.
    - (1) Reject mixes exceeding 325 deg F (163 deg C) in transport vehicle as required in Non-Conforming Work below.
    - (2) Dispose of cold mix in paver hopper as thin spread underlay.
- 3) Field Tests:
  - a) When tested with 10 foot (3 meter) straight edge, surface of completed work shall not contain irregularities in excess of 1/4 inch (6 mm).
  - b) Determine percent compaction per ASTM D2950/D2950M unless other nondestructive nonnuclear methods such as sonar are used.
  - c) Provide written nuclear density testing, or other nondestructive nonnuclear methods such as sonar, of asphalt paving at minimum rate of one (1) per 2,500 sq. ft. (232 sq. m). Select test locations by ASTM D3665 and sample per ASTM D979/D979M before compaction. Minimum of three (3) tests required.
  - d) Compact asphalt paving to ninety four (94) percent of Theoretical Maximum Specific Gravity (Rice) plus three (3) percent or minus two (2) percent.
  - e) Maximum average total air voids in completed hot mix asphalt shall be eight (8) percent but more than three (3) percent as determined by ASTM D2041/D2041M.
  - f) Determine thickness of paving being placed, no less than one (1) test per 10,000 sq. ft. (930 sq. m) of paving or portion thereof, three (3) tests minimum.
3. At Laboratory Testing:
  - a. General:
    - 1) Provide at least one (1) laboratory test series for every 10,000 sq. ft. (930 sq. m) or part thereof (minimum of one (1) test):
      - a) Test reports will show compliance with Contract Documents regarding type and depth of aggregate base, depth and density of asphalt paving, asphalt content, aggregate gradation, flow and stability, bulk specific gravity and maximum specific gravity.
      - b) Reports will also give test procedures used by testing laboratory.
  - b. Compaction and Final Density:
    - 1) Pavement thickness and final density to be determined by results of coring. Provide one (1) core per 10,000 sq. ft. (930 sq. m) or part thereof. Minimum of three (3) tests required if under 30,000 sq. ft. (2 787 sq. m).
      - a) Based upon core samples, compaction is acceptable if test deviations are within pay factor 1.00 limits.
      - b) At Project Manager's discretion, after consulting with Design Team, a Lot with a sub-lot test deviation greater than Reject may stay in place at fifty (50) percent cost.
      - c) Select test locations by ASTM D3665 and sample per ASTM D979/D979M after compaction.
  - c. Compaction Pay Factor:
    - 1) Based upon core samples, compaction is acceptable if test deviations are within pay factor 1.00 limits.
    - 2) At Project Manager's discretion, after consulting with design team, a Lot with a sub-lot test deviation greater than Reject may stay in place at fifty (50) percent cost.
    - 3) Average Density, in percent as shown in **Table 4 – COMPACTION PAY FACTORS:**

<b>Table 4 – COMPACTION PAY FACTORS</b> (94 percent of theoretical maximum specific gravity – Superpave (Rice) (ASTM D2041/D2041M plus three (3) or minus two (2) percent)		
Pay Factor	Density, in Percent	
	Average	Lowest Test
0.70	More than 96	---
1.00	92 to 96	89 or Greater
0.90	92 to 96	Less than 89
Reject	Less than 92	---
Notes: 1. At Contractor's discretion and expense, do Hamburg wheel track test (AASHTO T 304) on 3 additional random core samples from non-complying sub-lot of <b>5,000 sq. ft. (465 sq. m)</b> . Sub-lot will be accepted if average rut depth is less than 10 mm at 20,000 passes.		

- d. Pavement Thickness:
- 1) Pavement thickness and final density to be determined by results of coring. Provide one (1) core per **10,000 sq. ft. (930 sq. m) or part thereof**. Minimum of three (3) tests required if under **30,000 sq. ft. (2 787 sq. m)**.
    - a) Acceptance will be based on the average of all thickness tests.
    - b) At Project Manager's discretion, after consulting with design team, payment may be made for areas deficient in thickness by more than **0.75 inches (19.05 mm)** at fifty (50) percent. If not, remove and replace at no additional cost to the Owner as shown in **Table 5 – THICKNESS PAY FACTORS**:

<b>Table 5 – THICKNESS PAY FACTORS</b>	
Pay Factors	Thickness Deficiency, in Inches (ASTM D3549/D3549M)
1.00	0.00 to 0.25
0.90	0.26 to 0.50
0.70	0.51 to 0.75
Reject	0.76 to 1.00

- e. Air Voids:
- 1) Basis of evaluation is laboratory compacted samples (not field compacted samples).
  - 2) Air voids will be mix design target plus or minus one (1) percent.
  - 3) If test results are not within this Section's limits, options include correction of production procedures or alternate mix design acceptable to Civil Engineer.
- D. Non-Conforming Work: Non-conforming work as covered in the General Conditions applies, but is not limited to the following:
1. Asphalt Paving:
    - a. Deficient asphalt paving thickness:
      - 1) Place additional material over deficient areas. Do not skin patch. Mill for inlay if necessary. Correct deficient asphalt paving thickness at no additional cost to the Owner.
    - b. Rejection and Removal of Asphalt Paving:
      - 1) Remove asphalt paving found defective after installation and install acceptable product at no additional cost to the Owner.
    - c. Removal of Asphalt Paving:
      - 1) Remove spatter, over-coat, or mar at no additional cost to the Owner.
      - 2) Remove asphalt from borrow pits or gutters at no additional cost to the Owner.

- d. Repair of Asphalt Paving:
  - 1) Repair or replace defective joints, seams, edges at no additional cost to the Owner.

### **3.5 PROTECTION**

- A. Tack Coat:
  - 1. Protect all surfaces exposed to public view from being spattered or marred. Remove any spattering, over-coating, or marring at no additional cost to Owner.
  - 2. Traffic:
    - a. Do not permit traffic to travel over tacked surface until tack coat has cured and dried.
- B. Asphalt Paving:
  - 1. Protect hot mixed asphalt (HMA) pavement from traffic until mixture has cooled enough not to become marked.

### **3.6 CLEANING**

- A. Waste Management:
  - 1. Pre-emergent herbicide:
    - a. Follow Manufacturer's recommendations for disposal of product at approved waste disposal facility.
      - 1) Do not reuse empty containers.

**END OF SECTION**

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**SECTION 32 1723****PAVEMENT MARKINGS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Furnish acrylic paint and apply pavement and curb markings as described in Contract Documents including:

**1.2 REFERENCES**

- A. Reference Standards:
  - 1. Federal Specifications and Standards:
    - a. FED-STD-595C, 'Federal Standard: Colors Used in Government Procurement' (16 Jan 2008).
    - b. FED TT-P-1952F, 'Paint, Traffic and Airfield Marking, Waterborne' (17 Feb 2015).
  - 2. U.S. Department of Transportation Federal Highway Administration:
    - a. FHWA MUTCD-10, 'Manual on Uniform Traffic Control Devices'.

**1.3 SUBMITTALS**

- A. Action Submittal:
  - 1. Product Data:
    - 1) Manufacturer's published product data and certification that product supplied meets requirements of this specification.
- B. Informational Submittal:
  - 1. Test And Evaluation Reports:
    - a. Acrylic Paint:
      - 1) Provide reports showing compliance to FED TT-P-1952F.
- C. Closeout Submittals:
  - 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
    - a. Record Documentation:
      - 1) Manufacturer's Documentation:
        - a) Product data.
        - b) Specification compliance documentation.
      - 2) Testing and Inspection Reports:
        - a) Reports showing compliance.

**1.4 QUALITY ASSURANCE**

- A. Regulatory Agency Sustainability Approvals:
  - 1. Paint must meet requirements of FED TT-P-1952-F and local regulations for VOC.
  - 2. Paint handicap spaces to conform to ADA Standards and local code requirements.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Delivery and Acceptance Requirements:
  - 1. Materials shall be delivered in original, unopened containers with labels intact.

- a. Labels to include:
  - 1) Manufacturer's name and address.
  - 2) TT-P-1952F reference.
  - 3) Classification Type.
  - 4) Color.
- B. Storage And Handling Requirements:
  1. Follow Manufacturer's storage and handling requirements.
  2. Protect stored material from freezing at temperatures above 35 deg F (2 deg C) or above 115 deg F (46.1 deg C).
  3. Do not invert or roll containers.

## 1.6 FIELD CONDITIONS

- A. Ambient Conditions:
  1. Acrylic Paint:
    - a. Apply only on dry clean surfaces, during favorable weather (not excessively windy, dusty, or foggy), and when damage by rain, fog, or condensation not anticipated.
    - b. Paving surface and Ambient temperature shall be minimum 50 deg F (10 deg C) and rising.
    - c. Temperature shall not drop below 50 deg F (10 deg C) within twenty four (24) hour period following application.
    - d. Acetone based paints that are one hundred (100) percent acrylic shall not drop below 32 deg F (0 deg C) within twenty four (24) hour period following application.

## PART 2 - PRODUCTS

### 2.1 MATERIAL

- A. Acrylic Paint:
  1. Description:
    - a. Low VOC, ready-mixed, one- component, acrylic waterborne traffic marking paint suitable for application on concrete, asphalt, sealers, and previously painted areas of these surfaces.
  2. Design Criteria:
    - a. General:
      - 1) Traffic Paint.
      - 2) Non-volatile portion of vehicle for all classification types shall be composed of one hundred (100) percent acrylic.
      - 3) Meet FED TT-P-1952F specification requirements.
      - 4) Fast drying when applied at ambient conditions requirement.
      - 5) Low VOC.
      - 6) Non-Reflectorized.
      - 7) Traffic paints not intended for use as floor paints. Do not use on pedestrian walkways or large surfaces such as ramps, floors and stairs which may become slippery when wet.
    - b. Classification:
      - 1) Type I for use under normal conditions.
    - c. Composition:
      - 1) Non-volatile portion for all types shall be composed of one hundred (100) percent acrylic polymer as determined by infrared spectral analysis.
      - 2) Prohibited material:
        - a) Product does not contain mercury, lead, hexavalent chromium, toluene, chlorinated solvents, hydrolysable chlorine derivatives, ethylene-based glycol ethers and their acetates, nor any carcinogen.
    - d. Qualitative Requirements:
      - 1) Meet FED TT-P-1952F requirements for:
        - a) Abrasion resistance.

- b) Accelerated package stability.
  - c) Accelerated weathering.
  - d) Appearance.
  - e) Color requirements:
    - (1) Color Match (all colors except white and yellow).
    - (2) Daylight directional reflectance.
    - (3) Yellow color match.
  - f) Condition in container.
  - g) Dry-through (early washout) for Type II only.
  - h) Flexibility.
  - i) Freeze/thaw stability.
  - j) Heat-shear stability.
  - k) Scrub resistance.
  - l) Skinning.
  - m) Titanium dioxide content.
  - n) Water resistance.
- e. Quantitative requirements:
  - 1) Meet FED TT-P-1952F requirements (Table 1).
  - 2) Acetone based paints that are one hundred (100) percent acrylic and have exempt status under Federal law are exempt from meeting FED TT-P-1925F requirements.
- 3. Colors:
  - a. General:
    - 1) Traffic Paint will be furnished in white and any Federal Standard 595 color in accordance to FED-STD-595C:
      - a) Yellow: 33538.
      - b) Blue: 35180.
      - c) Red: 31136.
  - b. White (Yellow may be used at Owner Representative's discretion):
    - 1) Lane lines, edge lines, transverse lines, arrows, words, symbol markings, speed bump markings, parking space markings.
  - c. Yellow:
    - 1) Cross-hatching in medians, cross hatching in safety zones separating opposing traffic flows, crosswalk stripes, safety markings, centerlines, edge lines along left edge of one-way roadway or one way ramp.
  - d. Blue And White:
    - 1) In parking spaces specifically designated as reserved for disabled.
  - e. Red:
    - 1) Fire lanes, no parking zones, special raised pavement markers that are placed to be visible to "wrong-way" drivers.
- 4. Type Two Acceptable Products:
  - a. Any product meeting design criteria of this specification as approved by Architect/Owner's Representative before application. See Section 01 6200.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Acrylic Paint:
  - 1. Asphalt Surfaces:
    - a. Do not apply paint until asphalt has cooled.
    - b. Allow new seal coated surfaces to cure for at least twenty four (24) hours before applying paint.
  - 2. Concrete Surfaces:
    - a. Do not apply paint to new concrete surfaces until concrete has cured seven (7) days minimum.
- B. Surfaces shall be dry and free of grease and loose dirt particles.



- C. Perform layout with chalk or lumber crayon only.

### 3.2 APPLICATION

- A. General:
  - 1. Mix in accordance and apply as per Manufacturer's instructions.
  - 2. Apply at locations and to dimensions and spacing as shown on Contract Drawings.
- B. Tolerances:
  - 1. General: Make lines parallel, evenly spaced, and with sharply defined edges.
  - 2. Line Widths:
    - a. Plus or minus 1/4 inch (6 mm) variance on straight segments.
    - b. Plus or minus 1/2 inch (13 mm) variance on curved alignments.
- C. Coverage:
  - 1. Paint stripes added to new asphalt and concrete surfaces:
    - a. Apply single coat.
  - 2. Apply traffic paint at rate of 13 to 15 mils minimum wet thickness, 8 to 9 mils dry thickness. Application at more than 15 mils may result in extended dry times and may cause lifting or cracking on some asphalt surfaces.

### 3.3 FIELD QUALITY CONTROL

- A. Non-Conforming Work:
  - 1. Replace or correct defective material not conforming to requirements of this specification or any work performed that is of inferior quality at no cost to Owner.

### 3.4 CLEANING

- A. General:
  - 1. Remove drips, overspray, improper markings, and paint material tracked by traffic by sand blasting, wire brushing, or other method approved by Architect/Owner's Representative before performance.
- B. Waste Management:
  - 1. Remove debris resulting from work of this Section. Dispose of or recycle all trash and excess material in manner conforming to current EPA regulations and local laws.

**END OF SECTION**

**SECTION 32 3113****CHAIN LINK FENCES AND GATES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Furnish and install complete fence as described in Contract Documents.
- B. Related Requirements:
  - 1. Section 03 3053: Mow strips at fencing and setting sleeves in retaining walls.
  - 2. Section 05 0503: 'Shop-Applied Metal Coatings' for priming and galvanizing repair.
  - 3. Section 05 0523: 'Metal Fastening' for welding requirements.

**1.2 REFERENCES**

- A. Association Publications: / Organizations:
  - 1. Chain Link Fence Manufacturers Institute (CLFMI), Columbia, MD [www.chainlinkinfo.org](http://www.chainlinkinfo.org).
    - a. WLG 2445, '*Chain Link Fence Wind Load Guide for the Selection of Line Post and Line Post Spacing*' (2012).
    - b. CLF-SFR0111, '*Chain Link Fence Manufacturers Institute Security Fencing Recommendations*'.
    - c. CLF-PM0610, '*Field Inspection Guide*'.
    - d. CLF-TP0211, '*Tested and Proven Performance of Security Grade Chain Link Fencing Systems*'.
- B. Reference Standards:
  - 1. ASTM International:
    - a. ASTM A123/A123M-12, 'Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products'.
    - b. ASTM A153/A153M-09, 'Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware'.
    - c. ASTM A392-11a, 'Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric'.
    - d. ASTM A1011/A1011M-12b, 'Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength'.
    - e. ASTM C1107/C1107M-13, 'Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)'.
    - f. ASTM F1043-12, 'Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework'.
    - g. ASTM F1083-10, 'Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures'.

**1.3 SUBMITTALS**

- A. Action Submittals:
  - 1. Product Data: Manufacturer literature or cut sheets on fence components.
  - 2. Samples: Types of vision slats and colors for Architect's selection.
- B. Closeout Submittals:
  - 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
    - a. Warranty Documentation:
      - 1) Vision Slats:

- a) Final, executed copy of Warranty.

## 1.4 WARRANTY

### A. Vision Slats:

1. Manufacturers fifteen (15) year, pro-rata limited Warranty.

## PART 2 - PRODUCTS

### 2.1 ASSEMBLIES

#### A. Materials:

##### 1. Fabric:

- a. Chain link fabric of 9 ga (3.7 mm) wire, galvanized before or after weaving with 1.2 ounce (34 grams) zinc coating conforming to requirements of ASTM A392, Class I.

##### b. Mesh:

- 1) With Visual Privacy / Security slats:

- a) 2 inch (50 mm) square mesh required by specified vision slat.

##### c. Knuckle both selvages.

##### 2. Framework:

- a. Posts and rails shall be roll-formed, self-draining shapes meeting strength requirements of ASTM F1043, Table 3, and with 2 ounce (56.7 grams) zinc coating per 1 sq ft (0.0929 sq meter) of surface area conforming to ASTM A123/A123M.

##### b. Line Posts:

- 1) Line Posts 8 feet (2.45 m) and under:

- a) 1.875 by 1.625 inch (48 by 41 mm) C-section roll formed from steel conforming to ASTM A1011/A1011M, Grade 45, with minimum theoretical bending strength of 247 lbs (112 kg) under 6 foot (1.80 m) cantilever load.

- b) 2.375 inch (60 mm) outside diameter Schedule 40 tubular section weighing 3.65 lbs (1.6 kg) per lineal 1 ft (305 mm) meeting requirements of ASTM F1083.

- c) 2.375 inch (60 mm) outside diameter Schedule 40 tubular section weighing 3.12 lbs (1.42 kg) per lineal 1 ft (305 mm) formed from steel meeting requirements of ASTM A1011/A1011M.

##### c. Terminal Posts:

- 1) Terminal posts:

- a) 3.5 by 3.5 inch (89 by 89 mm) roll formed section with minimum theoretical bending strength of 486 pounds (220.5 kg) under 6 foot (1.80 m) cantilever load.

- b) 3 inch (76 mm) outside diameter Schedule 40 pipe weighing 5.79 lbs (2.63 kg) per lineal 1 ft (305 mm) meeting requirements of ASTM F1083.

- c) 3 inch (76 mm) outside diameter Schedule 40 tubular section weighing 4.64 lbs (2.11 kg) per lineal 1 ft (305 mm) formed from steel meeting requirements of ASTM A1011/A1011M.

##### d. Top And Brace Rail:

- 1) 1.625 by 1.25 inch (41 by 32 mm) roll formed section of 45,000 psi (310 MPa) yield strength channel shaped rail with minimum theoretical bending strength of 247 lbs (112 kg) on 10 foot (3.050 m) midpoint load.

- 2) 1.660 inch 42 mm outside diameter Schedule 40 pipe weighing 2.27 lbs (1.03 kg) per lineal 1 ft (305 mm) meeting requirements of ASTM F1083.

- 3) 1.660 inch 42 mm outside diameter Schedule 40 tubular section weighing 1.84 lbs (0.83 kg) per lineal 1 ft (305 mm) formed from steel meeting requirements of ASTM A1011/A1011M.

##### e. Fittings:

- 1) Pressed steel or malleable iron, hot-dip galvanized conforming to ASTM A153/A153M.

- 2) Tie wires shall be 12 ga (2.05 mm) minimum galvanized steel or 9 ga (3 mm) minimum aluminum wire.

- f. Tension Wire: 7 ga (3.66 mm) minimum galvanized spring steel.
- B. Mixes:
- 1. Post Foundation Concrete:
    - a. One cu ft cement, 2 cu ft (0.0566 cu m) sand, 4 cu ft (0.1132 cu m) gravel, and 5 gallons (18.93 liters) minimum to 6 gallons (22.71 liters) maximum water.
    - b. Mix thoroughly before placing.

## 2.2 ACCESSORIES

- A. Vision Slats:
- 1. Manufacturer Contact List:
    - a. PrivacyLink, Hyde Park, UT [www.eprivacylink.com](http://www.eprivacylink.com).
  - 2. Design Criteria:
    - a. Description:
      - 1) High-density polyethylene (HDPE), double-walled, self-locking or with locking feature that prevents slats from being removed.
  - 3. Visual Privacy / Security:
    - a. When installed, slats will provide 75 percent minimum visual privacy / security.
      - 1) Mesh: 2 inch x 2 inch (50 mm x 50 mm).
      - 2) Color: As selected by Architect from Manufacturer's standard colors.
      - 3) Slats: pre-woven, pre-inserted inserted into chain link fabric:
      - 4) Type Two Acceptable Product:
        - a) SlatLink by PrivacyLink.
        - b) Equal as approved by Architect before installation. See Section 01 6200:
  - 4. Color:
    - a. As selected by Architect from Manufacturer's standard colors.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Fence shall be installed by mechanics skilled and experienced in erecting fences of this type and in accordance with Contract Documents.
- 1. When general ground contour is to be followed, make changes of grade in gradual, rolling manner.
  - 2. Evenly space posts in line of fence a maximum of 10 feet (3.050 meter) center to center.
- B. Post Foundations:
- Set posts with concrete post foundations as specified below:
- a. Line Posts Diameter 8 inches Depth 36 inches.
  - b. End, And Corner Posts Diameter 12 inches Depth 42 inches.
  - c. At mow strips, set top of post foundation below grade sufficient to allow for placing of mow strip. Measure post foundation depth from top of mow strip.
  - d. Where fences are incorporated into slabs, measure post foundation depth from top of slab. Extend bottom of slab footing sufficient to allow specified amount of concrete around post. At existing slabs, install fence outside perimeter of slab.
  - e. For fences on retaining walls, provide 12 inch long sleeves to be cast into retaining wall. Set pipe in sleeve and grout space between sleeve and post full.
- C. Fence:
- 1. After posts have been permanently positioned and concrete cured for one (1) week minimum, install framework, braces, and top rail. Join top rail with 6 inch (150 mm) minimum couplings at not more than 21 foot (6.40 meter) centers.
  - 2. Stretch fabric by attaching one end to terminal post and supplying sufficient tension to other end of stretch so slack is removed.

- a. Fasten fabric to line posts with tie wires. Pass ties over one strand of fabric and hook under line post flange.
  - b. Place one tie as close to bottom of fabric as is possible with additional ties equally spaced between top and bottom band on approximately equal spacing not to exceed **14 inches (355 mm)** on center.
  - c. Attach fabric to roll formed terminals by weaving fabric into integral lock loops formed in post. Attach fabric to tubular terminals with tension bars and bands.
  - d. Hold fabric approximately **2 inches (50 mm)** above finish grade line.
  - e. On top rail, space tie wires at no more than **24 inches (610 mm)** on center.
  - f. Securely attach fittings and firmly tighten nuts.
3. Slats may either be installed by hand, or pre-inserted in fabric during manufacture.

### 3.2 CLEANING

- A. Spread dirt from foundation excavations evenly around surrounding area unless otherwise directed. Leave area free of excess dribbles of concrete, pieces of wire, and other scrap materials.

**END OF SECTION**

**SECTION 32 8423****UNDERGROUND SPRINKLERS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Furnish and install planting irrigation system as described in Contract Documents complete with accessories necessary for proper function.
- B. Related Requirements:
  - 1. Section 01 4301: 'Quality Assurance – Qualifications'.
  - 2. Section 22 1116: 'Domestic Water Piping' for stop and waste valve.
  - 3. Section 31 2213: 'Rough Grading'.
  - 4. Section 31 2216: 'Fine Grading'.
  - 5. Section 31 2316: 'Excavation'.
  - 6. Section 31 2323: 'Fill' for trench compaction.
  - 7. Section 32 9001: 'Common Planting Requirements'.
    - a. Pre-installation conference held jointly with other common planting related sections.
  - 8. Section 32 9120: 'Topsoil And Placement' for topsoil evaluation and placement required for topsoil grading.
  - 9. Section 32 9121: 'Topsoil Physical Preparation' for physical preparation of topsoil (section included based on Topsoil Testing Report).
  - 10. Section 32 9122: 'Topsoil Grading' for preparation of topsoil and addition of amendments prior to landscaping.
  - 11. Section 32 9223: 'Sodding'.
  - 12. Section 32 9300: 'Plants'.
  - 13. Division 26: Power to controller.

**1.2 REFERENCES**

- A. Definitions:
  - 1. Automated Self Flushing Filter: Filter located immediately downstream from point of connection in-lieu of backflow prevention device for irrigation systems that utilize non-potable, secondary and/or reclaimed water that is automatically self flushing to control unwanted debris from infiltrating remaining irrigation system.
  - 2. Dielectric Fittings: Special type of fitting used between dissimilar metals to prevent galvanic action from causing corrosion failure.
  - 3. High Wind Area: As defined in this specification, area with average sustained wind speed of over **7.5 mph (12 km/hr)**.
  - 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.
  - 5. Lateral Line: Downstream from electric control valves to pop-up spray heads and drip valve assemblies to emitters. Piping or tubing is under pressure during flow. In areas where potable or secondary water are used, pressure supply line shall be white. In areas where non-potable or reclaimed water are used, pressure supply line shall be purple.
  - 6. Main Line: Downstream from point of connection to electric control valves. Piping is under water-distribution-system pressure when activated by master valve or hydrometer. In areas where potable or secondary water are used, pressure supply line shall be white. In areas where non-potable or reclaimed water are used, pressure supply line shall be purple.
  - 7. Peak Flow: Maximum required flow for given month based on six (6) day week, nine (9) hour day watering window to be used for irrigation system design and to be used in hydraulic analysis.
  - 8. Point of Connection: Location where meter for irrigation system is located.
  - 9. Smart Controller: Irrigation clocks that automatically adjust irrigation run times in response to environmental changes using sensors and weather information to manage watering times and

- frequency. As environmental conditions vary, controller will increase or decrease irrigation. Smart Controllers have ability to turn off sprinklers automatically during rain, high wind or low temperature.
10. Static Water Pressure: Pressure at point of connection when system is not operable.
  11. Two Wire Path: Conducts power to solenoid valves, and also conducts communications signals from Controller to each device on system. Sensors receive instructions to take readings, transmit data and perform other tasks; solenoid valves and other devices also receive commands from controller over same wires used to carry power to valves.
  12. Working Pressure: Pressure at point of connection when system is operable.
- B. Definitions (Following are specifically referenced for testing):
1. Certified Water Audit: Irrigation system audit performed by Irrigation Association Certified Landscape Irrigation Auditor.
  2. Field Quality Control: Testing, Inspections, Special Testing and Special Inspections to assure compliance to Contract Documents.
  3. High Water Cost Area: Area where there is high water cost (over \$4/Kgal), tiered water system or greater than six month irrigation season.
  4. Inspection: Inspection of materials, installation, fabrication, erection or placement of components and connections requiring special expertise to ensure compliance with approved construction documents and referenced standards:
  5. Installer: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform particular construction operation, including installation, erection, application, and similar operations.
  6. Observation: Visual observation of building / site elements or structural system by registered design professional for general conformance to approved construction documents at significant construction stages and at completion. Observation does not include or waive responsibility for performing inspections or special inspections.
  7. Owner's Representative: Owner's Designated Representative (Project Manager or Facilities Manager) who will have express authority to bind Owner with respect to all matters requiring Owner's approval or authorization.
  8. Product Testing: Tests and inspections that are performed by testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
  9. Quality Assurance: Testing, Inspections, Special Testing and Special Inspections provided for by Owner.
  10. Quality Control: Testing, Inspections, Special Testing and Special Inspections provided for by Contractor.
  11. Service Provider: Agency or firm qualified to perform required tests and inspections.
  12. Test: Field or laboratory tests to determine characteristics and quality of building materials and workmanship.
  13. Testing Agency: Entity engaged to perform specific tests, inspections, or both.
  14. Verification: Act of reviewing, inspecting, testing, etc. to establish and document that product, service, or system meets regulatory, standard, or specification requirements.
- C. Reference Standards:
1. ASTM International:
    - a. ASTM D2564-12, 'Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems'.
    - b. ASTM E329-14a, 'Standard Specification for Agencies Engaged in Construction Inspection and/or Testing'.
    - c. ASTM F656-10, 'Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings'.

### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
1. Provide Coordination for required tests and inspections as described under Field Quality Control in Part 3 EXECUTION for following:
    - a. Manufacturer's Field Service: Provide necessary manufacturer's field service.

- b. Pressure Test: In presence of Landscape Architect or designated Representative(s), provide pressure test.
  - c. Substantial Completion Walkthrough: In presence of Landscape Architect or designated Representative(s), plan and provide walk through after completion of irrigation system.
  - d. Irrigation Final Acceptance: In presence of Landscape Architect or designated Representative(s), plan and provide final walk through after completion of all work listed on Substantial Completion walk through list provided by Landscape Architect.
- B. Pre-Installation Conference:
- 1. Participate in pre-installation conference as specified in Section 32 9001.
    - a. Irrigation Subcontractor's Representative and Foreman responsible for installation of irrigation system required to be in attendance.
    - b. Schedule pre-installation conference before irrigation system installation begins.
    - c. In addition to agenda items specified in Section 01 3100, review following:
      - 1) Landscape Architect or designated Representative will demonstrate or describe method to be used to maintain head spacing from concrete and to stabilize heads.
      - 2) Within project site, provide one (1) installed example of each type of irrigation detail for review and approval by Landscape Architect and Owner prior to beginning site work.
      - 3) Review required tests and inspections.
      - 4) Review Smart Controller requirements.
      - 5) Review Attachment 'Smart Controller Installation Checklist' in this specification.
- C. Sequencing:
- 1. Install sleeves before installation of cast-in-place concrete site elements and paving.

#### 1.4 SUBMITTALS

- A. Action Submittals:
- 1. Product Data:
    - a. Manufacturer's cut sheets for each element of system.
    - b. Parts list for operating elements of system.
- B. Informational Submittals:
- 1. Certificates:
    - a. Acceptance certificate of irrigation system.
      - 1) Upon acceptance of irrigation system, reviewer will provide signed acceptance certificate.
      - 2) Certificate will include name and signature of reviewer, reviewer's company, date of review, reviewer's telephone number, and stating that to best of reviewers knowledge, system is in full compliance with Contract Documents.
  - 2. Test And Evaluation Reports:
    - a. Provide report for results of main line service pressure testing before burial of mainline.
    - b. Provide following from Main Line Irrigation test and observation:
      - 1) Record and submit documentation of Irrigation Main Line tests, issues, and measure taking to correct problems.
  - 3. Manufacturer Instructions:
    - a. Manufacturer's printed literature on operation and maintenance of operating elements of system.
    - b. Instruction Manual:
      - 1) Includes complete directions for system operation and maintenance, including winterizing, controller program worksheet and scheduling based on local site specific conditions.
      - 2) Provide plant establishment schedule and long term maintenance establishment schedule.
  - 4. Field Quality Control Submittal:
    - a. Manufacturer's Smart Controller Approved Installer:
      - 1) Complete Irrisoft Weather Reach Controller Link installation Audit Report.
- C. Closeout Submittals:



1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
  - a. Maintenance Contracts:
    - 1) See Site Management Plan (SMP) for Establishment Period Maintenance and Irrigation System Operation.
  - b. Operations And Maintenance Data:
    - 1) Include one (1) copy in Operations and Maintenance Manual specified in Section 01 7800. Also include one (1) copy to be included in Site Management Plan. Include following information:
      - 2) Instruction Manual.
      - 3) Manufacturer's printed literature.
      - 4) Manufacturer's cut sheets for each element of system.
      - 5) Manufacturer's parts list.
      - 6) Freezing prevention instructions.
      - 7) Controller Program Schedule:
        - a) Provide month to month watering schedule for inclusion in Site Management Plan (SMP).
    - c. Warranty Documentation:
      - 1) Manufacturer's extended Warranty for Smart Controller.
    - d. Record Documentation:
      - 1) Certificates:
        - a) Acceptance certificate of irrigation system.
      - 2) Testing and Inspection Reports:
        - a) Pressure Test.
        - b) Completed Irrisoft Weather Reach Controller Link installation Audit.
      - 3) Record Drawings: As installation occurs, prepare accurate record drawing to be submitted before final inspection, including:
        - a) Detail and dimension changes made during construction.
        - b) Significant details and dimensions not shown in original Contract Documents.
        - c) Field dimensioned locations of valve boxes, manual drains, quick-coupler valves, control wire runs not in mainline ditch, soil moisture sensors (if soil moisture sensor technology is selected for site) and both ends of sleeves.
        - d) Take dimensions from permanent constructed surfaces or edges located at or above finish grade.
        - e) Take and record dimensions at time of installation.
        - f) Reduced copy of Record Drawings to **11 by 17 inches (275 by 425 mm)**, with color key circuits and laminated both sides with 5 mil thick or heavier plastic. Mount on **12 x 18 inch (300 by 450 mm)** hard board drilled with two (2) **1/2 inch (13 mm)** holes at top of board and hang on hooks in Custodial Room or location designated by Owner's Representative.
        - g) Two (2) additional reduced copies of Record Drawings to **11 by 17 inches (275 by 425 mm)**, with color key circuits, un-laminated, and un-mounted to be given to Owner's Representative.
      - 4) Photographs: Provide photographs prior to burial of key elements including but not limited to:
        - a) Valves.
        - b) Drains.
        - c) Hydrometers.
  2. Final payment for system will not be authorized until Closeout Submittals are received and accepted by Architect and Landscape Architect.

D. Maintenance Material Submittals:

1. Tools:
  - a. Furnish following items before Final Closeout Review:
    - 1) One (1) heavy-duty key for stop and waste or main shut-off valve.
    - 2) One (1) quick coupler key with brass hose swivel.

## 1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. General:
  - a. Work and materials shall be in accordance with latest rules and regulations, and other applicable state or local laws.
  - b. Nothing in Contract Documents is to be construed to permit work not conforming to these codes.
- B. Qualifications: Requirements of Section 01 4301 applies, but not limited to following:
  1. Irrigation Subcontractor:
    - a. Company specializing in performing work of this section.
    - b. Minimum five (5) years experience in irrigation sprinkler installations.
    - c. Minimum five (5) satisfactorily completed irrigation sprinkler installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
    - d. Use trained personnel familiar with required irrigation sprinkler procedures and with Contract Documents.
    - e. Foreman or supervisor required to attend pre-installation conference.
    - f. Agree to use only approved installers for Smart Controller technology.
    - g. Upon request, submit documentation.
  2. Irrigation Installer:
    - a. Perform installation under direction of foreman or supervisor.
    - b. Minimum three (3) years experience in irrigation sprinkler installations similar in size, scope, and complexity.
    - c. Upon request, submit documentation.
  3. Smart Controller Installer:
    - a. Approved installers familiar with required irrigation system and Smart Controller installation procedures:
      - 1) Agree to follow requirements as described under Installers in PART 3 EXECUTION.
      - 2) Agree to complete reporting documents.
      - 3) Agree to instruct Owner's designated personnel in complete operation and maintenance of smart controller.
      - 4) Agree to assist Landscape Architect in completing Watering Schedule for Site Management Plan (SMP).
- C. Mockups:
  1. Provide Mock-Ups of the following details at the staging area for review by Landscape Architect prior to installation of irrigation system. Review shall take place during the Preconstruction Meeting.
    - a. Each detail within a valve box.
    - b. Tree Drip-Plan View
    - c. Drip Emitter
    - d. Spray Head Assembly
    - e. Rotor Pop-Up
  2. These mock-ups may be installed with or without solvent weld cement so that they can later be used in field.
  3. Mock-ups shall include complete installation including weed barrier fabric, gravel sump, equipment assembly, valve box placement and branding in conformance with these specifications.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Storage And Handling Requirements:
  1. Storage and handling during installation; protect materials from damage and prolonged exposure to sunlight.

## **1.7 WARRANTY**

- A. Manufacturer Warranty:
  1. Irrigation System:

- a. Standard one (1) year guarantee stipulated in General Conditions Article 12.2 shall include:
  - 1) Filling and repairing depressions and replacing plantings due to settlement of irrigation system trenches.
  - 2) Adjusting system to supply proper coverage of areas to receive water.
  - 3) Ensuring system can be adequately drained.
- b. Filling and repairing depressions and replacing plantings due to settlement of irrigation system trenches.
- c. Adjusting system to supply proper coverage of areas to receive water.
- 2. Smart Controller:
  - a. Provide Manufacturer's extended warranty for two (2) years to be free of design, materials and workmanship defects.
- 3. Guarantee Period Services
  - a. The Contractor shall winterize the system and perform spring start-up of the system during the guarantee period. These functions shall be coordinated in advance with the Owner, and the Owner's personnel shall participate.
  - b. Upon re-energizing the system, the Contractor shall repair any leaks or breaks and shall check each head and valve, making any adjustment necessary.

## PART 2 - PRODUCTS

### 2.1 SYSTEM

#### A. Manufacturers:

- 1. Manufacturer Contact List:
  - a. 3M, Austin, TX [www.3m.com/elpd](http://www.3m.com/elpd).
  - b. Action Machining Inc, Bountiful, UT [www.actionfilters.com](http://www.actionfilters.com).
  - c. Amiad [www.amiadusa.com](http://www.amiadusa.com).
  - d. Apollo Valves by Conbraco Industries, Matthews, NC [www.apollovalves.com](http://www.apollovalves.com).
  - e. Carson Industries LLC, Glendora, CA [www.carsonind.com](http://www.carsonind.com).
  - f. GPH Irrigation Products, Fontana, CA [www.gphirrigation.com](http://www.gphirrigation.com).
  - g. Harrington Corporation (Harco), Lynchburg, VA [www.harcofittings.com](http://www.harcofittings.com).
  - h. Hunter Industries, San Marcos, CA [www.hunterindustries.com](http://www.hunterindustries.com).
  - i. HydroRain, North Salt Lake, UT [www.hydorain.com](http://www.hydorain.com).
  - j. King Innovation, St Charles, MO [www.kinginovation.com](http://www.kinginovation.com).
  - k. IPS Corporation, Compton, CA [www.ipscorp.com](http://www.ipscorp.com).
  - l. Irrisoft, Inc. North Logan, UT [www.weatherreach.com](http://www.weatherreach.com).
  - m. Leemco, Colton, CA [www.leemco.com](http://www.leemco.com).
  - n. Netafim, Inc. [www.netafimusa.com](http://www.netafimusa.com).
  - o. Nibco Inc, Elkhart, IN [www.nibco.com](http://www.nibco.com).
  - p. Northstar Industries, LLC, Methuen MA [www.northstarind.com](http://www.northstarind.com).
  - q. Orbit Irrigation Products, Inc. Bountiful, UT [www.orbitonline.com](http://www.orbitonline.com).
  - r. Paige Electric, Union, NJ [www.paigewire.com](http://www.paigewire.com).
  - s. Rain Bird Sprinkler Manufacturing Corp, Glendora, CA [www.rainbird.com](http://www.rainbird.com).
  - t. Salco by Weathermatic Irrigation Products, Garland, TX [www.weathermatic.com](http://www.weathermatic.com).
  - u. Toro Company, Irrigation Div, Riverside, CA [www.toro.com](http://www.toro.com).
  - v. T. Christy Enterprises, Inc. (Christy's), Anaheim, CA [www.tchristy.com](http://www.tchristy.com).
  - w. Valve and Filter Corporation, Arvada, CO [www.valveandfilter.com](http://www.valveandfilter.com).
  - x. Weathermatic Irrigation Products, Garland, TX [www.weathermatic.com](http://www.weathermatic.com).
  - y. Wilkins a Zurn Company, Paso Robles, CA [www.zurn.com](http://www.zurn.com).

#### B. Category Three National Account Approved Manufacturer. See Section 01 6200 for definitions of Categories:

- 1. Design Criteria:
  - a. Provide Smart Controller and all components from same Approved Manufacturer only.
- 2. Irrisoft, Inc., North Logan, UT [www.weatherreach.com](http://www.weatherreach.com).
  - a. Approved Distributor Contact Information:
    - 1) First Contact:
      - a) Steven Moore, (office) (435) 755-0400 (cell) (435) 770-3896 [smoore@irrisoft.net](mailto:smoore@irrisoft.net).

- 2) Second Contact:
  - a) Paul Urzagaste, (office) (435) 755-0400 (cell) (435) 754-6737  
[paulu@weatherreach.com](mailto:paulu@weatherreach.com).

C. Materials:

1. Rock-Free Soil:
  - a. For use as backfill around PVC pipe.
2. Native Material:
  - a. Soil having rocks no larger than **1/2 inch (13 mm)** in any dimension.
3. Pea Gravel:
  - a. For use around drains, valves, and quick couplers.
  - b. **1/2 inch (13 mm)** maximum dimension, washed rock.
4. Sand: Fine granular material naturally produced by rock disintegration and free from organic material, mica, loam, clay, and other deleterious substances.
5. Native Material: Soil native to project site free of wood and other deleterious materials and rocks over **1-1/2 inches (38 mm)**.
6. Topsoil:
  - a. Use soil as described in Section 32 9120, Section 32 9121, and Section 32 9122.
  - b. Achieve depths as described in Section 32 9122.
7. Pipe, Pipe Fittings, And Connections:
  - a. General:
    - 1) Pipe shall be continuously and permanently marked with Manufacturer's name, size, schedule, type, and working pressure.
    - 2) Pipe sizes shown on Contract Drawings are minimum. Larger sizes may be substituted at no additional cost to Owner.
  - b. Piping:
    - 1) Main Line: Schedule 40 PVC.
    - 2) Lateral Lines: Schedule 40 PVC.
    - 3) Backflow Assembly Piping: See Mechanical
    - 4) Quick Coupler Piping: Galvanized steel.
  - c. Fittings: Same material as pipe, except where detailed otherwise.
    - 1) Fittings **3 inch (76 mm)** or larger: Harco or Leemco of matching size.
  - d. Sleeves:
    - 1) Under Parking Area And Driveway Paving: Schedule 40 PVC Pipe.
    - 2) All Other: Class 200 PVC Pipe.
    - 3) Sleeve diameter shall be two (2) times larger than pipe installed in sleeve.
8. Sprinkler Heads:
  - a. Each type of head shall be product of single manufacturer.
  - b. Spray Heads in Lawn Areas:
    - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      - a) Rainbird: RD 1804 or RD 1806 Series with MPR, U-Series, or HE-VAN nozzles with SAM.
      - b) Refer to plans for additional information.
  - c. Rotor Pop-ups:
    - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      - a) Rainbird: 5000/5000 plus MPR series, **(25'-35')**.
      - b) Refer to plans for additional information.
9. Sprinkler Risers:
  - a. Spray Heads (Pre-Manufactured Swing Assemblies):
    - 1) Type Two Acceptable Products:
      - a) Hunter: SJ-512 (**12 inch (305 mm) x 1/2 inch (12.7 mm)**) thread) or SJ-7512 (**12 inch (305 mm) x 3/4 inch (19 mm) x 1/2 inch (12.7 mm)**) thread).
      - b) Rain Bird model SA125050.
      - c) Hydorain: Blu-lock model BLJ-050-MC-1..
      - d) Equal as approved by Architect before use. See Section 01 6200.
  - b. Spray Heads (Field Manufactured Assemblies):
    - 1) Risers for sprinkler heads **14 inches (355 mm)** long minimum and **24 inches (610 mm)** maximum.
      - a) Type Two Acceptable Products:
        - (1) Hunter: FLEXsg tubing with HSBE spiral barbed fittings.

- (2) Hydro-Rain: Blu-lock Swing pipe & fittings.
    - (3) Rainbird: Swing Pipe with barbed fittings.
    - (4) Toro: Super Funny Pipe with barbed fittings, SPFA-5125, SPFA-51275.
    - (5) Equal as approved by Architect before installation. See Section 01 6200.
  - c. Rotor Pop-Up Sprinklers (Pre-Manufactured Assemblies):
    - 1) Type Two Acceptable Products:
      - a) 3/4 inch (19 mm) rotor pop-up sprinklers shall have an adjustable pre-assembled swing assembly riser. Swing assemblies shall be 3/4 inch x 12 inch (19 mm x 300 mm) and shall be threaded both ends. Swing assemblies shall be:
        - (1) Blu-lock: Model BLJ-075-TT-12.
        - (2) Rain Bird: Model TSJ-12075.
        - (3) Hunter: SJ-712 12 inch (305 mm) thread.
    - 2) Equal as approved by Architect before installation:
- 10. Automatic Irrigation Controller And Control Wiring:
  - a. Automatic Controller:
    - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      - a) Hunter:
        - (1) 6 to 42 Stations: I-Core Series.
        - (2) Refer to plans for additional information.
    - b. Smart Controller:
      - 1) Category Three National Account Approved Product. See Section 01 6200 for definitions of Categories:
        - a) Weather Reach Controller Link as manufacturer by Irrisoft, Inc.:
          - (1) Model: CLw.
          - (2) Description: Weather Reach Ethernet Controller Link.
          - (3) Durable, weather resistant cabinet for outdoor installation.
          - (4) All other components required for complete and operational system.
        - b) Weather Reach Tipping Rain Gauge: Model WR-PRG (Description: Pronamic\*\*\* Tipping Rain Gauge (1mm/ tip) w/ 30' Cable & Mounting Bracket).
    - c. Control Wiring:
      - 1) Wiring:
        - a) Traditional control wire shall be UF-UL listed, color coded PE insulated copper conductor direct burial size 14. For wire runs exceeding 3,300 feet (1 005.84 meter), use 12 AWG wire. Do not use green color coded wire.
      - 2) Communication:
        - a) Communication wire between controller and hydrometer to be Paige Electric PE-393. Run underground communication wire in gray electrical conduit.
          - (1) Class Two Quality Standards. See Section 01 6200:
            - (a) Paige Electric Cadweld Connection.
      - 3) Waterproof Wire Connectors:
        - a) Control wire connections shall consist of properly-sized wire nut inserted in waterproof grease cap:
        - b) Type Two Acceptable Products:
          - (1) DBY or DBR by 3M.
          - (2) 'One Step' 20111SP by King Innovation.
          - (3) DB 57905, 57505 by Orbit.
          - (4) Equal as approved by Architect before installation. See Section 01 6200.
    - d. Conduit:
      - 1) Exterior applications or inside mechanical shed:
        - a) Galvanized IMC. Where in contact with earth or concrete, wrap galvanized IMC conduit and fittings completely with vinyl tape.
      - 2) In-ground: commercial grade grey conduit.
      - 3) Size conduit as follows:
        - a) Traditional Wiring:

Galvanized IMC Conduit
------------------------

Wire Size (AWG)	Number of Wires					
14	7	13	22	32	47	67
12	6	8	18	25	38	59
Conduit Size	3/4 inch (19 mm)	1 inch (25 mm)	1 1/4 inch (32 mm)	1 1/2 inch (38 mm)	2 inch (50 mm)	2 1/2 inch (64 mm)
PVC Sch. 40 Conduit						
Wire Size (AWG)	Number of Wires					
14	6	11	20	29	43	61
12	5	7	17	23	35	54
Conduit Size	3/4 inch (19 mm)	1 inch (25 mm)	1 1/4 inch (32 mm)	1 1/2 inch (38 mm)	2 inch (50 mm)	2 1/2 inch (64 mm)
PVC Sch. 80 Conduit						
Wire Size (AWG)	Number of Wires					
14	5	9	17	24	39	55
12	4	6	14	19	32	49
Conduit Size	3/4 inch (19 mm)	1 inch (25 mm)	1 1/4 inch (32 mm)	1 1/2 inch (38 mm)	2 inch (50 mm)	2 1/2 inch (64 mm)

## 11. Valves:

- a. Manual Drain Valves:
  - 1) Brass ball valve with 'T' handle on main lines and in valve boxes on lateral lines.
  - 2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
    - a) Apollo Valves: 78-621-01 Series ball valve, 3/4 inch (19 mm).
- b. Automatic Valves:
  - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
    - a) Rainbird: PESB series. If required, provide with PRS-Dial pressure regulator.
- c. Isolation Valves:
  - 1) Non-rising stem gate valve, size to match pipe size (use in cold, northern climates- eco-regions 1.0, 5.0, 6.0, 7.0, 9.1, 9.2, and 10.1).
  - 2) Class Two Quality Standards. See Section 01 6200:
    - a) Nibco: T-113 (cold, northern climates).
- d. Backflow Preventer:
  - 1) Theft Prevention Reduced Pressure Principle Assembly:
    - a) Design Criteria:
      - (1) Black fusion epoxy coating applied to exterior bronze surfaces of assembly to help deter theft.
    - b) Type Two Acceptable Products:
      - (1) Model 375B by Wilkins.
      - (2) Equals as approved by Architect before use. See Section 01 6200.
  - 2) Standard Backflow Preventer:
    - a) Acceptable Products:
      - (1) Make and Model shown on Contract Drawings or as required by local code, see mechanical drawings.
- e. Hydrometer:
  - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:

- a) Netafim:
      - (1) LHM15TG0053-MEL (Photo Diode High Frequency (PDH) Register is required) for Weather Reach Controller Link.
  - f. Quick Coupling Valves and Keys:
    - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      - a) Rainbird: 33DRC with 33DK and SH-O swivel.
- 12. Valve Accessories:
  - a. Valve manifolds:
    - 1) Type Two Acceptable Products.
      - a) Action Machining: 1800 Series, Models 18001, 18001-1-5, and 18001-2.0, **1, 1-1/2, and 2 inch (25, 38, and 50 mm)** sizes.
      - b) Hydro-Rain: HRM Series.
      - c) Equals as approved by Architect before use. See Section 01 6200.
  - b. Valve Boxes And Extensions:
    - 1) Lid Colors:
      - a) Green: Lawn areas (potable and secondary water).
      - b) Tan: Bare soil and rock areas (potable and secondary water).
      - c) Purple: Reclaimed water.
    - 2) Type Two Acceptable Products:
      - a) Carson Industries:
        - (1) **12 Inch (300 mm)** Model 1419-12.
        - (2) **10 Inch (255 mm)** Model 0910.
      - b) Rainbird:
        - (1) 12 Inch Model VBSTD series (standard).
        - (2) 10 Inch Model VB10RND series (round).
      - c) Equal as approved by Architect before use. See Section 01 6200.
  - c. Valve ID tags:
    - 1) Type Two Acceptable Products:
      - a) Christy's: Stamped ID tag.
      - b) Equal as approved by Architect before use. See Section 01 6200.
  - d. Valve Box Supports:
    - 1) Standard size fired clay paving bricks without holes.
    - 2) Standard size **6 inch x 8 inch x 16 inch (150 mm x 200 mm x 400 mm)** CMU Block.
- 13. Drip System:
  - a. Drip Valve Assembly:
    - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      - a) Rainbird:
        - (1) Over 15 GPM: XCZ-150-PRB-COM series (15-40 gpm). Does not include ball valve. Automatic valve will operate in some dirty water conditions.
        - (2) Over 5 GPM: XCZ-100-PRB-COM series (5-20 gpm). Automatic valve will operate in some dirty water conditions.
        - (3) Over 5 GPM: XCZ-100-PRB-MC (5-20 gpm). Does not include ball valve.
        - (4) Under 5 GPM: XCZ-LF-100-PRF series (0.20-5 gpm).
      - b) Refer to drawings for additional information.
  - b. Distribution Tubing (from lateral lines to emitter):
    - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      - a) GPH: GPST IH Series, pre-assembled flexible riser w/fittings (size as required).
  - c. Drip Emitters:
    - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      - a) GPH: GPST-CV Series.
  - d. Indicator Emitter:
    - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      - a) Tree drip indicator:
        - (1) Rainbird: XB-10PC with barbed fittings, DBC-025 diffuser cap, TS-025 stake, and XQ **1/4 inch (6.4 mm)** tubing.
  - e. Distribution Tubing (from lateral lines to in-line emitter tubing).
    - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
      - a) Flexible polyethylene pipe.
  - f. In-Line Emitter Tubing:
    - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:



- a) Rainbird: XFCV or XFS drip line, 1/2 inch (12.7 mm) air relief valves, flush valves, and XF series insert fittings.
  - g. Valve Box Supports:
    - 1) Standard size fired clay paving bricks without holes.
    - 2) Standard size 6 inch x 8 inch x 16 inch (150 mm x 200 mm x 400 mm) CMU Block.
- 14. Solvent Cement:
  - a. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
    - 1) Primer:
      - a) Meet ASTM F656 standard and applicable sections of latest edition of '*Uniform Plumbing Code*'.
      - b) Meet NSF/ANSI standard for use on potable water applications.
      - c) Low VOC emissions and compliant with LEED.
      - d) Product: Weld-On P-70 primer by IPS.
    - 2) PVC Solvent Cement:
      - a) Heavy bodied, medium setting, high strength:
        - (1) Meet ASTM D2564 standard and applicable sections of latest edition of '*Uniform Plumbing Code*'.
        - (2) Meet NSF/ANSI standard for use on potable water applications.
        - (3) Meet CSA standards for use in pressure and non-pressure potable water applications.
        - (4) Low VOC emissions and compliant with LEED.
        - (5) Product: Weld-On 711 Low VOC PVC Cement by IPS.
      - b) Flexible, medium bodied, fast setting, high strength (flexible pipe only):
        - (1) Meet ASTM D2564 standard and applicable sections of latest edition of '*Uniform Plumbing Code*'.
        - (2) Meet NSF/ANSI standard for use on potable water applications.
        - (3) Low VOC emissions and compliant with LEED.
        - (4) Product: Weld-On 795 Low VOC Flex PVC Cement by IPS.
- 15. Other Components:
  - a. Recommended by Manufacturer and subject to Architect's review and acceptance before installation.
  - b. Provide components necessary to complete system and make operational.

## PART 3 - EXECUTION

### 3.1 INSTALLERS

- A. Approved Irrigation System Installers:
  - 1. Thuesen Sprinklers and Landscape, Jake Thuesen 406-855-2771.
  - 2. The Good Earth Works Company, Inc., Jeff Spooner 406-698-1760.
  - 3. PointScape, Inc., Tom Lutke 406-321-0421.
  - 4. River Edge Landscape Company, Steve Lehenbauer, 406-628-7317.
  - 5. Equal approved by Architect and / or Landscape Architect before bidding. See Section 01 4301.
- B. Category Three National Account Approved Smart Controller Installers. See Section 01 6200 for definitions of Categories:
  - 1. Provide Qualification documentation as described under Informational Submittals in Part 1 GENERAL:
    - a. Weather Reach: Manufacture approved Installer (see [www.weatherreach.com](http://www.weatherreach.com) for details).

### 3.2 EXAMINATION

- A. Verification Of Conditions:
  - 1. Perform pressure test at stub-out on main water line provided for potable irrigation system, or at near-by fire hydrant.
  - 2. Perform pressure test at pitless adapter for well supplied irrigation system.



3. Notify Architect if pressures over **70 psi (480 kPA)** or under **55 psi (379 kPA)** are found to determine if some re-design of system is necessary before beginning work on system.

### 3.3 PREPARATION

- A. Protection:
  1. Protection Of In-Place Conditions:
    - a. Repair or replace work damaged during course of Work at no additional cost to Owner. If damaged work is new, installer of original work shall perform repair or replacement.
    - b. Do not cut existing tree roots measuring over **2 inches (50 mm)** in diameter in order to install irrigation lines.
- B. Surface Preparation:
  1. Layout of Irrigation Heads:
    - a. Location of heads and piping shown on Contract Drawings is approximate. Actual placement may vary slightly as is required to achieve full, even coverage without spraying onto buildings, sidewalks, fences, etc.
    - b. During layout, consult with Architect to verify proper placement and make recommendations, where revisions are advisable.
    - c. Minor adjustments in system layout will be permitted to avoid existing fixed obstructions.
    - d. Make certain changes from Contract Documents are shown on Record Drawings.

### 3.4 INSTALLATION

- A. Trenching And Backfilling:
  1. Pulling of pipe is not permitted.
  2. Excavate trenches to specified depth. Remove rocks larger than **1-1/2 inch (38 mm)** in any direction from bottom of trench. Separate out rocks larger than **1-1/2 inch (38 mm)** in any direction uncovered in trenching operation from excavated material and remove from areas to receive landscaping.
  3. Cover pipe both top and sides with **2 inches (50 mm)** of rock-free soil or sand as specified under PART 2 PRODUCTS. Remainder of backfill to topsoil depth as specified in Section 32 9122 using native material as specified under PART 2 PRODUCTS and topsoil as specified in Section 32 9120, Section 32 9121 and Section 32 9122.
  4. Do not cover pressure main, irrigation pipe, or fittings until Architect has inspected and approved system.
- B. Sleeving:
  1. Sleeve water lines, control wires, communications wires, etc. under walks and paving. Extend sleeves **6 inches (150 mm)** minimum beyond walk or pavement edge. Cover sleeve ends until pipes and wires are installed to keep sleeve clean and free of dirt and debris.
  2. Position sleeves with respect to buildings and other obstructions so pipe can be easily removed.
- C. Grades And Draining:
  1. In localities where winterization is required, grade piping so system can be completely drained or blown out with compressed air. If system is not designed to be blown out with compressed air:
    - a. Slope pipe to drain to control valve box where possible.
    - b. Where this is not possible, slope pipe to minimum number of low points. At these low points, install:
      - 1) **3/4 inch (19 mm)** brass ball valve for manual drain. Do not use automatic drain valves.
      - 2) Install **2 inch (50 mm)** Class 200 PVC pipe over top of drain and cut at finish grade.
      - 3) Provide rubber valve cap marker.
      - 4) Provide **one cu ft (0.03 cu m)** pea gravel sump at outlet of each drain.
    - c. Slope pipes under parking areas or driveways to drain outside these areas.
    - d. Provide and install quick-coupling valve or valves in location for easy blowout of entire system. Install quick coupler valves with **2 lineal feet (0.60 m)** minimum of galvanized pipe between valve and main line.

**D. Installation of Pipe:**

1. Install pipe in manner to provide for expansion and contraction as recommended by Manufacturer.
2. Unless otherwise indicated on Contract Drawings, install main lines with minimum cover of **18 inches (450 mm)** based on finished grade. Install lateral lines, including those connecting drip tubing, with minimum of **12 inches (300 mm)** of cover based on finish grade.
3. Install pipe and wires under driveways or parking areas in specified sleeves **18 inches (450 mm)** below finish grade or as shown on Contract Drawings.
4. Locate pipe so no sprinkler head will be closer than **12 inches (300 mm)** from building foundation.
5. Cut plastic pipe square. Remove burrs at cut ends before installation so unobstructed flow will result.
6. Make solvent weld joints as follows:
  - a. Do not make solvent weld joints if ambient temperature is below **35 deg F (2 deg C)**.
  - b. Clean mating pipe and fitting with clean, dry cloth and apply one (1) coat of primer to each surface.
  - c. Apply uniform coat of solvent cement to outside of pipe.
  - d. Apply solvent cement to fitting in similar manner.
  - e. Insert pipe completely into fitting.
  - f. Give pipe or fitting quarter turn to insure even distribution of solvent and make sure pipe is inserted to full depth of fitting socket.
  - g. Allow joints to set at least twenty four (24) hours before applying pressure to PVC pipe.
7. Tape threaded connections with teflon tape.
8. Isolation Valves:
  - a. Install as detailed and per Manufacturers recommendations.
9. If pipe is larger than **3 inches (75 mm)**, install joint restraints wherever change of direction occurs on PVC main lines.

**E. Control Valves And Control Valve Wiring:**

1. Install valves in plastic boxes with reinforced heavy duty plastic covers. Locate valve boxes within **12 inches (300 mm)** to **24 inches (600 mm)** of sidewalks and shrub bed edges with tops at finish grade. Do not install more than two (2) valves in single box.
2. Place **3 inches (75 mm)** minimum of pea gravel below bricks supporting valve boxes to drain box. Set valve boxes over valve so all parts of valve can be reached for service. Set cover of valve box even with finish grade. Valve box cavity shall be reasonably free from dirt and debris.
3. Wiring:
  - a. For traditional wiring, tape control wire to side of main line every **10 feet (3.050 m)**. Where control wire leaves main or lateral line, enclose it in gray conduit.
  - b. Use waterproof wire connectors consisting of properly-sized wire nut and grease cap at splices and locate all splices within valve boxes.
  - c. Use white or gray color for common wire and other colors for all other wire. Each common wire may serve only one (1) controller.
  - d. Run one (1) spare control wire from panel continuously from valve to valve throughout system similar to common wire for use as replacement if wire fails:
    - 1) Spare wire shall be different color than other wires. Use of green wire is not acceptable.
    - 2) Mark spare control wire visibly within valve box as an 'Un-Connected Wire'. Extend spare control wires **24 inches (600 mm)** and leave coiled in each valve box. Mark spare wire visibly within controller as 'Un-Connected Wire'.

**F. Smart Controller:**

1. Fill out 'Smart Controller Installation Checklist' provided in Attachment of this specification during installation of Controller.
2. Install Smart Controller as per Controller Manufacturer's details and installation recommendations.
3. In hot climates, install out of sun exposure.
4. Install grounding as per Manufacturer's recommendations:
  - a. Note: if controller is mounted within building, coordinate grounding with Electrical Engineer.
5. Install automatic rain sensor as per Manufacturer's recommendations.
6. Provide sticker with Facility Manager's Contact information inside Controller, but in plain view.
7. Install communication connections as required: Ethernet.

- G. Hydrometer:
1. Install as detailed and as per manufacturer's recommendations.
  2. If installed on secondary system, install downstream of filter.
  3. Connect communication cables to Smart Controller. Run cables within conduit as specified in specification.
- H. Backflow Preventer (Culinary Water Supply Only):
1. By Mechanical
- I. Sprinkler Heads And Rotor Pop-ups:
1. Set sprinkler heads and quick-coupling valves perpendicular to finish grade.
  2. Do not install sprinklers using side inlets. Install using base inlets only.
  3. Heads immediately adjacent to mow strips, walks, or curbs shall be **one inch (25 mm)** below top of mow strip, walk, or curb and have **one inch (25 mm)** to **3 inch (75 mm)** clearance between head and mow strip, walk, or curb.
  4. Set sprinkler heads at consistent distance from walks, curbs, and other paved areas and to grade by using specified components or other method demonstrated in Pre-Construction Conference.
- J. Drip Assembly:
1. Install pipe providing for expansion and contraction as recommended by Manufacturer.
  2. Cut tubing square and remove burrs at cut ends.
  3. Distribution tubing shall be between **14 inches (350 mm)** minimum and **48 inches (1 200 mm)** maximum long. Layout PVC lateral lines as necessary to keep distribution tubing lengths within specified tolerances.
  4. Locate drip emitter on uphill side of plant within rootball zone.
  5. Layout in-line tubing for trees as indicated on Contract Drawings. Layout in-line tubing for shrubs and groundcovers so plants receive water within rootball zones.
  6. Locate in-line tubing on top of soil but under bark mulch and weed barrier fabric.
  7. Staple in-line tubing to ground at **6 foot (1 800 mm)** maximum intervals and within **12 inches (300 mm)** of ends and intersections.
  8. Assembly Using Solvent Weld Joints:
    - a. Do not make solvent weld joint if ambient temperature is below **35 deg F (2 deg C)**.
    - b. Clean mating pipe and fitting with clean, dry cloth.
    - c. Apply uniform coat of PVC solvent cement to outside of pipe and inside socket of fitting.
    - d. Insert pipe completely into fitting.
    - e. Give pipe or fitting quarter turn to insure even distribution of solvent and make sure pipe is inserted to full depth of fitting socket.
    - f. Allow joints to set twenty four (24) hours minimum before applying pressure to pipe.
  9. Assembly Using 'Funny Pipe' Type Joints:
    - a. Connect distribution tubing to lateral line using barbed ell fitting.
    - b. Connect fitting to distribution tubing using straight barbed fitting with **1/2 inch (13 mm)** threaded end.
- K. Before installation of sprinkler heads and drip emitters, open control valves and use full head of water to flush out system.
- L. Arrange valve stations to operate in an easy-to-view progressive sequence around building. Tag valves with waterproof labels showing final sequence station assignments.

### 3.5 FIELD QUALITY CONTROL

- A. Field Tests and Inspections:
1. Irrigation System:
    - a. Pressure Test:
      - 1) In presence of Landscape Architect, pressure test main line with all valves installed. Notify Landscape Architect two (2) working days minimum before conducting test.
      - 2) Before backfilling main line, test pressure at **100 psi (690 kPA)** minimum for two (2) hours minimum and make certain there are no leaks.
    - b. Test report:

- 1) Report of Pressure Test results along with photographs of testing process are to be provided to Architect and Landscape Architect or his authorized representative at completion of testing.
  - 2) Pressure test report shall be included in Operations and Maintenance Manual.
  2. Smart Controller Testing:
    - a. Use Smart Controller Installation Checklist to test system to verify following:
      - 1) Verify all aspects of Smart Controller installation checklist are complete.
      - 2) Verify controller is installed correctly and will automatically adjust irrigation run times in response to environmental changes using sensor and weather information to manage watering times and frequency.
  3. Weather Reach Controller Link Audit:
    - a. Installer to submit installation documentation to manufacturer and request 'Installation / Operational Audit' by manufacturer:
      - 1) Submittals include:
        - a) Completed 'Smart Controller Installation Checklist'.
        - b) Installation photographs.
        - c) Irrigation Controller Settings Worksheet.
        - d) Controller Link Settings Worksheet.
      - 2) Manufacturer shall review submittals, device logs, settings and operational performance:
        - a) Operational Report shall be provided by manufacturer.
        - b) Installer to correct problems identified in Operational Report.
  4. Substantial Completion Walkthrough:
    - a. Landscape Architect or designated representative(s) will inspect site and create list of non-conforming items to be resolved prior to Irrigation Final Acceptance. Date on this list will act as date of Landscape Substantial Completion.
    - b. Installations completed after water source has been turned off for season, as determined by Landscape Architect, will be inspected following spring after system can be checked for proper operation.
  5. Irrigation Final Acceptance:
    - a. Irrigation Final Acceptance will be awarded when all non-conforming work is brought into conformance.
    - b. Landscape Architect will create signed certificate to be included in 'Operations and Maintenance Manual' at completion of all non-conforming work. This certifies that Landscape Architect has inspected irrigation system and to best of his/her knowledge, it complies with Contract Drawings Details and Specifications.
- B. Non-Conforming Work: Non-conforming work as covered in General Conditions applies, but is not limited to following:
1. Underground Sprinkler System:
    - a. Correct any work found defective or not complying with Contract Document requirements at no additional cost to Owner.

### 3.6 ADJUSTING

- A. Sprinkler Heads:
1. Adjust sprinkler heads to proper grade when turf is sufficiently established to allow walking on it without appreciable harm. Such lowering and raising of sprinkler heads shall be part of original contract with no additional cost to Owner.
  2. Adjust sprinkler heads for proper distribution and trim so spray does not fall on building.
- B. Watering Time:
1. Adjust watering time of valves to provide proper amounts of water to plants.

### 3.7 CLOSEOUT ACTIVITIES

- A. Training:

1. After system is installed and approved, instruct Owner's designated personnel in complete operation and maintenance procedures using Meetinghouse Site Management Plan (MSMP) on new construction projects.
  - a. Describe difference between plant establishment schedule and long term maintenance schedule.
  - b. Describe annual and regular filter maintenance.
2. Smart Controller Training:
  - a. Following completion of Irrisoft Weather Reach Controller Link installation Audit, Installer to instruct Owner's designated personnel in complete operation and maintenance of smart controller.
  - b. Installer to review terms of Warranty, Maintenance procedures and contact information with Owner's Representative.

#### **END OF SECTION**

#### **ATTACHMENTS**

# Smart Controller Installation Checklist

## Weather Reach Controller Link

Procedures for Final Inspection of LDS Church Installations:

The following checklist details all items for Weather Reach Controller Link installation that are required by Irrisoft and certified by Installer prior to final inspection by Irrisoft technician. This checklist is for smart controller verification purposes only and does not cover all requirements given in Project Specifications.

### 1. Pre-Installation:

- ☐ Brand and model of host irrigation controller is listed as compatible or approved by Irrisoft, Inc.
- ☐ Installation location within operating range of compatible facility operated Wi-Fi Access Point.
- ☐ If existing irrigation system; the system was tested, inspected and repaired (as needed).

### 2. Installation:

- ☐ Controller Link mounted near host irrigation controller in vertical upright position.
- ☐ 24 volt AC power connected from host controller to Controller Link 24VAC Power Input.
- ☐ Controller Link ground terminal connected to earth ground.
- ☐ Valve common from host controller connected to Controller Link Common IN terminal.
- ☐ Valve common wire going to all sprinkler valves connected to Controller Link Common OUT terminal.
- ☐ Program Start Sensors wired per site conditions and manufacturer's instructions.
- ☐ All valves can be activated by host irrigation controller when Controller Link enables irrigation.
- ☐ No valves can be activated by host irrigation controller when Controller Link interrupts irrigation.
- ☐ Wires properly routed through wire entry seal.

### 3. Host Controller Programming:

- ☐ Zones assigned to Programs with similar watering requirements.
- ☐ Program cycle Water Days set to every day (unless special circumstances exist).
- ☐ Program Cycle Start times set based on site needs.
- ☐ Station run-times set to apply the amount of water to satisfy site-specific required irrigation amount).
- ☐ Program cycles do not overlap.
- ☐ Settings documented on Irrigation Controller Settings Worksheet.
- ☐ Host irrigation controller set to Auto/Run.

### 4. Controller Link Programming:

- ☐ Controller Link is connected to the Internet.
- ☐ Representative Weather Source selected.
- ☐ Connect Rain Source selected.
- ☐ Passed "Check PGM (Program) Wiring" test in accordance with Installation and Operation Guide.
- ☐ Programs are set to Smart Control (unless there are site specific exceptions or program is not used).
- ☐ Number of cycle starts setting matches host controller settings.
- ☐ Irrigation Amount settings consistent with site conditions, valve run-time and sprinkler precipitation rates.
- ☐ Landscape Adjustment percent is in accordance with site conditions and irrigation.
- ☐ Weather Interrupts settings appropriate for site conditions.
- ☐ Flow Sensor settings (if used) appropriate for site conditions.
- ☐ Program Moisture Levels consistent with current field conditions.
- ☐ Verify weather data is current.
- ☐ Settings documented on Controller Link Settings Worksheet.

**5. Weather Reach Access (Web-based Remote Management):**

- ☐ Call Irrisoft customer service at 435-755-0400 to setup account.
- ☐ Provide: Project Information detail.
- ☐ Email notifications setup complete.
- ☐ Controller Link settings and logs are updating in Weather Reach Access.

**6. Netafim Hydrometer Installation (if required):**

- ☐ Installed in accordance with manufacturer's guidelines.
- ☐ Wire connections made with approved water-tight wire connectors.
- ☐ Master Valve wiring connected to host irrigation controller.
- ☐ Flow sensor wiring connected to Controller Link Flow Sensor terminal.
- ☐ Controller Link reports expected flow - tested at 3 flow rates.

**7. Tipping Rain Gauge Installation (if required):**

- ☐ Tipping rain gauge installed in an unobstructed location to catch natural rainfall.
- ☐ Tipping rain gauge level and securely installed.
- ☐ Wire from the rain gauge to the Controller Link is protected and secure.
- ☐ Rain gauge wire connected to Controller Link Rain Tip terminal.
- ☐ Controller Link "Rain Source" set to "Rain Gauge 1mm/tip".
- ☐ Test rain gauge by tipping the spoon and verifying the 0.04" of rain measurement in the Controller Link.

**8. Final Check:**

- ☐ Landscape health inspected – plants are getting adequate water but not too much.
- ☐ Controller Link irrigation logs match actual watering history.
- ☐ Prepared installation documents to be submitted to Irrisoft, Inc. for Installation Audit. Include: 1) Signed Installation Check List. 2) Digital photographs clearly showing all wiring connections made in and between the host controller and Controller Link. 3) If installed, rain gauge and Hydrometer installation photographs. 4) Irrigation Controller Settings Worksheet. 5) Controller Link Settings Worksheet.
- ☐ Completed programming worksheets left in host irrigation controller and include with Closing Submittals.
- ☐ Landscape health inspected – plants are getting adequate water but not too much.

PROJECT INFORMATION (available from Owner's Representative or Project Architect)

Project Name: \_\_\_\_\_ Property No.: \_\_\_\_\_

Project Site Address: \_\_\_\_\_

FM Group: : \_\_\_\_\_ FM Office Address: \_\_\_\_\_

.....

Controller Link Installation Date: \_\_\_\_\_ Date Code: \_\_\_\_\_ Serial Number: \_\_\_\_\_

Host irrigation controller model number and number of stations: \_\_\_\_\_

I hereby certify that Smart Controller Installation Checklist has been completed and all deficiencies have been corrected.

Installer Name: \_\_\_\_\_ Phone No.: \_\_\_\_\_ Date: \_\_\_\_\_

Signature: \_\_\_\_\_ Printed Signature: \_\_\_\_\_

Order Installation Audit Service and submit required installation documentation to Irrisoft, Inc.

Date: \_\_\_\_\_

**SECTION 32 9001****COMMON PLANTING REQUIREMENTS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Common procedures and requirements for landscaping work.
  - 2. Provide maintenance for new landscaping as described in Contract Documents.
- B. Related Requirements:
  - 1. Pre-Installation conferences held jointly with Section 32 9001 as described in Administrative Requirements on Part 1 of this specification section:
  - 2. Section 01 4301: 'Quality Assurance – Qualifications'.
  - 3. Section 31 0501: 'Common Earthwork Requirements'.
  - 4. Section 31 1100: 'Clearing and Grubbing'.
  - 5. Section 31 1413: 'Topsoil Stripping and Stockpiling'.
  - 6. Section 31 2213: 'Rough Grading'.
  - 7. Section 31 2216: 'Fine Grading'.
  - 8. Section 31 2316: 'Excavation'.
  - 9. Section 31 2323: 'Fill'.
  - 10. Section 32 8423: 'Underground Sprinklers'.
  - 11. Section 32 9120: 'Topsoil And Placement'.
  - 12. Section 32 9121: 'Topsoil Physical Preparation' (section included based on Topsoil Testing Report).
  - 13. Section 32 9122: 'Topsoil Grading'.
  - 14. Section 32 9223: 'Sodding'.
  - 15. Section 32 9300: 'Plants'.
  - 16. Section 32 9413: 'Landscape Edging'.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- A. Pre-Installation Conference:
  - 1. Participate in pre-installation conference as specified in Section 01 3100 and held jointly with following sections:
    - a. Section 32 8423: 'Underground Sprinklers'.
    - b. Section 32 9120: 'Topsoil And Placement'.
    - c. Section 32 9121: 'Topsoil Physical Preparation' (section included based on Topsoil Testing Report).
    - d. Section 32 9122: 'Topsoil Grading'.
    - e. Section 32 9223: 'Sodding'.
    - f. Section 32 9300: 'Plants'.
    - g. Section 32 9413: 'Landscape Edging'.
  - 2. In addition to agenda items specified in Section 01 3100, review the following:
    - a. Site Visits:
      - 1) Landscape Architect to visit site five (5) times during project construction.
      - 2) If site conditions necessitate additional visits, Landscape Architect can schedule addition site visits with approval from Architect prior to bid.
      - 3) During construction, additional site visits may be approved in writing by Architect or Owner for special considerations before commencement.
      - 4) Site visits caused by lack of work progress by Landscape Subcontractor shall reimburse Landscape Architect amount determined by Architect or Owner for additional site visits.
    - b. Coordination:
      - 1) Landscape Subcontractor and Landscape Architect to coordinate site visits and include Architect and General Contractor in communications.



- c. Landscape Maintenance:
    - 1) Establish responsibility for maintenance of new landscaping during all phases of construction period.
  - d. Percolation Test:
    - 1) Prepare two (2) typical landscape planting excavations and conduct percolation test to verify that water drains away within two (2) hours.
    - 2) Discuss results of percolation tests with Architect and Owner's Representative.
  - e. Review additional agenda items as specified in related sections listed above.
3. Approved Site Visits:
- a. Site Visit No. 1:
    - 1) Description:
      - a) Landscape pre-installation Conference.
    - 2) Schedule: Conduct pre-installation conference after completion of Fine Grading specified in Section 31 2216, but one (1) week minimum before beginning landscape work.
    - 3) Required Attendees:
      - a) Project Manager, Facilities Manager, Architect, General Contractor, Landscape Subcontractor, Excavator, and Landscape Architect.
      - b) Include Landscaping Subcontractor Foreman and those responsible for installation of landscaping to be in attendance.
    - 4) Related Sections:
      - a) Section 31 0501: 'Common Earthwork Requirements'.
      - b) Section 32 8423: 'Underground Sprinklers'.
      - c) Section 32 9120: 'Topsoil And Placement'.
      - d) Section 32 9121: 'Topsoil Physical Preparation' (section included based on Topsoil Testing Report).
      - e) Section 32 9122: 'Topsoil Grading'.
      - f) Section 32 9223: 'Sodding'.
      - g) Section 32 9300: 'Plants'.
    - 5) Notes:
      - a) Verify project site conditions and review scope of work before installation begins.
      - b) Verify appropriate sub-grades have been established.
  - b. Site Visit No. 2:
    - 1) Description:
      - a) Irrigation system pressure test compliance, main line inspection, valve inspection.
    - 2) Schedule: Conduct site visit one (1) week minimum after notification before beginning irrigation system pressure test.
    - 3) Required Attendees:
      - a) General Contractor, Landscape Subcontractor, Landscape Architect.
    - 4) Recommended Attendees:
      - a) Project Manager, Facilities Manager.
    - 5) Related Sections:
      - a) Section 32 8423: 'Underground Sprinklers'.
      - b) Section 32 9120: 'Topsoil And Placement'.
      - c) Section 32 9122: 'Topsoil Grading'.
    - 6) Notes:
      - a) Verify finish grading in preparation for planting.
  - c. Site Visit No. 3:
    - 1) Description:
      - a) Inspect and approve plant quality, plant quantity, plant pits, plant pit backfill, planting depths, and removal of packaging/distribution materials, wire, and ties.
    - 2) Schedule: Conduct site visit one (1) week minimum after notification from Contractor before beginning site visit no. 3.
    - 3) Required Attendees:
      - a) General Contractor, Landscape Subcontractor, Landscape Architect.
    - 4) Recommended Attendees:
      - a) Project Manager, Facilities Manager.
    - 5) Related Sections:
      - a) Section 32 9300: 'Plants'.
    - 6) Notes:
      - a) Inspect irrigation system installation, Inspect weed barrier fabric.

- d. Site Visit No. 4:
  - 1) Description:
    - a) Comprehensive Substantial Completion inspection prior to beginning thirty (30) day Landscape Subcontractor maintenance period.
  - 2) Schedule: Conduct site visit one (1) week minimum after notification before beginning site visit no. 4.
  - 3) Required Attendees:
    - a) Project Manager, Facilities Manager, Architect, General Contractor, Landscape Subcontractor, Landscape Architect.
  - 4) Related Sections:
    - a) Section 32 8423: 'Underground Sprinklers'.
    - b) Section 32 9300: 'Plants'.
  - 5) Notes:
    - a) Verify contract requirements have been followed including but not limited to: planting compliance, irrigation system coverage and irrigation system operation.
- e. Site Visit No. 5:
  - 1) Description:
    - a) At the end of thirty (30) day Landscape Subcontractor maintenance period, verify deficient items have been corrected and verify no others exist.
  - 2) Schedule: Conduct site visit one (1) week minimum after notification before beginning site visit no. 5.
  - 3) Required Attendees:
    - a) Project Manager, Facilities Manager, Architect, General Contractor, Excavation Subcontractor, Landscape Subcontractor, Landscape Architect.
  - 4) Related Sections:
    - a) Section 32 8423: 'Underground Sprinklers'.
    - b) Section 32 9300: 'Plants'.
  - 5) Notes:
    - a) Review Site Management Plan (SMP) with Owner. Provide landscape maintenance training.

### 1.3 SUBMITTALS

- A. Informational Submittals:
  - 1. Special Procedure Submittals:
    - a. Landscape Architect and Landscape Subcontractor shall jointly provide the following:
      - 1) Maintenance recommendations for Site Management Plan (SMP).
      - 2) Recommendation procedures to be established by Owner for maintenance of landscape work for one (1) full year after contract maintenance period ends required by Contract Documents.
  - 2. Qualification Statement:
    - a. Landscape Subcontractor:
      - 1) Provide Qualification documentation if requested by Landscape Architect or Owner.
    - b. Installer:
      - 1) Provide Qualification documentation if requested by Landscape Architect or Owner.
- B. Closeout Submittals:
  - 1. Include the following in Operations And Maintenance Manual specified in Section 01 7800:
    - a. Maintenance:
      - 1) Maintenance recommendations for Site Management Plan (SMP).
    - b. Operations And Maintenance Data:
      - 1) At completion of landscape work, submit two (2) copies of typewritten instructions of the following:
        - a) Provide maintenance recommendations for Site Management Plan (SMP).
        - b) Provide recommended procedures to be established by Owner for maintenance of landscape work for one (1) full year after contract maintenance period ends.

## **1.4 QUALITY ASSURANCE**

- A. Regulatory Agency Sustainability Approvals:
  - 1. Post-Emergent Weed Control:
    - a. Products shall be recognized for intended use by AHJ.
- B. Qualifications:
  - 1. Landscape Subcontractor. Requirements of Section 01 4301 applies, but not limited to following:
    - a. Company specializing in performing work of this section.
    - b. Minimum five (5) years experience in landscaping installations.
    - c. Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
    - d. Upon request, submit documentation.
  - 2. Installer:
    - a. Planting shall be performed under direction of foreman or supervisor with minimum three (3) years experience in landscape installations similar in size, scope, and complexity.
    - b. Foreman or supervisor required to attend pre-installation conference.
    - c. Use trained personnel familiar with required planting procedures and with Contract Documents.
    - d. Upon request, submit documentation.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Storage And Handling Requirements:
  - 1. Deliver packaged materials in containers showing weight, analysis, and name of Manufacturer.
  - 2. Deliver sod, plants, trees, and shrubs in healthy and vigorous condition.
  - 3. Protect materials from deterioration during delivery.
- B. Storage And Handling Requirements:
  - 1. Store in location on site where they will not be endangered and where they can be adequately watered and kept in healthy and vigorous condition.
  - 2. Protect materials from deterioration while stored at site.

## **PART 2 - PRODUCTS**

### **2.1 POST-EMERGENT WEED CONTROL**

- A. Type Two Acceptable Products:
  - 1. Enide by Upjohn.
  - 2. Dymid by Elanco.
  - 3. Treflan or Surflan by Dow Agrosiences.
  - 4. Eptan by Syngenta.
  - 5. Equal as approved by Architect before use. See Section 01 6200.

## **PART 3 - EXECUTION**

### **3.1 INSTALLERS**

- A. Acceptable Installers:
  - 1. Thuesen Sprinklers and Landscape, Jake Thuesen 406-855-2771.
  - 2. The Good Earth Works Company, Inc., Jeff Spooner 406-698-1760.
  - 3. PointScape, Inc., Tom Lutke 406-321-0421.
  - 4. River Edge Landscape Company, Steve Lehenbauer, 406-628-7317.
  - 5. Equal approved by Architect and / or Landscape Architect before bidding. See Section 01 4301.

### **3.2 EXAMINATION**

- A. Verification Of Conditions:
  - 1. Inspect site and Contract Documents to become thoroughly acquainted with locations of irrigation, ground lighting, and utilities.

### **3.3 PREPARATION**

- A. Before proceeding with work, verify dimensions and quantities. Report variations between Drawings and site to Architect before proceeding with landscape work.
  - 1. Plant totals are for convenience of Contractor only and are not guaranteed. Verify amounts shown on Drawings.
  - 2. All planting indicated on Contract Documents is required unless indicated otherwise.
- B. Protection:
  - 1. Take care in performing landscaping work to avoid conditions that will create hazards. Post signs or barriers as required.
  - 2. Provide adequate means for protection from damage through excessive erosion, flooding, heavy rains, etc. Repair or replace damaged areas.
  - 3. Keep site well drained and landscape excavations dry.

### **3.4 INSTALLATION**

- A. Interface With Other Work:
  - 1. Do not plant trees and shrubs until major construction operations are completed. Do not commence landscaping work until work of Section 31 2216 and Section 32 8423 has been completed and approved.
- B. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.
- C. Hand excavate as required.
- D. Maintain grade stakes until parties concerned mutually agree upon removal.
- E. When conditions detrimental to plant growth are encountered, such as rubble fill or adverse drainage conditions, notify Architect before planting.

### **3.5 FIELD QUALITY CONTROL**

- A. Field Inspection:
  - 1. Architect will inspect landscaping installation approximately two (2) weeks before Substantial Completion.
- B. Non-Conforming Work. Non-conforming work as covered in the General Conditions applies, but is not limited to the following:
  - 1. Replace landscaping that is dead or appears dead as directed by Architect within ten (10) days of notification and before Substantial Completion at no additional cost to Owner.
  - 2. Replace damaged plantings at no additional cost to Owner.
  - 3. Repair damage to irrigation, ground lighting, utilities, asphalt paving, concrete paving, concrete sidewalks, concrete curb and gutters and other items adjacent to landscaping caused by work of this Section or replace at no additional cost to Owner.

### **3.6 CLEANING**

- A. Waste Management:

1. Immediately clean up soil or debris spilled onto pavement and dispose of deleterious materials.

### 3.7 PROTECTION

- A. Protect planted areas against traffic or other use immediately after planting is completed by placing adequate warning signs and barricades.
- B. Provide adequate protection of planted areas against trespassing, erosion, and damage of any kind. Remove this protection after Architect has accepted planted areas.

### 3.8 MAINTENANCE

- A. General:
  1. Before beginning maintenance period, plants shall be in at least as sound, healthy, vigorous, and in approved condition as when delivered to site, unless accepted by Architect in writing at final landscape inspection.
  2. Maintain landscaping from completion of landscape installation to thirty (30) days after Substantial Completion Meeting. Areas sodded or seeded after November 1st will accepted following spring approximately one (1) month after start of growing season, June 1st or as determined by Architect, if specified conditions have been met.
  3. Replace landscaping that is dead or appears unhealthy or non-vigorous as directed by Architect before end of maintenance period. Make replacements within ten (10) days of notification. Lawn that does not live and has to be replaced shall be guaranteed and maintained an additional thirty (30) days from date of replacement.
- B. Sodded Lawn:
  1. Maintain sodded lawn areas until lawn complies with specified requirements and throughout maintenance period.
  2. Water sodded areas in sufficient quantities and at required frequency to maintain sub-soil immediately under sod continuously moist **3 to 4 inches (75 to 100 mm)** deep.
  3. Cut grass first time when it reaches **3 inches (75 mm)** high. Continue to mow at least once each week throughout maintenance period. Remove clippings.
  4. Apply weed killer as necessary to maintain weed-free lawn. Apply weed killer in accordance with manufacturer's instructions during calm weather when air temperature is between **50 and 80 deg F (10 and 27 deg C)**.
  5. At end of thirty (30) day maintenance period, fertilize lawns as recommended in Section 32 9113.
- C. Trees, Shrubs, And Plants:
  1. Maintain by pruning, cultivating, and weeding as required for healthy growth.
  2. Restore planting basins.
  3. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical positions as required.
  4. Spray as required to keep trees and shrubs free of insects and disease.
  5. Provide supplemental water by hand as needed in addition to water from sprinkling system.

### END OF SECTION

**SECTION 32 9120****TOPSOIL AND PLACEMENT****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Perform topsoil evaluation and placement required prior to topsoil grading as described in Contract Documents.
- B. Related Requirements:
  - 1. Section 31 0501: 'Common Earthwork Requirements':
  - 2. Section 31 1413: 'Topsoil Stripping And Stockpiling' for stripping and storing of existing topsoil.
  - 3. Section 31 2216: 'Finish Grading' for landscaping and planting areas.
  - 4. Section 32 9001: 'Common Planting Requirements':
    - a. Pre-installation conference held jointly with other common planting related sections.
  - 5. Section 32 9121: 'Topsoil Physical Preparation' for physical preparation of topsoil (section included based on Topsoil Testing Report).
  - 6. Section 32 9122: 'Topsoil Grading' for preparation of topsoil and addition of amendments prior to landscaping.

**1.2 REFERENCES**

- A. Reference Standards:
  - 1. ASTM International:
    - a. ASTM D1557-12, 'Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>))'.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Pre-Installation Conference:
  - 1. Participate in pre-installation conference as specified in Section 32 9001.
  - 2. In addition to agenda items specified in Section 01 3100 and Section 32 9001, review the following:
    - a. Review finish grade elevation and tolerance requirements.
    - b. Review surface preparation requirements including disking, tilling, ripping, or aerating.
    - c. Review test requirements as per Attachment 'Topsoil Testing Report' in this specification.

**1.4 SUBMITTALS**

- A. Informational Submittals:
  - 1. Field Quality Control Submittals:
    - a. Submit tests on imported and site topsoil by licensed laboratory before use, using Owner Form 'Topsoil Testing Report':
      - 1) On-site topsoil testing has been completed and specifications are modified based on the previously completed testing. Contractor is responsible for all testing of imported topsoil. Soil Testing Laboratory indicated on Topsoil Testing Report form shall be used. Contractor is responsible for all amendments and fertilizers required to bring imported topsoil into compliance with the specified design criteria.
      - 2) Topsoil shall meet minimum specified physical requirements and be approved by Landscape Architect.

- 3) If in-place topsoil does not comply, enhance and test until installed topsoil complies with Project Specifications.
- 4) If necessary, submit proposed amendments and application rates necessary to bring topsoil up to minimum specified requirements.
- b. Submit report stating location of source of imported topsoil and account of recent use.
2. Installer Reports:
  - a. Delivery slips indicating amount of physical amendments delivered to Project site.
- B. Closeout Submittals:
  1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
    - a. Record Documentation:
      - 1) 'Topsoil Testing Report'.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Topsoil:
  1. Design Criteria:
    - a. Topsoil used in landscaped areas, whether imported, stockpiled, or in place, shall be weed free, fertile, loose, friable soil meeting following criteria:
      - 1) Chemical Characteristics:
        - a) pH 5.5 to 8.0.
        - b) Soluble Salts: less than 3.0 mmhos/cm.
        - c) Sodium Absorption Ratio (SAR): less than 6.0.
        - d) Organic Matter: greater than 4.0 percent.
      - 2) Physical Characteristics:
        - a) Gradation as defined by USDA triangle of physical characteristics as measured by hydrometer.
          - (1) Sand: 15 to 60 percent.
          - (2) Silt: 10 to 60 percent.
          - (3) Clay: 5 to 30 percent.
        - b) Clean and free from toxic minerals and chemicals, noxious weeds, rocks larger than or equal to 1-1/2 inch (38 mm) in any dimension, and other objectionable materials.
        - c) Soil (Coordinate screening as specified in Section 31 1413 'Topsoil Stripping And Stockpiling' to meet these characteristics):
          - (1) Soil shall not contain more than five (5) percent by volume of rocks measuring over 1/4 inch (6 mm) in largest size.
          - (2) Soil shall be topsoil in nature.
          - (3) Soil resembling road base or other like materials are not acceptable.
    2. Project Topsoil Requirements:
      - a. It is anticipated that following percentages of material will be required to meet topsoil requirements of Project site:
        - 1) Imported Topsoil: 22 percent of landscape area:
          - a) Lawn Areas: 16 percent of imported topsoil. Refer to plans for lawn areas to receive imported topsoil and depth.
          - b) Shrub / Tree Areas: 84 percent of imported topsoil. Refer to plans for shrub/tree areas to receive imported topsoil and depth.
          - c) Native Grass / Shrub / Tree Areas: 0 percent of imported topsoil.
        - 2) Stockpiled Topsoil: 78 percent of landscape area:
          - a) Lawn Areas: 100 percent of stockpiled topsoil. Refer to plans for lawn areas to receive stockpiled topsoil and depth.
          - b) Shrub / Tree Areas: 0 percent of stockpiled topsoil.
          - c) Native Grass / Shrub / Tree Areas: 0 percent of stockpiled topsoil.
        - 3) In-Place Topsoil: 0 percent of landscape area:
          - a) Lawn Areas: 0 percent of in-place topsoil.
          - b) Shrub / Tree Areas: 0 percent of in-place topsoil.

- c) Native Grass / Shrub / Tree Areas: 0percent of in-place topsoil.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verification Of Conditions:
1. Do not commence work of this Section until grading tolerances specified in Section 31 2216 are met.
  2. Do not commence work of this Section until coordination with Section 32 9121 'Physical Preparation' and Section 32 9122 'Topsoil Grading' and if required by these specifications prior to placement.
  3. Receive approval from Landscape Architect of subgrade elevations prior to commencement of this Work.

### 3.2 PREPARATION

- A. Protection Of In-Place Conditions:
1. Protect utilities and site elements from damage.
- B. Surface Preparation:
1. Surfaces to receive Imported and Stockpiled Topsoil:
    - a. Disk, till, rip, or aerate with approved agricultural aerator to depth of 6 inches (150 mm).
    - b. Place specified and approved topsoil on prepared surface.

### 3.3 PERFORMANCE

- A. General:
1. After Surface Preparation requirements are completed, limit use of heavy equipment to areas no closer than 6 feet (1.80 meter) from building or other permanent structures. Use hand held tillers for preparation of subsoil in areas closer than 6 feet (1.80 m).
  2. Do not expose or damage existing shrub or tree roots.
- B. Topsoil Depth/Quantity:
1. Total imported topsoil depth of 5 inches (125 mm) minimum in lawn areas on the North, South, and West of building, see plans.
  2. Total on-site topsoil depth of 5 inches (125 mm) minimum in lawn areas outside of those mentioned previously, see plans.
  3. Total imported topsoil depth of 12 inches minimum in planter areas.
  4. Provide no less than quantity required to achieve tolerance described in Section 32 9122 'Topsoil Grading' along with additional physical soil amendments required in Section 32 9121 'Topsoil Physical Preparation'. Installer of this section responsible for providing sufficient topsoil material.
- C. Imported Topsoil:
1. Place tested and approved topsoil:
    - a. Before placing topsoil, remove organic material, rocks and clods greater than 1-1/2 inch (38 mm) in any dimension, and other objectionable materials.
    - b. Do not place topsoil whose moisture content makes it prone to compaction during placement process.
    - c. Do not place topsoil when subgrade is either wet or frozen enough to cause clodding.
- D. Stockpiled Topsoil:
1. Redistribute tested and approved existing topsoil stored on site as result of work of Section 31 1413 'Topsoil Stripping And Stockpiling'.



- a. Before placing topsoil, remove organic material, rocks and clods greater than 1-1/2 inch (38 mm) in any dimension, and other objectionable materials.
  - b. Do not place topsoil whose moisture content makes it prone to compaction during placement process.
  - c. Do not place topsoil when subgrade is either wet or frozen enough to cause clodding.
- E. In Place Topsoil:
1. At locations where topsoil can remain in place and has been tested and approved, perform the following:
    - a. Remove existing vegetation as required in preparation for new landscaping.
    - b. Remove vegetative layer, roots, organic material, rocks and clods greater than 1-1/2 inch (38 mm) in any dimension, and other objectionable materials.
- F. Grading:
1. Slope grade away from building for 12 feet (3.60 m) minimum from walls at slope of 1/2 inch in 12 inches (13 mm in 300 mm) minimum unless otherwise noted.
    - a. High point of finish grade at building foundation shall be 6 inches (150 mm) minimum below finish floor level.
    - b. Direct surface drainage in manner indicated on Contract Documents by molding surface to facilitate natural run-off of water.
    - c. Fill low spots and pockets with topsoil and grade to drain properly.

**END OF SECTION**

**ATTACHMENTS**

# Topsoil Testing Report- For Use With Imported Topsoil

Project	Name		Property Number
	Site Street Address, City, State/Province		
Person Submitting Test	Name		Date Requested
	Address, City, State/Province		Phone
Soil Testing Laboratory	Name QA Consulting & Testing		Date Submitted
	Address, City, State/Province 645 S. 240 E., Salem, UT 84653		Phone 801-423-1116
			Fax

## General

- Contractor shall pay for testing of all imported topsoil.

## Contractor Instructions

- Test topsoil for importing.
- Topsoil test results to be reviewed and approved by Landscape Architect prior to importing.

## Testing Instructions

- Collect at least two (2) samples of each anticipated topsoil source. If borrow pit are not uniform, additional samples shall be taken. Uniform composite samples may also be used if properly acquired and documented.
- Submit required soil samples to soil testing laboratory along with all required (for this report and laboratory) information.

## Soil Testing Laboratory Instructions

- This report must be completely filled out and provide soil interpretation and amendment, fertilizer, and soil conditioner recommendations for use by Landscape Architect. These recommendations should consider lawn areas, tree and shrub areas, and native plant areas.
- Provide appropriate times for fertilizing.
- Return completed Topsoil Testing Report to person submitting the test.

SOIL SAMPLE LOG		
Soil Sample No.	Description of location where sample was taken	History of use of the soil

## Existing Conditions Test Report ("Acceptable Levels" refers to the allowable soil specifications prior to being amended)

SOIL TEST DATA												
Sample No.	pH <sup>(1)</sup>	EC <sup>(1)</sup> Mmhos/cm	SAR <sup>(1)</sup>	% Sand	% Silt	% Clay	Text <sup>(2)</sup> Class	% <sup>(3)</sup> OM	NO <sub>3</sub> -N <sup>(4)</sup> ppm	P <sup>(5)</sup> ppm	K <sup>(5)</sup> ppm	Fe <sup>(5)</sup> Ppm
Acceptable Level(s)	5.5 - 8.4	<3.0	<6.0	15-60	10-60	5-30	(2)	>4.0	>20	>11	>130	>10

<sup>(1)</sup> Saturated soil paste 1:1 soil:water method (please Indicate)

<sup>(2)</sup> Hydrometer method (Acceptable soil- sand:15-60 percent, silt:10-60 percent, clay-5-30 percent)

<sup>(3)</sup> Potassium dichromate method (Walkey-Black) or loss of ignition

<sup>(4)</sup> Chromotropic acid method

<sup>(5)</sup> AB-DTPA method

If other methods are used for NO<sub>3</sub>-N, P, K, and Fe, then note.

ROCKS (Coarse Fragments)		
Sample No.	Percent > 1/4 inch (6.4 mm)	Rocks Present ≥ 1.5 inch (38 mm) Indicate as present or not present
	percent	
	percent	
Acceptable Level	≤ 5.0 percent	< 1.5 inch (38 mm)

### Landscape Area Description

Lawn Areas: Receive 5 inch (125 mm) topsoil plus recommended amendments and fertilizers.

Shrub/Tree Areas: Unless otherwise indicated, plant pits are to be backfilled with three (3) parts native soil and one part compost or other recommended amendments. Additionally, contractor will add recommended fertilizer.

Native Grass/Shrub/Tree Areas: Planting to receive minimum recommended amendments and fertilizers for establishment.

INFILTRATION RATE	
Documented Infiltration rate of test sample(s) based on texture at 90 percent relative density (to nearest 1/10th of an inch)	
Sample No.	Rate
	Inches/Hour
	Inches/Hour

### Interpretation Summary of Test Results:

### Soil Amendments, Fertilizer and Soil Conditioner – Recommendations:

Lawn Areas

Shrub/Tree Areas

Native Grass/Shrub/Tree Areas

### Long Term (5 Year) Fertilizer and Soil Conditioner – Recommendations:

Lawn Areas

Shrub/Tree Areas

Native Grass/Shrub/Tree Areas

# Topsoil Testing Report- On-Site Topsoil

Project	Name <b>Sweet Grass Creek</b>	Property Number : not given	
	Site Street Address, City, State/Province not given		
Person Submitting Test	Name <b>Nathan Steiner Thuesen</b> <b>nathan@steinerthuesen.net</b>	Date Requested <b>21 Jul 2016</b>	Phone <b>406 252 5545</b>
	Address, City, State/Province <b>473 W 4800 S, SLC, UT 84123</b>		Fax <b>245 9855</b>
Soil Testing Laboratory	Name <b>QA Consulting and Testing, LLC</b>	Date Submitted <b>22 Jul 2016</b>	Phone 801 423 1116
	Address, City, State/Province <b>645 South 240 East Salem, UT 84653 vonisaman@comcast.net</b>		Fax 1813

## General

- Owner will pay for pre-bid testing and one (1) final topsoil test.

## Landscape Architect Instructions

- Landscape Architect shall determine by investigation quality and quantity of topsoil on site before landscape design. Add physical and fertility recommendations from laboratory recommendations to relevant Church specifications.

## Contractor Instructions

- Test installed topsoil. Installed topsoil shall comply with Project Specifications.
- If installed topsoil does not comply, Contractor will enhance and test at no cost to Owner until installed topsoil complies with Project Specifications.

## Testing Instructions

- Collect at least two (2) samples of on-site topsoil and each anticipated topsoil source. If site soil profile or borrow pit are not uniform, additional samples shall be taken. Uniform composite samples may also be used if properly acquired and documented.
- Submit required soil samples to soil testing laboratory along with all required (for this report and laboratory) information.

## Soil Testing Laboratory Instructions

- This report must be completely filled out and provide soil interpretation and amendment, fertilizer, and soil conditioner recommendations for use by Landscape Architect. These recommendations should consider lawn areas, tree and shrub areas, and native plant areas.
- Provide appropriate times for fertilizing.
- Return completed Topsoil Testing Report to person submitting the test.

SOIL SAMPLE LOG		
Soil Sample No.	Description of location where sample was taken	History of use of the soil
<b>SWEET GRASS CREEK</b>	Topsoil 0-6"	Not given

## Existing Conditions Test Report ("Acceptable Levels" refers to the allowable soil specifications prior to being amended)

SOIL TEST DATA												
Sample No.	pH <sup>(1)</sup>	EC <sup>(1)</sup> Mmhos/cm	SAR <sup>(1)</sup>	% Sand	% Silt	% Clay	Text <sup>(2)</sup> Class	% <sup>(3)</sup> OM	NO <sub>3</sub> -N <sup>(4)</sup> ppm	P <sup>(5)</sup> ppm	K <sup>(5)</sup> ppm	Fe <sup>(5)</sup> ppm
<b>SWEET GRASS CREEK</b>	7.8	<b>4.4</b>	1.4	28	35	<b>37</b>	Clay-Loam	2.4	<b>4</b>	<b>2</b>	252	13
Acceptable Level(s)	5.5 - 8.4	<b>&lt;3.0</b>	<6.0	15-60	10-60	<b>5-30</b>	(2)	>1.0	<b>&gt;20</b>	<b>&gt;11</b>	>130	>10

<sup>(1)</sup> Saturated soil paste 1:1 soil:water method (please Indicate)

<sup>(2)</sup> Hydrometer method (Acceptable soil- sand:15-60 percent, silt:10-60 percent, clay-5-30 percent)

<sup>(3)</sup> Potassium dichromate method (Walkey-Black) or loss of ignition

<sup>(4)</sup> Chromotropic acid method

<sup>(5)</sup> AB-DTPA method

If other methods are used for NO<sub>3</sub>-N, P, K, and Fe, then note.

Continued next page.

ROCKS (Coarse Fragments)		
Sample No.	Percent > 1/4 inch (6.4 mm)	Rocks Present ≥ 1.5 inch (38 mm) Indicate as present or not present
<b>SWEET GRASS CREEK</b>	0.1%	Not Present
Acceptable Level	≤ 5.0 percent	< 1.5 inch (38 mm)

### Landscape Area Description

Lawn Areas: Receive 5 inch (125 mm) topsoil plus recommended amendments and fertilizers.

Shrub/Tree Areas: Unless otherwise indicated, plant pits are to be backfilled with three (3) parts native soil and one part compost or other recommended amendments. Additionally, contractor will add recommended fertilizer.

Native Grass/Shrub/Tree Areas: Planting to receive minimum recommended amendments and fertilizers for establishment.

INFILTRATION RATE	
Documented Infiltration rate of test sample(s) based on texture at 90 percent relative density (to nearest 1/10th of an inch)	
Sample No.	Rate
<b>SWEET GRASS CREEK</b>	0.9 Inches/Hour
	Inches/Hour

### Interpretation Summary of Test Results:

**SWEET GRASS CREEK** does not meet Acceptable Levels for: EC, % Clay, NO<sub>3</sub>N and P.

Due to the elevated salt content (EC) caution is given should this soil be used for landscaping purposes. If this soil is used then specify plant species tolerant of soils with an elevated salt content.

Due to the elevated clay content caution is given should this soil be used for landscaping purposes. If this soil is used then specify plant species tolerant of soils with elevated clay content.

### Soil Amendments, Fertilizer and Soil Conditioner – Recommendations:

**Lawn Areas:** Amendments: Apply an organic material (compost, etc.) at 7.5 cu yds/1000 sq ft for every 5" of topsoil depth. Incorporate well. See the Compost Quality Guidelines for Landscaping, attached. Or, apply a similar product at label rate following manufacturer's recommendation for soil preparation and turf maintenance. No additional organic material is recommended for organic matter content ≥5%. Fertilizer: apply an NP fertilizer at label rate. Conditioner: Apply gypsum at label rate to mitigate the effects of the elevated clay content.

**Shrub/Tree Areas:** Amendments: See **Landscape Area Description** above. Fertilizer: apply an NP fertilizer at label rate. Conditioner: Apply gypsum at label rate to mitigate the effects of the elevated clay content.

**Native Grass/Shrub/Tree Areas:** Amendments: None. Conditioners: Apply gypsum at label rate to mitigate the effects of the elevated clay content. Fertilizer: apply an NP fertilizer at 1/2 label rate, or per nurseryman's recommendation.

**Scarify the subsoil at least 6" before applying topsoil.**

### Long Term (5 Year) Fertilizer and Soil Conditioner – Recommendations:

**Lawn Areas: Amendments:** Core aerate annually and top dress with an organic material 1/8" to 1/4". Fertilizer: Continue with above recommendation. Conditioner: Apply gypsum at label rate to mitigate the effects of the elevated clay content.

**Shrub/Tree Areas:** Amendments: None. Conditioner: Apply gypsum at label rate to mitigate the effects of the elevated clay content. Fertilizer: As top dress, continue with above recommendation.

**Native Grass/Shrub/Tree Areas:** Amendments: None. Conditioner: None. Fertilizer: Top dress every other year with 1/2 label rate of fertilizer; or per nurseryman's recommendation.

**SECTION 32 9122****TOPSOIL GRADING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Perform topsoil grading required to prepare site for installation of landscaping as described in Contract Documents.
  - 2. Perform topsoil placement and finish grading work required to prepare site for installation of landscaping as described in Contract Documents.
  - 3. Furnish and apply soil amendments as described in Contract Documents.
- B. Related Requirements:
  - 1. Section 31 0501: Common Earthwork Requirements:
  - 2. Section 31 1413: Stripping and storing of existing topsoil.
  - 3. Section 31 2216: 'Finish Grading' for landscaping and planting areas.
  - 4. Section 32 9001: 'Common Planting Requirements':
    - a. Pre-installation conference held jointly with other common planting related sections.
  - 5. Section 32 9120: 'Topsoil And Placement' for topsoil evaluation and placement required for topsoil grading.
  - 6. Section 32 9121: 'Topsoil Physical Preparation' for physical preparation of topsoil (section included based on Topsoil Testing Report).

**1.2 ADMINISTRATIVE REQUIREMENTS**

- A. Pre-Installation Conference:
  - 1. Participate in pre-installation conference as specified in Section 32 9001.
  - 2. In addition to agenda items specified in Section 01 3100, review the following:
    - a. Review compost requirements to be within acceptable range as per Attachment 'Compost Quality Guidelines For Landscaping' and 'Compost Verification Report' in this specification.
    - b. Review soil fertility amendments and fertilizer requirements as per Attachment 'Topsoil Testing Report' in Section 32 9120.

**1.3 SUBMITTALS**

- A. Action Submittals:
  - 1. Product Data:
    - a. Soil Fertility Amendments and Fertilizer:
      - 1) Product literature and chemical / nutrient analysis of soil amendments and fertilizers.
  - 2. Samples:
    - a. Soil Fertility Amendments and Fertilizer:
      - 1) Sample of soil conditioner for approval before delivery to site.
      - 2) Include product analysis list.
- B. Informational Submittals:
  - 1. Field Quality Control Submittals:
    - a. Soil Fertility Amendments and Fertilizer:
      - 1) Submit proposed amendments and application rates necessary to bring topsoil up to minimum specified requirements.
      - 2) Submit report stating location of source of imported topsoil and account of recent use.
      - 3) Submit report to verify compost meets Ideal or Acceptable requirements.
  - 2. Installer Reports:

- a. Soil Fertility Amendments and Fertilizer:
  - 1) Delivery slips indicating amount of soil amendments, compost, conditioner, and fertilizer delivered to Project site.
- C. Closeout Submittals:
  - 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
    - a. Record Documentation:
      - 1) 'Compost Verification Report'.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Soil Amendments for On-Site Topsoil: **TO BE DETERMINED**
  - 1. Incorporate following soil amendments into topsoil used for Project:
    - a. Acceptable Soil Amendments, Soil Conditioners, And Application Rates. (Choose one):
      - 1) 'Soil Pep': **<Insert Application Rate from Topsoil Testing Report>.**
      - 2) 'Compost': **<Insert Rate from Topsoil Testing Report>.**
      - 3) Other amendments and conditioners as specified by topsoil Testing Report, such as lime, gypsum, Axis, etc: **<Insert Material and Application Rate from Topsoil Testing Report>.**
      - 4) Equals as approved by Architect before use. See Section 01 6200.
    - b. Acceptable Fertilizers And Application Rates:
      - 1) **<Insert Fertilizer and Application Rates from Topsoil Testing Report>.**
      - 2) **<Insert Fertilizer and Application Rates from Topsoil Testing Report>.**
      - 3) **<Insert Fertilizer and Application Rates from Topsoil Testing Report>.**
      - 4) Equal as approved by Architect before installation. See Section 01 6200.
- B. Soil Amendments for Imported Topsoil: **TO BE DETERMINED**
  - 1. Incorporate following soil amendments into topsoil used for Project: Amendments to be determined by Contractor provided topsoil testing.
    - a. Acceptable Soil Amendments, Soil Conditioners, And Application Rates. (Choose one):
      - 1) 'Soil Pep': **<Insert Application Rate from Topsoil Testing Report>.**
      - 2) 'Compost': **<Insert Rate from Topsoil Testing Report>.**
      - 3) Other amendments and conditioners as specified by topsoil Testing Report, such as lime, gypsum, Axis, etc: **<Insert Material and Application Rate from Topsoil Testing Report>.**
      - 4) Equals as approved by Architect before use. See Section 01 6200.
    - b. Acceptable Fertilizers And Application Rates:
      - 1) **<Insert Fertilizer and Application Rates from Topsoil Testing Report>.**
      - 2) **<Insert Fertilizer and Application Rates from Topsoil Testing Report>.**
      - 3) **<Insert Fertilizer and Application Rates from Topsoil Testing Report>.**
      - 4) Equal as approved by Architect before installation. See Section 01 6200.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verification Of Conditions:
  - 1. Do not commence work of this Section until imported, stockpiled and in place topsoil are placed as specified in Section 32 9120 'Topsoil And Placement'.

### 3.2 PREPARATION

- A. Protection Of In-Place Conditions:
  - 1. Protect utilities and site elements from damage.
- B. Surface Preparation:
  - 1. Surfaces that meet specified topsoil elevations.
    - a. Seven (7) days maximum before beginning seeding and planting:
      - 1) Loosen topsoil **6 inch (150 mm)** deep, dampen thoroughly, and cultivate to properly break up clods and lumps.
      - 2) Rake area to remove clods, rocks, weeds, roots, debris or other material **1-1/2 inches (38 mm)** or more in any dimension.
      - 3) Grade and shape landscape area to bring surface to true uniform planes free from irregularities and to provide drainage and proper slope to catch basins.
  - 2. Addition of Soil Amendments:
    - a. Add specified soil amendments at specified rates to topsoil as directed by Topsoil Testing Report found in Section 32 9120 'Topsoil And Placement'.
    - b. Add specified fertilizers at specified rates into topsoil as directed by Soil Testing Laboratory.
    - c. Roto-till or otherwise mix soil amendments evenly into topsoil.
    - d. Incorporate and leach soil amendments which require leaching, such as gypsum, within such time limits that soil is sufficiently dry to allow proper application of fertilizer and soil conditioners.

### 3.3 PERFORMANCE

- A. General:
  - 1. Limit use of heavy equipment to areas no closer than **6 feet (1.80 meter)** from building or other permanent structures. Use hand held tillers for preparation of subsoil in areas closer than **6 feet (1.80 m)**.
  - 2. Do not expose or damage existing shrub or tree roots.
- B. Finish Grade Tolerances (As shown on General Planting Details in Contract Documents):
  - 1. Finish topsoil grade of planting areas before planting and after addition of soil additives shall be specified distances below top of adjacent pavement of any kind:
    - a. Ground Cover Areas: **2 inches (50 mm)** below.
    - b. Seeded Areas: **One inch (25 mm)** below.
    - c. Sodded Areas: **2 inches (50 mm)** below.
    - d. Tree and Shrub Areas (not individual trees): **4 inches (100 mm)** below.
- C. Placed Topsoil:
  - 1. At locations where topsoil has been placed as per Section 32 9120 'Topsoil And Placement', perform the following:
    - a. Remove existing vegetation as required in preparation for new landscaping.
    - b. Remove organic material, rocks and clods greater than **1-1/2 inch (38 mm)** in any dimension, and other objectionable materials.
- D. Grading:
  - 1. Coordinate grading as described in Section 32 9120 'Topsoil And Placement'.
- E. Immediately before planting lawn and with topsoil in semi-dry condition, roll areas that are to receive lawn in two directions at approximately right angles with water ballast roller weighing **100 to 300 lbs (45 to 135 kg)**, depending on soil type.
- F. Rake or scarify and cut or fill irregularities that develop as required until area is true and uniform, free from lumps, depressions, and irregularities.



### **3.4 PROTECTION**

- A. After landscape areas have been prepared, take no heavy objects over them except lawn rollers.

**END OF SECTION**

**ATTACHMENTS**

## COMPOST QUALITY GUIDELINES FOR LANDSCAPING

[Source: Von Isaman MS, President of QA Consulting and Testing LLC, Dr. Rich Koenig, USU Cooperative Extension Soils Specialist, and Dr. Teresa Cerny, USU Cooperative Extension Horticulturalist, 3 March 2003]

Category	pH <sup>a</sup>	Soluble Salts <sup>a</sup> dS/m or mmho/cm	Sodium Adsorption Ratio <sup>a</sup> (SAR)	Carbon Nitrogen Ratio <sup>b</sup> (C:N)	Percent Moisture <sup>c</sup>	≥ 98 percent Coarse Material Passing (dry wt basis)
Ideal	6 to 8	≤ 5	< 10	≤ 20:1	25 to 35	3/8 inch (9.5 mm)
Acceptable	5-6, 8-9	≤ 10	≤ 20	21:1 to 30:1	< 25, > 35	3/4 inch (19 mm)
Suspect	< 5, > 9	> 10	> 20	<10:1, > 30:1	< 20, > 50	< 98 percent 3/4 inch (19 mm)

<sup>a</sup> 1.5 Compost: Water Slurry on Coarse Material passing 3/8 inch (9.5 mm).

<sup>b</sup> on Coarse Material passing 3/8 inch (9.5 mm).

<sup>c</sup> on Total Sample

For composts with biosolid feedstocks, biosolids must meet EPA 503 Class A standard.

Acceptable level Soluble Salts and/or SAR composts should not exceed 3 cu yds (2.29 cu m) /1,000 sq ft (93 sq m) for every 3 inches (76 mm) of soil depth.

## COMPOST VERIFICATION REPORT

	pH <sup>a</sup>	Soluble Salts <sup>a</sup> dS/m or mmho/cm	Sodium Adsorption Ratio <sup>a</sup> (SAR)	Carbon Nitrogen Ratio <sup>b</sup> (C:N)	Percent Moisture <sup>c</sup>	≥ 98 percent Coarse Material Passing (dry wt basis)
Results						

See Compost Quality Guidelines for Landscaping for footnote references.

I hereby certify that the Compost meets Ideal or Acceptable requirements as set forth in COMPOST QUALITY GUIDELINES FOR LANDSCAPING as listed with the COMPOST VERIFICATION STATEMENT. If Compost does not fall within this range, explain why and justify.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Signature: \_\_\_\_\_ Printed Signature: \_\_\_\_\_

Date: \_\_\_\_\_

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**SECTION 32 9223****SODDING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Furnish and install sodded lawn as described in Contract Documents.
- B. Related Requirements:
  - 1. Section 32 8423: Irrigation system.
  - 2. Section 32 9001: Common Planting Requirements:
    - a. Pre-installation conference held jointly with other common planting related sections.
  - 3. Section 32 9121: 'Topsoil Physical Preparation' (section included based on Topsoil Testing Report).
  - 4. Section 32 9122: 'Topsoil Grading'.

**1.2 REFERENCES**

- A. Definitions:
  - 1. Crop Coefficients and Hydro-Zones: Crop coefficients (Kc) are used with ETo to estimate specific plant evapotranspiration rates. The crop coefficient is a dimensionless number (between 0 and 1.2) that is multiplied by the ETo value to arrive at a plant ET (ETc) estimate. Plants grouped by water needs, organized into one irrigation zone.
  - 2. Eco-Region Irrigation Design: A bio-regional approach to irrigation and planting design that is relevant to the geographic area for which the planting plan and irrigation system is designed. These geographic areas are defined by the Environmental Protection Agency and have been modified by the LDS church into 15 geographical areas throughout North America, and the Hawaiian Islands.
  - 3. Hardiness Zone: A hardiness zone is a more precisely geographically-defined zone within an Eco-Region in which a specific category of plant life is capable of growing, as defined by temperature hardiness, or ability to withstand the minimum temperatures of the zone. Hardiness Zones may be defined by one of two sources:
    - a. Sunset Western Garden Book Maps.
    - b. USDA Hardiness Zone Map.Plant Hardiness zone sources shall be listed by the architect through the planting and irrigation design process.
  - 4. Hydro-Zone: Plants grouped by water needs (similar Crop Coefficients (Kc), organized into one irrigation zone.
  - 5. Reference Evapotranspiration (ETo): The total water lost from the soil (evaporation) and from the plant surface (transpiration) over some period.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Pre-Installation Conference:
  - 1. Participate in pre-installation conference as specified in Section 32 9001.

**1.4 SUBMITTALS**

- A. Informational Submittals:
  - 1. Source Quality Control Submittals:
    - a. Written certification confirming lawn seed quality and mix.

- B. Closeout Submittals:
  - 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
    - a. Maintenance Contracts:
      - 1) See Site Management Plan (SMP) for Establishment Period Maintenance.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery And Acceptance Requirements:
  - 1. Harvest, deliver, store, and handle sod in accordance with requirements of Turfgrass Producers International (TPI) (formally American Sod Producers Association) Specifications for Turfgrass Sod Materials and Transplanting / Installing.
  - 2. Schedule deliveries to coincide with topsoil operations and laying. Keep storage at job site to minimum without causing delays.
    - a. Deliver, unload, and store sod on pallets within 24 hours of being lifted.
    - b. Do not deliver small, irregular, or broken pieces of sod.
- B. Storage And Handling Requirements:
  - 1. Cut sod in pieces approximately **3/4 to one inch (19 to 25 mm)** thick. Roll or fold sod so it may be lifted and handled without breaking or tearing and without loss of soil.
  - 2. During wet weather, allow sod to dry sufficiently to prevent tearing during lifting and handling.
  - 3. During dry weather, protect sod from drying before installation. Water as necessary to insure vitality and to prevent excess loss of soil in handling. Sod that dries out before installation will be rejected.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Description:
  - 1. Superior sod grown from certified, high quality, seed of known origin or from plantings of certified grass seedlings or stolons:
    - a. Assure satisfactory genetic identity and purity.
    - b. Assure over-all high quality and freedom from noxious weeds or an excessive amount of other crop and weedy plants at time of harvest.
  - 2. Sod shall be Fescue Blend as supplied by Tvetne Turf, Inc., 406-652-8485.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Interface With Other Work:
  - 1. Do not commence work of this Section until work of Sections 32 9122 and 32 9300 has been completed and approved.
- B. Tolerances:
  - 1. Final grade of soil after sodding of lawn areas is complete shall be **one inch (25 mm)** below top of adjacent pavement of any kind.
- C. Laying of Sod:
  - 1. Lay sod during growing season and within 48 hours of being lifted.
  - 2. Lay sod while top **6 inches (150 mm)** of soil is damp, but not muddy. Sodding during freezing temperatures or over frozen soil is not acceptable.

3. Lay sod in rows perpendicular to slope with joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with a sharp knife.
  4. Lay sod flush with adjoining existing sodded surfaces.
  5. Do not sod slopes steeper than 3:1. Consult with Architect for alternate treatment.
- D. After Laying of Sod Is Complete:
1. Roll horizontal surface areas in two directions perpendicular to each other.
  2. Repair and re-roll areas with depressions, lumps, or other irregularities. Heavy rolling to correct irregularities in grade will not be permitted.
  3. Water sodded areas immediately after laying sod to obtain moisture penetration through sod into top 6 inches (150 mm) of topsoil.

### 3.2 FIELD QUALITY CONTROL

- A. Field Inspection:
1. Sodded areas will be accepted at Project closeout if:
    - a. Sodded areas are properly established.
    - b. Sod is free of bare and dead spots and is without weeds.
    - c. No surface soil is visible when grass has been cut to height of 2 inches (50 mm).
  2. Sodded areas have been mowed a minimum of twice.

**END OF SECTION**

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**SECTION 32 9300****PLANTS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Furnish and install landscaping plants as described in Contract Documents.
- B. Related Requirements:
  - 1. Section 32 8423: Irrigation system.
  - 2. Section 32 9001: 'Common Planting Requirements'.
    - a. Pre-installation conference held jointly with other common planting related sections.
  - 3. Section 32 9120: 'Topsoil And Placement'.
  - 4. Section 32 9121: 'Topsoil Physical Preparation' (section included based on Topsoil Testing Report).
  - 5. Section 32 9122: 'Topsoil Grading'.
  - 6. Section 32 9223: 'Sodding'.

**1.2 REFERENCES**

- A. Definitions:
  - 1. Crop Coefficients and Hydro-Zones: Crop coefficients (Kc) are used with ETo to estimate specific plant evapotranspiration rates. Crop coefficient is dimensionless number (between 0 and 1.2) that is multiplied by ETo value to arrive at plant ET (ETc) estimate. Plants grouped by water needs, organized into one irrigation zone.
  - 2. Eco-Region Irrigation Design: Bio-regional approach to irrigation and planting design that is relevant to geographic area for which planting plan and irrigation system is designed. These geographic areas are defined by Environmental Protection Agency and have been modified by the LDS Church into 15 geographical areas throughout North America, and Hawaiian Islands.
  - 3. Hardiness Zone: Hardiness zone is more precisely geographically-defined zone within an Eco-Region in which specific category of plant life is capable of growing, as defined by temperature hardiness, or ability to withstand minimum temperatures of zone. Hardiness Zones may be defined by one of two sources:
    - a. Sunset Western Garden Book Maps.
    - b. USDA Hardiness Zone Map.Plant Hardiness zone sources shall be listed by Landscape Architect through planting and irrigation design process.
  - 4. Hydro-Zone: Plants grouped by water needs (similar Crop Coefficients (Kc), organized into one irrigation zone.
  - 5. Reference Evapotranspiration (ETo): Total water lost from the soil (evaporation) and from plant surface (transpiration) over some period.
- B. Reference Standards:
  - 1. American Nursery & Landscape Association / American National Standards Institute:
    - a. ANLA / ANSI Z60.1-2004, 'American Standard for Nursery Stock.'

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Pre-Installation Conference:
  - 1. Participate in pre-installation conference as specified in Section 32 9001.



## 1.4 SUBMITTALS

- A. Action Submittals:
  - 1. Samples:
    - a. Top dressing mulch for approval before delivery to site.
    - b. Sample of river rock to be used for crushed river rock prior to crushing if custom crushing is used.
- B. Closeout Submittals:
  - 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
    - a. Maintenance Contracts:
      - 1) See Site Management Plan (SMP) for Establishment Period Maintenance.
    - b. Operations And Maintenance Data:
      - 1) Installer Instructions:
        - a) Provide written instructions covering maintenance requirements by Owner for one year beyond Contract maintenance period specified in Section 32 9001.
    - c. Warranty Documentation:
      - 1) Include final, executed copy of warranty.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery And Acceptance Requirements:
  - 1. Deliver trees, shrubs, ground covers, and plants after preparations for planting have been completed and install immediately.
  - 2. Do not prune before delivery, except as approved by Landscape Architect.
  - 3. Protect bark, branches, and root systems from sun scald, drying, whipping, and other handling and tying damage.
  - 4. Do not bend or bind-tie trees or shrubs in such a manner as to destroy natural shape.
  - 5. Provide protective covering during delivery.
- B. Storage And Handling Requirements:
  - 1. Handle balled stock by root ball or container. Do not drop trees and shrubs during delivery.
  - 2. If planting is delayed more than six hours after delivery, set planting materials in shade and protect from weather and mechanical damage.
  - 3. Set balled stock on ground and cover ball with soil, saw dust, or other acceptable material approved by Landscape Architect.
  - 4. Do not remove container-grown stock from containers before time of planting.
  - 5. Do not store plant material on pavement.
  - 6. Water root systems of trees and shrubs stored on site with fine spray. Water as often as necessary to maintain root systems in moist condition. Do not allow plant foliage to dry out.

## 1.6 WARRANTY

- A. Special Warranty:
  - 1. Provide written warranties as follows:
    - a. Guarantee shrubs, ground covers, and vines to live and remain in strong, vigorous, and healthy condition for 90 days minimum from date landscape installation is accepted as complete and meet or exceed material standards set forth in Materials heading of Part 2 of this specification.
    - b. Guarantee trees to live and remain in strong, vigorous, and healthy condition and meet or exceed material standards set forth in Materials heading of Part 2 of this specification for one year from date landscape installation is accepted as complete.
    - c. When trees are completely accepted at end of warranty period, remove staking.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Plants:
  - 1. Conform to requirements of Plant List and Key on Contract Documents and to ANLA / ANSI Z60.1.
  - 2. Nomenclature:
    - a. Plant names used in Plant List conform to 'Standardized Plant Names' by American Joint Committee on Horticultural Nomenclature except in cases not covered. In these instances, follow custom of nursery trade. Plants shall bear tag showing genus, species, and variety of at least 10 percent of each species delivered to site.
  - 3. Quality:
    - a. Plants shall be sound, healthy, vigorous, free from plant disease, insect pests or their eggs, noxious weeds, and have healthy, normal root systems. Container stock shall be well established and free of excessive root-bound conditions.
    - b. Do not prune plants or top trees prior to delivery.
    - c. Plant materials shall be subject to approval by Landscape Architect as to size, health, quality, and character.
    - d. Bare root trees are not acceptable.
    - e. Provide plant materials from licensed nursery or grower.
  - 4. Measurements:
    - a. Measure height and spread of specimen plant materials with branches in their normal position as indicated on Contract Documents or Plant List.
    - b. Measurement should be average of plant, not greatest diameter. For example, plant measuring **15 inches (375 mm)** in widest direction and **9 inches (225 mm)** in narrowest would be classified as **12 inch (300 mm)** stock.
    - c. Plants properly trimmed and transplanted should measure same in every direction.
    - d. Measure caliper of trees **6 inches (150 mm)** above surface of ground.
    - e. Where caliper or other dimensions of plant materials are omitted from Plant List, plant materials shall be normal stock for type listed.
    - f. Plant materials larger than those specified may be supplied, with prior written approval of Landscape Architect, and:
      - 1) If complying with Contract Document requirements in all other respects.
      - 2) If at no additional cost to Owner.
      - 3) If sizes of roots or balls are increased proportionately.
  - 5. Shape and Form:
    - a. Plant materials shall be symmetrical or typical for variety and species and conform to measurements specified in Plant List.
    - b. Well grown material will generally have height equal to or greater than spread. However, spread shall not be less than 2/3's of height.

### 2.2 ACCESSORIES

- A. Planting Mix:
  - 1. Mixture of three (3) parts excavated soil and one part well rotted composted manure, approved commercial mix, or other amendment recommended in 'Topsoil Testing Report'.
  - 2. Add gypsum as required by 'Topsoil Testing Report'.
- B. Fertilizer:
  - 1. Fertilizer as recommended on 'Topsoil Testing Report'.
- C. Tree Stakes:
  - 1. Type Two Acceptable Products:
    - a. **2 inch (50 mm)** diameter Lodgepole Pine.
    - b. Equal as approved by Landscape Architect before installation. See Section 01 6200.

- D. Tree Staking Ties:
  - 1. Type Two Acceptable Products:
    - a. 32 inch (800 mm) Cinch-Tie tree ties by V.I.T. Products Inc, Escondido, CA [www.vitproducts.com](http://www.vitproducts.com).
    - b. Flex strap Tree Ties by Aquarius Brands Inc, Ontario, CA [www.aquariusbrands.com](http://www.aquariusbrands.com).
    - c. Equal as approved by Landscape Architect before installation. See Section 01 6200.
- E. Tree Guys:
  - 1. Type Two Acceptable Products:
    - a. Duckbill Model 68DTS guying kit.
    - b. Equal as approved by Landscape Architect before installation. See Section 01 6200.
- F. Pre-Emergent Herbicide:
  - 1. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
    - a. Chipco Dimension Granular by The Andersons Inc, Maumee, IL [www.andersonsinc.com](http://www.andersonsinc.com).
    - b. Elanco XL2G granular by Crop Data Management Systems, Marysville, CA [www.cdms.net](http://www.cdms.net).
    - c. Ronstar G granular by Bayer Crop Science, Monheim, Germany [www.bayercropscience.com](http://www.bayercropscience.com).
    - d. Surflan AS liquid by United Phosphorous Inc, Trenton, NJ [www.upi-usa.com](http://www.upi-usa.com).
    - e. Oryzalin 4 A.S. liquid by FarmSaver, Seattle, WA [www.farmsaver.com](http://www.farmsaver.com).
- G. Weed Barrier:
  - 1. Type Two Acceptable Products:
    - a. DeWitt 4.1 oz (121 ml) 20 year woven polypropylene weed barrier.
    - b. Equal as approved by Landscape Architect before bidding. See Section 01 6200.
- H. Bark Or Wood Top Dressing Mulch:
  - 1. Type Two Acceptable Products:
    - a. Gorilla Hair
      - 1) Shredded pine bark.
      - 2) Shredded Cedar.
    - b. Equal as approved by Landscape Architect before installation. See Section 01 6200.
- I. Rock Mulch:
  - 1. Type Two Acceptable Products:
    - a. **CRUSHED RIVER ROCK**
      - 1) Size:
        - a) 1"x 2-1/2", no fines.
      - 2) Color:
        - a) Primary colors to be white and gray.
      - 3) Equal as approved by Landscape Architect before installation. See Section 01 6200.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Evaluation And Assessment:
  - 1. Before proceeding with work, check and verify dimensions and quantities. Report variations between Drawings and site to Landscape Architect before proceeding with work of this Section.
  - 2. Plant totals are for convenience only and are not guaranteed. Verify amounts shown on Contract Documents. All planting indicated on Contract Documents is required unless indicated otherwise.
  - 3. Do not commence with this Work until grading tolerances specified in Section 32 9122 'Topsoil Grading' are met.

### 3.2 PREPARATION

- A. Plant Approval:
  - 1. Compliance:
    - a. Prior to any plant installation, evaluate plants for compliance with material standards.
    - b. Remove plants from site that do not comply.
  - 2. Inspection:
    - a. Prior to any tree installation, inspect one (1) extra deciduous tree and one (1) extra evergreen tree for root health.
    - b. In presence of Landscape Architect or by video recording, remove root container/packing material and inspect root balls for soil depth, firmness and root structure by washing soil off of roots.
    - c. If delivered plants exhibit soil **1 inch (25 mm)** or more above root collar, demonstrate that all trees have had excess soil removed prior to planting or that they meet standard.
    - d. If roots are loose, significantly circling, significantly asymmetrical or damaged, all tree plant material to be removed from site and replaced.
    - e. Continue inspection process until trees meet standard.
- B. Layout individual tree and shrub locations and areas for multiple plantings:
  - 1. Stake locations and outline areas.
  - 2. Secure Landscape Architect 's acceptance before planting.
  - 3. Make minor adjustments as may be requested.

### 3.3 INSTALLATION

- A. Interface With Other Work:
  - 1. Do not commence work of this Section until work of Section 32 9122 has been completed and approved.
- B. Excavation:
  - 1. If underground construction work or obstructions are encountered in excavation of planting holes, Landscape Architect will select alternate locations.
  - 2. Plant Excavation Size:
    - a. Diameter: Twice diameter of root ball or container minimum.
    - b. Depth: Equal to container or rootball depth.
  - 3. Unless excavated material meets topsoil requirements as specified in Section 32 9113, remove from landscape areas and do not use for landscaping purposes.
  - 4. Roughen sides and bottoms of excavations.
  - 5. With approval of Landscape Architect, select five (5) typical planting excavations throughout site for drainage testing.
    - a. Fill selected excavations with water and verify that water drains away at rate of **3 inches (75 mm)** per hour minimum. Inform Landscape Architect in writing of excavations where water does not drain properly.
    - b. Select three (3) excavations approximately **5 feet (1 500 mm)** away from each non-draining excavation and repeat tests. Continue testing process until non-draining areas have been identified.
    - c. In excavations located in identified non-draining areas, auger **6 inch (150 mm)** diameter hole **4 feet (1 200 mm)** deep in low point of each excavation and fill with tamped planting mix.
    - d. Do not plant trees or shrubs in holes that do not properly drain.
- C. Planting:
  - 1. Removing Binders And Containers:
    - a. Remove top one / third of wire basket and burlap binders.
    - b. Remove plastic and twine binders from around root ball and tree trunk.
    - c. Remove plastic containers.
    - d. Remove wood boxes from around root ball. Remove box bottoms before positioning plant in hole. After plant is partially planted, remove remainder of box without injuring root ball.
  - 2. Plant immediately after removing binding material and containers:

- a. Place tree and shrub root balls on undisturbed soil.
  - b. After watering and settling, top of tree root balls shall be approximately **two inches (50 mm)** higher than finished grade and trunk flare is visible.
  - c. Shrub root balls shall be approximately **one inch (25 mm)** higher than finished grade.
  3. Properly cut off broken or frayed roots.
  4. Center plant in hole, remove remaining wire basket and burlap taking care not to damage root ball:
    - a. Replace damaged material.
    - b. Backfill with specified planting mix.
    - c. Except in heavy clay soils, make ring of mounded soil around hole perimeter to form watering basin.
  5. Add fertilizer in plant pit as per 'Topsoil Testing Report' and during proper season.
  6. Fill landscape excavations with tamped planting mix and recommended fertilizer:
    - a. Compact in **6 inch (150 mm)** lifts.
    - b. Settle by watering to ensure top of root ball is **2 inches (50 mm)** higher for trees and **one inch (25 mm)** higher for shrubs than surrounding soil following compaction and settling.
  7. Do not use muddy soil for backfilling.
  8. Make adjustments in positions of plants as directed by Landscape Architect.
  9. Thoroughly water trees and shrubs immediately after planting.
  10. At base of each tree, leave **36 inch (900 mm)** diameter circle free of any grass unless noted otherwise on drawings.
- D. Supports for New Trees:
1. Provide new supports for trees noted on Contract Documents to be staked.
    - a. Remove nursery stakes delivered with and attached to trees.
    - b. Support shall consist of at least two (2) tree stakes driven into hole base before backfill so roots are not damaged. Place stakes vertically and run parallel to tree trunk. Install stakes so **3 feet (900 mm)** of stake length is below finish grade.
    - c. Deciduous Trees:
      - 1) Place tree ties **6 to 12 inches (150 to 300 mm)** below crotch of main tree canopy. Second set of tree ties may be required **18 to 24 inches (450 to 600 mm)** above finish grade, if directed by Landscape Architect.
      - 2) Remove tops of tree stakes so top of stake is **6 inches (150 mm)** below main tree canopy to prevent damage to tree branches and canopy growth.
    - d. Evergreen Trees:
      - 1) Place tree ties 2/3's of height of tree up from root ball.
  2. Provide root guying kits to support **24 inch (600 mm)** box, **3 inch (75 mm)** caliper and larger trees.
  3. Staking and guying should allow some tree movement.
- E. Vines:
1. Remove from stakes, untie, and securely fasten to wall or fence next to which they are planted.
- F. Ground Covers:
1. Container-grown unless otherwise specified on Contract Documents. Space evenly to produce a uniform effect, staggered in rows and intervals shown.
- G. Post Planting Weed Control:
1. Apply specified pre-emergent herbicide to shrub and ground cover planting areas and grass-free areas at tree bases after completion of planting.
  2. Areas shall be weed free growth before application of herbicide.
- H. Weed Barrier Fabric:
1. After planting and application of herbicide in shrub beds and at base of trees, apply covering of specified weed barrier fabric.
  2. Achieve 100 percent coverage over ground areas.
  3. Overlap seams **6 inches (150 mm)** minimum.
  4. Staple at **5 feet (1500 mm)** on center each way and within **3 inches (75 mm)** of edge of shrub bed, with two (2) at each corner.
- I. Mulching:

1. After application of herbicide, mulch shrub and ground cover planting areas with 3 inches (75 mm) deep minimum layer of specified top dressing or rock mulch.
2. Cover grass-free area at tree bases with 3 inches (75 mm) of top dressing mulch.
3. Place mulch to uniform depth and rake to neat finished appearance.
4. Provide additional mulch as needed to completely cover weed barrier.

**END OF SECTION**

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**SECTION 32 9413****LANDSCAPE EDGING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Furnish and install landscape edging and headers as described in Contract Documents.
- B. Related Requirements:
  - 1. Section 03 3053: Concrete mow strips.
  - 2. Section 32 9001: 'Common Planting Requirements':
    - a. Pre-installation conference held jointly with other common planting related sections.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- A. Pre-Installation Conference:
  - 1. Participate in pre-installation conference as specified in Section 32 9001.

**PART 2 - PRODUCTS****2.1 MATERIALS**

- A. Aluminum Edging:
  - 1. All edging shall be 3000 Series, 1/8" x 4" aluminum edging, mill finish, as manufactured by Curv-Rite; Wayland, MI (800) 366-2878.
  - 2. Stakes: Manufacturer's aluminum stakes.

**PART 3 - EXECUTION****3.1 INSTALLATION**

- A. Aluminum Edging:
  - 1. Extend edging **one inch (25 mm)** above grade and hold in place with specified stakes extending into solid earth full length. Set top of stakes **1/2 inch (13 mm)** below top of header.
  - 2. Place line stakes approximately 3.2' o.c., and plumb. Edging shall have a minimum of 2 inches of interlocking overlap between sections. Place splicer stakes in a manner so that smooth lines are maintained at all times. Kinked or waving edging, or edging not uniformly graded, shall be rejected, and replaced at no additional cost to the Owner.
- B. Compact backfill on both sides of headers to density of undisturbed adjoining earth.

**END OF SECTION**



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## **DIVISION 33: UTILITIES**

### **33 1000 WATER UTILITIES**

33 1116 SITE WATER UTILITY DISTRIBUTION PIPING  
33 1119 FIRE SUPPRESSION UTILITY WATER DISTRIBUTION PIPING

### **33 3000 SANITARY SEWERAGE UTILITIES**

33 3313 SANITARY UTILITY SEWERAGE

### **33 4000 STORM DRAINAGE UTILITIES**

33 4116 SITE STORM UTILITY DRAINAGE PIPING

### **33 5000 FUEL DISTRIBUTION UTILITIES**

33 5100 NATURAL-GAS DISTRIBUTION

END OF TABLE OF CONTENTS

**SECTION 33 1116****SITE WATER UTILITY DISTRIBUTION PIPING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Perform trenching and backfilling required for work of this Section.
  - 2. Furnish and install piping from water main to meter inside of building as described in Contract Documents complete with shut-off valve and connections.
- B. Related Requirements:
  - 1. Section 31 2316: 'Excavation' for criteria for performance of excavation.
  - 2. Section 31 2323: 'Fill' for criteria for performance of backfill and compaction.

**1.2 REFERENCES**

- A. Reference Standards:
  - 1. American Welding Society / American National Standards Institute:
    - a. AWS/ANSI A5.8-2004, 'Specification for Brazing Filler Metals'.
  - 2. ASTM International:
    - a. ASTM B88-09, 'Standard Specification for Seamless Copper Water Tube'.

**PART 2 - PRODUCTS****2.1 SYSTEM**

- A. Materials:
  - 1. Pipe: Type K copper meeting requirements of ASTM B88 with wrought copper, brazed fittings.
  - 2. Water Meter: As required by local agency furnishing water.
  - 3. Connection Material:
    - a. Brazing Rods In accordance with ANSI / AWS A5.8:
      - 1) Classification BCuP-4 Copper Phosphorus (6 percent silver).
      - 2) Classification BCuP-5 Copper Phosphorus (15 percent silver).
      - 3) Classification BAg-5 Silver (45 percent silver).
      - 4) Do not use rods containing Cadmium.
    - b. Flux:
      - 1) Type Two Acceptable Products:
        - a) Stay-Silv white brazing flux by J W Harris Co, Cincinnati, OH [www.jwharris.com](http://www.jwharris.com).
        - b) High quality silver solder flux by Handy & Harman, Fairfield, CT [www.handyharman.com](http://www.handyharman.com).
        - c) Equal as approved by Architect before use. See Section 01 6200.
  - 4. Stop And Waste Valves:
    - a. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
      - 1) Mueller: Mark II Oriseal stop and waste valve H10288.
      - 2) Mueller: Buffalo screw type curb box H-10350 complete with lid and H-10349 enlarged base.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Excavate and backfill as specified in Sections 31 2316 and 31 2323 with following additional requirements:
  - 1. Runs shall be as close as possible to those shown on Drawings.
  - 2. Excavate to required depth.
  - 3. Bottom of trenches shall be hard. Tamp as required.
  - 4. Remove debris from trench before laying pipe.
  - 5. Do not cut trenches near footings without consulting Architect.
  - 6. Pipe bedding shall be Type 1 and Type 2 bedding meeting the requirements of MPWSS Standard Drawing 02221-2 to a depth of 24 inches below the bottom of the pipe.
  - 7. To mitigate the travel of water through pipe bedding, impermeable trench plugs are to be installed in utility trenches 10 feet from building and every 200 feet thereafter.
  - 8. Excavate trenches so outside pipe will be 6.5 feet minimum below finish grade.
  - 9. Backfill only after pipe lines have been tested and inspected, and approved by Architect.
- B. Install piping system so it may contract and expand freely. Completely eliminate cross connections, backflow, and water hammer.
- C. Install shut-off valve at meter.

### **3.2 FIELD QUALITY CONTROL**

- A. Field Tests
  - 1. Sterilization And Negative Bacteriological Test:
    - a. Sterilize potable water system with solution containing 200 parts per million minimum of available chlorine and maintaining a pH of 7.5 minimum. Introduce chlorinating materials into system in manner approved by Architect. Allow sterilization solution to remain for twenty four (24) hours and open and close valves and faucets several times during that time.
    - b. After sterilization, flush solution from system with clean water until residual chlorine content is less than 0.2 parts per million.
    - c. Water system will not be accepted until negative bacteriological test is made on water taken from system. Repeat dosing as necessary until such negative test is accomplished.
  - 2. Pressure Test: Before covering pipes, test system in presence of Architect or governing agency at 100 psi (0.69 MPa) hydrostatic pressure for two (2) hours and show no leaks.

### **3.3 CLEANING**

- A. Remove excess earth from site or place as directed by Architect.

**END OF SECTION**

**SECTION 33 1119****FIRE SUPPRESSION UTILITY WATER DISTRIBUTION PIPING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Perform excavation and backfill required for installation of work of this Section.
  - 2. Furnish and install fire water system as described in Contract Documents.
  - 3. Furnish and install connection to water main.
- B. Related Requirements:
  - 1. Section 03 1113: 'Structural Cast-In-Place Concrete Forming' for installation of sleeve where piping penetrates slab.
  - 2. Section 03 3111: 'Normal Weight Structural Concrete' for:
    - a. Mix Type concrete mixes and admixtures.
    - b. Pre-installation conference held jointly with other concrete specifications.
  - 3. Section 21 1313: 'Wet-Pipe Sprinkler Systems'.
  - 4. Section 31 2316: 'Excavation' for procedure and quality of excavating.
  - 5. Section 31 2323: 'Fill' for procedure and quality of backfilling and compacting.

**1.2 REFERENCES**

- A. Association Publications:
  - 1. American Water Works Association:
    - a. AWWA Manual M41, 'Ductile-Iron Pipe and Fittings' (third edition 2009).
- B. Reference Standards:
  - 1. American National Standards Institute / American Water Works Association:
    - a. ANSI/AWWA C110/A21.10-12, 'Ductile-Iron and Gray-Iron Fittings'.
    - b. ANSI/AWWA C111/A21.11-12, 'Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings'.
    - c. ANSI/AWWA C150-A21.50-08, 'Thickness Design of Ductile-Iron Pipe'.
    - d. ANSI/AWWA C151/A21.51-09, 'Ductile-Iron Pipe, Centrifugally Cast'.
    - e. ANSI/AWWA C502-05 'Dry-Barrel Fire Hydrants'.
  - 2. ASTM International:
    - a. ASTM A126-04(2009), 'Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings'.
    - b. ASTM A197/A197M-00(2011), 'Standard Specification for Cupola Malleable Iron'.
    - c. ASTM A307-10, 'Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength'.
    - d. ASTM A506-12, 'Standard Specification for Alloy and Structural Alloy Steel, Sheet and Strip, Hot-Rolled and Cold-Rolled'.
    - e. ASTM A575-96(2007), 'Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades'.
  - 3. National Fire Protection Association:
    - a. NFPA 13: 'Standard for the Installation of Sprinkler Systems' (2013 Edition).
      - 1) Contractor's Material & Test Certification for Underground Piping'.
    - b. NFPA 24 Installation of Private Fire Service Mains and their Appurtenances' (2013 Edition).

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Pre-Installation Conference:

1. Participate in pre-installation conference as specified in Section 03 3111.

## 1.4 SUBMITTALS

- A. Informational Submittals:
  1. Certificates:
    - a. Submit certification required by field test.

## 1.5 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
  1. Install exterior fire water system according to NFPA 13, NFPA 24, and AWWA Manual M41, 'Ductile-Iron Pipe and Fittings' procedures unless specified otherwise below.
  2. Install hydrant in accordance with ANSI/AWWA C502.
  3. Install exterior fire water system up to and including pipe flange **12 inches (300 mm)** above floor inside building.

## PART 2 - PRODUCTS

### 2.1 SYSTEM

- A. Manufacturers:
  1. Manufacturer Contact List:
    - a. Ipex Inc, Englewood, CO [www.ipexinc.com](http://www.ipexinc.com).
    - b. Mueller Company, Decatur, IL [www.muellerflo.com](http://www.muellerflo.com).
    - c. Nibco Inc, Elkhart, IN [www.nibco.com](http://www.nibco.com).
    - d. Potter Electric Signal Company, St Louis, MO [www.pottersignal.com](http://www.pottersignal.com).
    - e. Potter-Roemer, Santa Ana, CA [www.potterroemer.com](http://www.potterroemer.com).
- B. Materials:
  1. Pipe:
    - a. Ductile iron pipe in accordance with ANSI/AWWA C151/A21.51 and ANSI/AWWA C150-A21.50.
    - b. Blue-Brut by Ipex Inc.
    - c. Fittings: Ductile iron pipe fitting in accordance with ANSI/AWWA C110 and rubber gaskets joints in accordance with ANSI/AWWA C111/A21.11.
  2. Hydrants:
    - a. Dry-barrel fire hydrant (base valve type) complying with ANSI/AWWA C150-A21.50, with **150 psi (1.03 MPa)** working pressure with two **2-1/2 inch (64 mm)** hose connections and one **4-1/2 inch (115 mm)** pumper connection with caps and chains.
    - b. Nozzle cap nuts to match operating stem nuts.
    - c. Minimum **6 inch (150 mm)** supply pipe.
    - d. Class Two Quality Standard. See Section 01 6200:
      - 1) Hydrants accepted by authority having jurisdiction are approved.
  3. Gate Valves:
    - a. Cast iron body with bolted bonnet.
    - b. Indicator post pattern.
    - c. Non-rising stem.
    - d. **175 psi (1.21 MPa)** working pressure.
    - e. Category Four Approved Products. See Section 01 6200 for definition of Categories:
      - 1) Nibco:
        - a) Model M-609 with mechanical connection.
        - b) Model F-609 with flanged connection.
      - 2) Mueller:
        - a) Model A-2052-5 with mechanical connection.

- b) Model A-2052-6 with flanged connection.
- 4. Tamper Switch:
  - a. UL / ULC / FM Approved.
  - b. Weather and tamper resistant.
  - c. Single Pole Double Throw Switch.
  - d. Category Four Approved Products. See Section 01 6200 for definition of Categories:
    - 1) Potter Electric Signal: Model PCVS.
- 5. Anchorages:
  - a. Provide anchorages for tees, plugs, caps, bends, and hydrants in accordance with NFPA 24.
  - b. Miscellaneous Fittings:
    - 1) Clamps, Straps, And Washers: Steel, meeting requirements of ASTM A506.
    - 2) Rods: Steel, meeting requirements of ASTM A575.
    - 3) Rod Couplings: Malleable iron, meeting requirements of ASTM A197/A197M.
    - 4) Bolts: Steel, meeting requirements of ASTM A307.
    - 5) Cast Iron Washers: Meeting requirements of ASTM A126, Class A.
    - 6) Thrust Block: 2500 psi (17.92 MPa) concrete.
- 6. Pipe Sleeve at slab penetration:
  - a. Class Two Quality Standard. See Section 01 6200:
    - 1) Any material rigid enough to resist deformation when concrete poured.
    - 2) Size: Provide 2 inch (50 mm) space between piping assembly and sleeve.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Before installation, inspect pipe for defects and cracks. Do not use defective, damaged, or unsound pipe.

### 3.2 PREPARATION

- A. Excavate and backfill as specified in Sections 31 2316 and 31 2323 with following additional requirements:
  - 1. Runs shall be as close as possible to those shown on Contract Documents.
  - 2. Excavate to required depth.
  - 3. Grade to obtain fall required.
  - 4. Bottom of trenches shall be hard. Tamp as required.
  - 5. Remove debris from trench prior to laying of pipe.
  - 6. Do not cut trenches near footings without consulting Architect.
  - 7. Excavate trenches so outside pipe will be 6.5 feet minimum below finish grade.
  - 8. Cover pipe only after testing is complete and accepted by Architect.

### 3.3 INSTALLATION

- A. General:
  - 1. When work is not in progress, close open ends of pipe and fittings so no trench water, soil, or other substances will enter pipes or fittings.
  - 2. Keep trenches free from water until pipe jointing material has set. Do not lay pipe when condition of trench or weather is unsuitable for such work.
- B. Placing And Laying of Underground Pipe:
  - 1. Deflections from straight line or grade, as required by vertical curves, horizontal curves, or offsets, shall not exceed 6/D inches per linear foot (12 500/D mm per m) of pipe where D represents nominal diameter of pipe expressed in inches (mm).
  - 2. Deflections to be determined between center lines extended of two connecting pipes.

3. If alignment requires deflection in excess of these limitations, provide special bends or sufficient number of shorter lengths of pipe to provide angular deflections within limits approved by Architect.
4. Laying:
  - a. Shape trench bottom to give substantially uniform circumferential support to lower third of each pipe.
  - b. Pipe laying shall proceed up-grade with spigot ends of bell-and-spigot pipe pointing in direction of flow.
  - c. Lay each pipe true to line and grade and in such manner as to form close concentric joint with adjoining pipe and to prevent sudden offsets of flow line.
  - d. Support fittings at bends in pipe line by concrete thrust blocks firmly wedged against vertical face of trench. Blocks shall be at least **two cu ft (0.06 cu m)** in size.
  - e. As work progresses, clear interior of pipe of dirt and superfluous materials. Where cleaning after laying is difficult because of small pipe, keep suitable swab or drag in pipe and pull forward past each joint immediately after jointing has been completed.
- C. Make joints between ductile iron and cast iron pipe and other types of pipe with standard manufactured cast-iron adapters and fittings.
- D. Provide cast iron valve box for fire protection valve. Encase valve box in concrete.
- E. Install ductile iron pipe to flange connection **12 inches (300 mm)** above floor. Provide **2 inch (50 mm)** minimum clearance around pipe at penetration through floor. Fill clearance with mastic.
- F. Make joints between ductile iron and other types of pipe with standard manufactured adapters and fittings. Make connections between new work and existing mains using specials fittings to suit actual conditions.
- G. Incidental Items of Work:
  1. Valve, plug, or cap, as directed by Architect, where pipe ends are left for future connections.
  2. Make key for unlocking valve handle identical to key used to open doors to building.
- H. Fire Hydrant Color-Code:
  1. Laps and Nozzle caps should be painted IAW NFPA 24:
 

a. Less ten <b>500 gpm</b> :	Red
b. <b>500 to 999 gpm</b> :	Orange
c. <b>1000 to 1499 gpm</b> :	Green
d. <b>1500 gpm</b> and above	Light Blue

### 3.4 FIELD QUALITY CONTROL

- A. Field Tests: Test system according to NFPA 13 (2010), figure 24.1, 'Contractor's Material & Test Certification for Underground Piping'.

### END OF SECTION



**SECTION 33 3313****SANITARY UTILITY SEWERAGE****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Perform excavating and backfilling required for work of this Section.
  - 2. Furnish and install sanitary sewage system as described in Contract Documents beginning at **5 feet (1.50 meter)** from where it enters building and connecting to serving sewer system.
- B. Related Requirements:
  - 1. Section 22 1313: 'Facility Sanitary Sewers' for sanitary sewage system within building and within **5 feet (1.50 meter)** of building.
  - 2. Section 31 2316: 'Excavation' for criteria for performance of excavation.
  - 3. Section 31 2323: 'Fill' for criteria for performance of backfill and compaction.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- A. Pre-Installation Conference: Participate in pre-installation conference specified in Section 03 3111.

**1.3 REFERENCES**

- A. Reference Standards:
  - 1. ASTM International:
    - a. ASTM A74-13a, 'Standard Specification for Cast Iron Soil Pipe and Fittings'.
    - b. ASTM A888-13a, 'Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications'.
    - c. ASTM C564-12, 'Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings'.
    - d. ASTM D2235-04(2011), 'Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings'.
    - e. ASTM D2321-11, 'Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications'.
    - f. ASTM D2564-12, 'Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems'.
    - g. ASTM D2661-11, 'Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings'.
    - h. ASTM D2665-12, 'Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings'.
    - i. ASTM D3034-14, 'Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings'.
    - j. ASTM F656-10, 'Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings'.
  - 2. Cast Iron Soil Pipe Institute:
    - a. CISPI 301-09, 'Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications'.
    - b. CISPI 310-12, 'Standard Specification for Couplings for use in connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications'.
    - c. CISPI Handbook. 'Cast Iron Soil Pipe and Fittings Handbook' (1990).
  - 3. International Code Council:
    - a. ICC IPC-2012, 'International Plumbing Code'.

## 1.4 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals
  - 1. Install cleanouts in accordance with local governing authority and State codes.

## PART 2 - PRODUCTS

### 2.1 COMPONENTS

- A. ABS:
  - 1. ABS Schedule 40 solid wall plastic pipe and fittings meeting requirements of ASTM D2661 joined with pipe cement meeting requirements of ASTM D2235.
- B. Cast Iron Soil Pipe And Fittings:
  - 1. Meet requirements of ASTM A74, Service Grade:
    - a. Cast iron for bell and spigot fittings.
    - b. Cast iron for no-hub joints.
  - 2. Approved Joint Material And Manufacturers:
    - a. For Bell And Spigot Pipe: Rubber gaskets meeting requirements of ASTM C564 and compatible with pipe used.
    - b. For No-Hub Pipe:
      - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
        - a) SuperGrip 304 American Brass & Iron (AB&I), Oakland, CA [www.abifoundry.com](http://www.abifoundry.com).
        - b) Husky SD 4000 coupling by Anaco-Husky, Corona, CA [www.anaco-husky.com](http://www.anaco-husky.com).
        - c) Neoprene gaskets with type 304 stainless steel clamp and 24 ga type 304 stainless steel housing by Clamp-All Corp, Haverhill, MA [www.clampall.com](http://www.clampall.com).
        - d) MG Coupling by MG Piping Products Co, Stanton, CA [www.mgcoupling.com](http://www.mgcoupling.com).
- C. PVC:
  - 1. Schedule 40 solid wall plastic pipe and fittings meeting requirements of ASTM D2665 joined using cement primer meeting requirements of ASTM F656 and pipe cement meeting requirements of ASTM D2564.
  - 2. Gasket joint gravity sewer pipe and fittings meeting requirements of ASTM D3034. Joints shall be integral wall and elastomeric gasket.

### 2.2 COMPONENTS

- A. ABS:
  - 1. ABS Schedule 40 solid wall plastic pipe and fittings meeting requirements of CAN/CSA B181.1 joined with pipe cement meeting requirements of ASTM D2235.
- B. Cast Iron Soil Pipe And Fittings:
  - 1. Meet requirements of ASTM A74, Service Grade:
    - a. Cast iron for bell and spigot fittings.
    - b. Cast iron for no-hub joints.
  - 2. Approved Joint Material And Manufacturers:
    - a. For Bell And Spigot Pipe: Rubber gaskets meeting requirements of ASTM C564 and compatible with pipe used.
    - b. For No-Hub Pipe:
      - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
        - a) SuperGrip 304 American Brass & Iron (AB&I), Oakland, CA [www.abifoundry.com](http://www.abifoundry.com).
        - b) Husky SD 4000 coupling by Anaco-Husky, Corona, CA [www.anaco-husky.com](http://www.anaco-husky.com).
        - c) Neoprene gaskets with type 304 stainless steel clamp and 24 ga type 304 stainless steel housing by Clamp-All Corp, Haverhill, MA [www.clampall.com](http://www.clampall.com).
        - d) MG Coupling by MG Piping Products Co, Stanton, CA [www.mgcoupling.com](http://www.mgcoupling.com).

## C. PVC:

1. PVC Schedule 40 solid wall plastic pipe and fittings meeting requirements of CAN/CSA B182.2, SDC 28 joined using cement primer meeting requirements of ASTM F656 and pipe cement meeting requirements of ASTM D2564.
2. Under areas subject to vehicular travel, use Blue Brute pipe and fittings by Ipex Inc, Englewood, CO [www.ipexinc.com](http://www.ipexinc.com).

**PART 3 - EXECUTION****3.1 EXAMINATION**

## A. Verification Of Conditions:

1. Before installation, inspect pipe for defects and cracks.
2. Do not use defective, damaged, or unsound pipe.

**3.2 PREPARATION**

## A. Excavate and backfill as specified in Sections 31 2316 and Section 31 2323 with following additional requirements:

1. Runs shall be as close as possible to those shown on Drawings.
2. Excavate to required depth and grade to obtain fall required.
3. Bottom of trenches shall be hard. Tamp as required.
4. Remove debris from trench before laying pipe.
5. Do not cut trenches near footings without consulting Architect/Engineer.
6. Excavate trenches so outside pipe will be 5 feet minimum below finish grade.

**3.3 INSTALLATION**

## A. General:

1. When work is not in progress, close open ends of pipe and fittings so no trench water, soil, or other substances will enter pipes or fittings.
2. Keep trenches free from water until pipe jointing material has set. Do not lay pipe when condition of trench or weather is unsuitable for such work.
3. Trench width at top of pipe:
  - a. Minimum: **18 inches (450 mm)** or diameter of pipe plus **one foot (305 mm)**, whichever is greater.
  - b. Maximum: Outside diameter of pipe plus **two feet (610 mm)**.

## B. Placing And Laying of Underground Pipe:

1. Deflections from straight line or grade, as required by vertical curves, horizontal curves, or offsets, shall not exceed **6/D inches per linear foot (12 500/D mm per m)** of pipe where D represents nominal diameter of pipe expressed in **inches mm**.
2. Deflections to be determined between center lines extended of two connecting pipes.
3. If alignment requires deflection in excess of these limitations, provide special bends or sufficient number of shorter lengths of pipe to provide angular deflections within limits approved by Architect.
4. Laying:
  - a. Pipe bedding shall be Type 1 and Type 2 bedding meeting the requirements of MPWSS Standard Drawing 02221-2 to a depth of 24 inches below the bottom of the pipe.
  - b. Pipe laying shall proceed up-grade with spigot ends of bell-and-spigot pipe pointing in direction of flow.
  - c. Lay each pipe true to line and grade and in such manner as to form close concentric joint with adjoining pipe and to prevent sudden offsets of flow line.

- d. As work progresses, clear interior of pipe of dirt and superfluous materials. Where cleaning after laying is difficult because of small pipe, keep suitable swab or drag in pipe and pull forward past each joint immediately after jointing has been completed.
  - e. To mitigate the travel of water through pipe bedding, impermeable trench plugs are to be installed in utility trenches 10 feet from building and every 200 feet thereafter.
  5. Make joints between cast iron pipe and other types of pipe with standard manufactured cast-iron adapters and fittings.
  6. Valve, plug, or cap, as directed by Architect, where pipe ends are left for future connections.
- C. Cast Iron Pipe And Fittings:
1. Shape trench bottom to give substantially uniform circumferential support to lower third of each pipe. Provide depression under bell of each joint to maintain even bearing of sewer pipe.
  2. Connect to street main as required by local authorities.
  3. Use jacks to make-up gasketed joints.
- D. Thermoplastic Pipe And Fittings:
1. Install in accordance with Manufacturer's recommendations and ASTM D2321.
  2. Stabilize unstable trench bottoms.
  3. Bed pipe true to line and grade with continuous support from firm base.
    - a. Bedding depth: 4 to 6 inches (100 to 150 mm).
    - b. Material and compaction to meet ASTM standard noted above.
  4. Excavate bell holes into bedding material so pipe is uniformly supported along its entire length. Blocking to grade pipe is forbidden.
  5. Piping and joints shall be clean and installed according to Manufacturer's recommendations. Break down contaminated joints, clean seats and gaskets and reinstall.
  6. Do not use back hoe or power equipment to assemble pipe.
  7. Initial backfill shall be 12 inches (305 mm) above top of pipe with material specified in referenced ASTM standard.
  8. Minimum cover over top of pipe:
    - a. 36 inches (915 mm) before allowing vehicular traffic over pipe.
    - b. 48 inches (1 200 mm) before use of compaction equipment other than hand or impact tampers.

### 3.4 FIELD QUALITY CONTROL

- A. Non-Conforming Work:
1. Failure to install joints properly shall be cause for rejection and replacement of piping system at no additional cost to Owner.

**END OF SECTION**

**SECTION 33 4116****SITE STORM UTILITY DRAINAGE PIPING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Perform excavating and backfilling required for work of this Section.
  - 2. Furnish and install storm drainage system as described in Contract Documents from point of water collection to terminating point.
- B. Related Requirements:
  - 1. Section 31 2316: 'Excavation' for criteria for performance of excavation.
  - 2. Section 31 2323: 'Fill' for criteria for performance of backfill and compaction.

**1.2 REFERENCES**

- A. Reference Standards:
  - 1. American Association Of State Highway And Transportation Officials:
    - a. AASHTO M 252-09 (2012), 'Standard Specification for Corrugated Polyethylene Drainage Pipe'.
    - b. AASHTO M 294-15, 'Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter'.
  - 2. ASTM International:
    - a. ASTM A74-15, 'Standard Specification for Cast Iron Soil Pipe and Fittings'.
    - b. ASTM A536-84(2015), 'Standard Specification for Ductile Iron Castings'.
    - c. ASTM A929/A929M-01(2013), 'Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe'.
    - d. ASTM C14-15a, 'Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe'.
    - e. ASTM C14M-15a, 'Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe (Metric)'.
    - f. ASTM C76-15a, 'Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe'.
    - g. ASTM C564-14, 'Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings'.
    - h. ASTM D2321-14, 'Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications'.
    - i. ASTM D3034-15, 'Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings'.
    - j. ASTM D3212-07(2013), 'Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals'.
    - k. ASTM F794-03(2014), 'Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter'.
    - l. ASTM F1336-15, 'Standard Specification for Poly (Vinyl Chloride) (PVC) Gasketed Sewer Fittings'.
  - 3. Cast Iron Soil Pipe Institute:
    - a. CISPI 301-09, 'Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications'.
    - b. CISPI 310-11, 'Standard Specification for Couplings for use in connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications'.
    - c. CISPI Handbook. 'Cast Iron Soil Pipe and Fittings Handbook' (2006).
  - 4. International Code Council:

- a. ICC IPC, '2015 International Plumbing Code'.

## PART 2 - PRODUCTS

### 2.1 SYSTEM

#### A. Materials:

1. Bedding Material: **3/8 inch (9.5 mm)** crushed gravel.
2. Catch Basins, Curb Inlets, Etc:
  - a. Concrete:
    - 1) Construct of **4000 psi (27.57 MPa)** minimum concrete.
    - 2) Include cover inlet with cast iron frame and grate as shown on Drawings.
  - b. PVC:
    - 1) Comply with requirements of ASTM D3212, ASTM F794, and ASTM F1336.
    - 2) Metal grates, Frames, and hoods shall comply with ASTM A536, Grade 70-50-05.
    - 3) Type One Acceptable Products:
      - a) Nyloplast-ADS, Buford, GA (866) 888-8479. [www.nyloplast-us.com](http://www.nyloplast-us.com).
      - b) Equal as approved by Architect before bidding. See Section 01 6200.
3. Concrete Pipe:
  - a. Non-Reinforced: Meet requirements of ASTM C14 or ASTM C14M.
  - b. Reinforced:
    - 1) Meet requirements of ASTM C76, plain end.
    - 2) Determine class of pipe by depth of cover over pipe at rough-graded elevations as follows:
 

a) Depth Of Cover	Class Of Pipe
b) Under <b>2 feet</b>	V
c) <b>2 feet to 3</b>	IV
d) <b>3 feet to 6 feet</b>	III
e) Over <b>6 feet</b>	II
4. PVC Pipe And Fittings:
  - a. Meet requirements of ASTM D3034, SDR 35.
  - b. Fittings: Slip Joint type with elastomeric seals.
5. Fittings: Slip Joint type with elastomeric seals.
6. Corrugated Polyethylene Pipe And Fittings:
  - a. Meet requirements of AASHTO M 252 or AASHTO M 294, Type S.
    - 1) Corrugated, helical or annular, exterior with smooth interior and gasketed connectors.
    - 2) Corrugated, annular, with silt and watertight joints for storm sewers.
7. Corrugated Metal Pipe:
  - a. Meet requirements of ASTM A929/A929M.
  - b. **16-ga (1.6 mm)**, standard round, galvanized with **2 oz (56.7 g)** zinc per **sq ft (0.0929 sq m)** sheet steel.
  - c. Corrugations:
    - 1) **6 to 10 Inch (150 to 255 mm)** Pipe: **1-1/2 by 1/4 inch (38 by 6 mm)** depth helical corrugations.
    - 2) **12 to 60 Inch (300 to 1 500 mm)** Pipe: **2-2/3 by 1/2 inch (17 by 12.7 mm)** depth helical corrugations.
8. Cast Iron Soil Pipe And Fittings:
  - a. Meet requirements of ASTM A74.
  - b. Joint Material: Rubber gaskets meeting requirements of ASTM C564 and compatible with pipe used.
9. Subsurface Stormwater Management.
  - a. Manufacturers:
    - 1) Pipe Systems for use in non-pressure gravity flow storm water collection systems utilizing continuous outfall structure.
    - 2) Type One Acceptable Systems:
      - a) Landmax Storm Water Management System, Hancor (Retention/Detention) Hancor, Inc. [www.hancor.com](http://www.hancor.com).
      - b) Equal as approved by Architect before bidding. See Section 01 6200.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Excavate and backfill as specified in Section 31 2316 and Section 31 2323 with following additional requirements:
  - 1. Runs shall be as close as possible to those shown on Contract Documents.
  - 2. Excavate to required depth.
  - 3. Grade to obtain fall required.
  - 4. Remove debris from trench before laying bedding and pipe.
  - 5. Do not cut trenches near footings without consulting Architect.
  - 6. Backfill only after pipe lines have been tested, inspected, and approved by Architect/Engineer.

### **3.2 INSTALLATION**

- A. Concrete Pipe:
  - 1. Provide **3 inches (75 mm)** of uncompacted bedding material below pipe.
  - 2. After installation of pipe, provide additional bedding material up to springline of pipe.
- B. PVC / Polyethylene Pipe:
  - 1. Install in accordance with ASTM D2321.
  - 2. Minimum cover for corrugated polyethylene pipe and fittings shall be **12 inches (300 mm)** for H-20 load.
  - 3. Pipe bedding shall be Type 1 and Type 2 bedding meeting the requirements of MPWSS Standard Drawing 02221-2 to a depth of 24 inches below the bottom of the pipe.
  - 4. To mitigate the travel of water through pipe bedding, impermeable trench plugs are to be installed in utility trenches 10 feet from building and every 200 feet thereafter.
- C. Use jacks to make-up gasketed joints.

### **3.3 FIELD QUALITY CONTROL**

- A. Non-Conforming Work:
  - 1. Failure to install joints properly shall be cause for rejection and replacement of piping system at no additional cost to Owner.

### **3.4 CLEANING**

- A. Remove excess earth from site or place as directed by Architect.

**END OF SECTION**

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**SECTION 33 5100****NATURAL-GAS DISTRIBUTION****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Perform excavation and backfill required for work of this Section.
  - 2. Furnish and install gas piping and fittings as described in Contract Documents from gas main to meter.
  - 3. Provide, make necessary arrangements for, and pay necessary fees to local gas utility company for gas service lines and proper size gas meter.
- B. Related Requirements:
  - 1. Section 03 3053: 'Miscellaneous Cast-In-Place Concrete' for concrete meter base.
  - 2. Section 05 0523: 'Metal Fastening' for welding standards and requirements.
  - 3. Section 31 2316: 'Excavation' for procedure and quality of excavating.
  - 4. Section 31 2323: 'Fill' for procedure and quality of backfilling and compacting.

**1.2 REFERENCES**

- A. Reference Standards:
  - 1. ASTM International:
    - a. ASTM A53/A53M-10, 'Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.'
    - b. ASTM A234/A234-11, 'Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.'
    - c. ASTM D2513-11e1, 'Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.'

**1.3 SUBMITTALS**

- A. Informational Submittals:
  - 1. Certificates:
    - a. Welder certificates certifying welders comply with requirements specified under Quality Assurance Article of this Section.

**1.4 QUALITY ASSURANCE**

- A. Regulatory Agency Sustainability Approvals:
  - 1. Lay underground pipe in accordance with federal pipeline safety regulations and local gas utility company regulations and specifications.
- B. Qualifications: Requirements of Section 01 4301 applies, but not limited to following:
  - 1. Polyethylene Pipe Installers:
    - a. Properly trained and certified in procedure for joining polyethylene pipe.
  - 2. Welders:
    - a. Certified and bear evidence of certification 30 days before commencing work on project.
    - b. If there is doubt as to proficiency of welder, Owner's Representative may require welder to take another test.
    - c. This shall be done at no cost to Owner.
    - d. Certification shall be by Pittsburgh Testing Laboratories or other approved authority.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Storage And Handling Requirements:
  - 1. Do not store polyethylene pipe so it is exposed to sunlight.

## PART 2 - PRODUCTS

### 2.1 COMPONENTS

- A. Above-Ground Pipe And Fittings:
  - 1. Black carbon steel, butt welded, Schedule 40 pipe meeting requirements of ASTM A53/A53M.
  - 2. Welded forged steel fittings meeting requirements of ASTM A234/A234M.
- B. Below-Ground Pipe And Fittings:
  - 1. Polyethylene pipe and fittings meeting requirements of ASTM D2513 with No. 14 coated copper tracer wire.
- C. Valves:
  - 1. Iron body, 125 psi (862 kPa) square head cock, with bronze plug.
  - 2. Class One Quality Standard: Powell No. 2200:
    - a. Crane Valves, Long Beach, CA [www.cranevalve.com](http://www.cranevalve.com) or Crane Canada Inc, Plumbing Div, Montreal, QB (514) 735-3592.
    - b. The Powell Co, Cincinnati, OH [www.powellvalves.com](http://www.powellvalves.com).
    - c. Stockham Valve, Birmingham. AL [www.stockham.com](http://www.stockham.com).

## PART 3 - EXECUTION

### 3.1 INSTALLATION

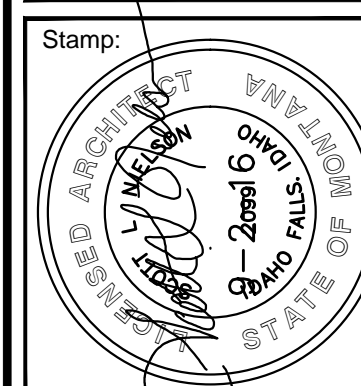
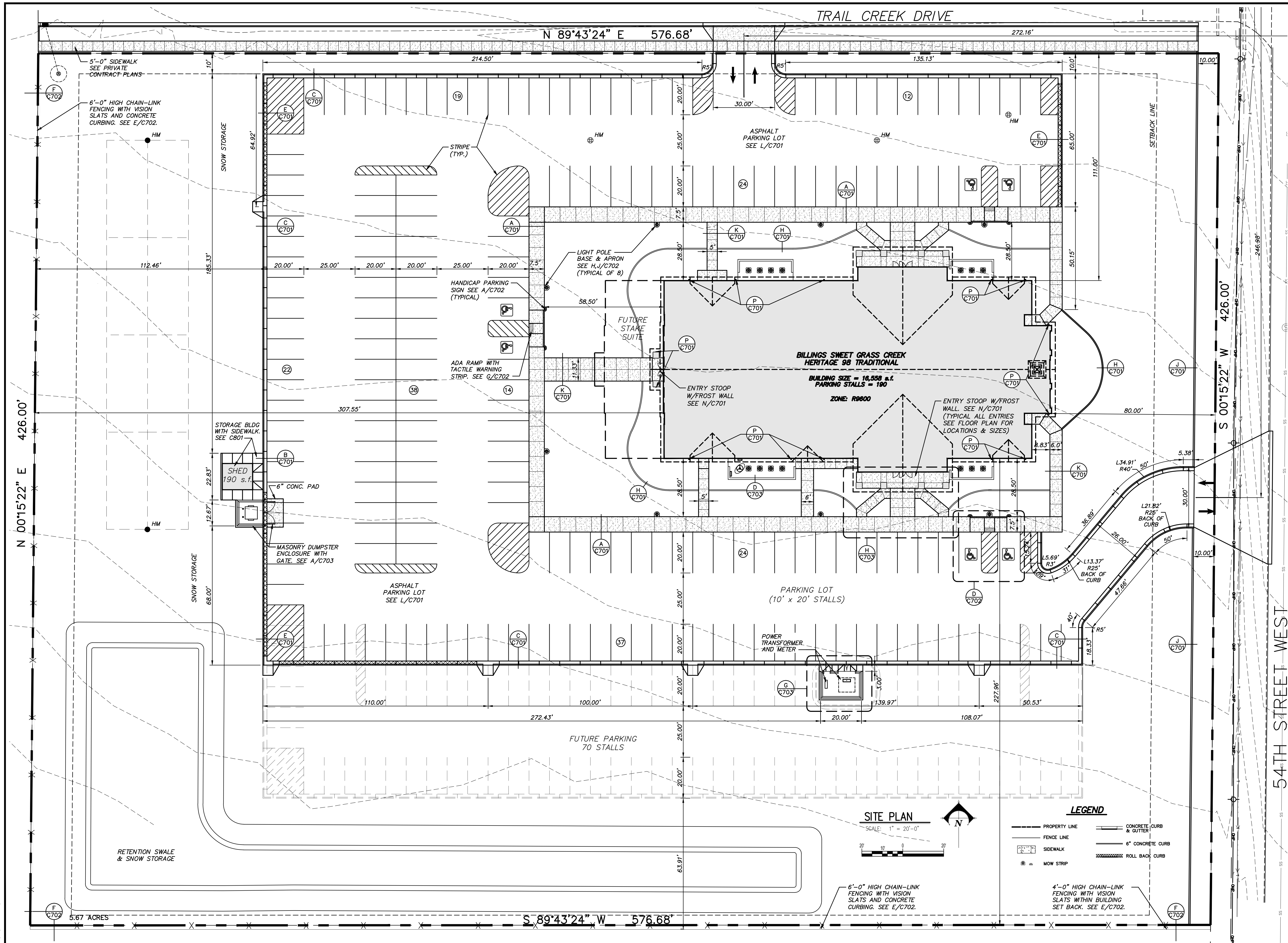
- A. Excavate and backfill as specified in Section 31 2316 and 31 2323 with following additional requirements:
  - 1. Runs shall be as close as possible to those shown on Drawings.
  - 2. Excavate to required depth.
  - 3. Bottom of trenches shall be hard. Tamp as required.
  - 4. Remove debris from trench before laying pipe.
  - 5. Do not cut trenches near footings without consulting Architect.
  - 6. Place 4 inches (100 mm) of sand around pipe before trench is backfilled.
  - 7. Bury outside pipe 12 inches (300 mm) minimum below frost line or 18 inches (450 mm) minimum below finish grade, whichever is deeper.
  - 8. Backfill only after pipe lines have been tested, inspected, and approved by Architect.
- B. General installation shall be as specified in Division 23:
  - 1. Steel pipe 2-1/2 inches (64 mm) and larger shall have welded fittings and joints.
  - 2. Provide 24 inch (600 mm) minimum steel pipe between vertical rise of riser and end of polyethylene line if anode-less riser is not used. Use plastic-to-steel transition or compression fitting between end of service line and steel meter riser. Provide cathodic protection for steel riser or use anode-less riser.
  - 3. Place tracer wire along side of polyethylene pipe from meter to main.
- C. Set meter on concrete base.

### 3.2 PROTECTION

- A. Provide necessary protection against damage for meter.

**END OF SECTION**

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Billings Sweet Grass Creek  
Heritage 98  
Billings Montana Stake  
2620 54th Street W.  
Billings, Montana 59106

Project for:

THE CHURCH OF  
**JESUS CHRIST**  
OF LATTER-DAY SAINTS

x	x	x	x	x	x	x
x	x	x	x	x	x	x

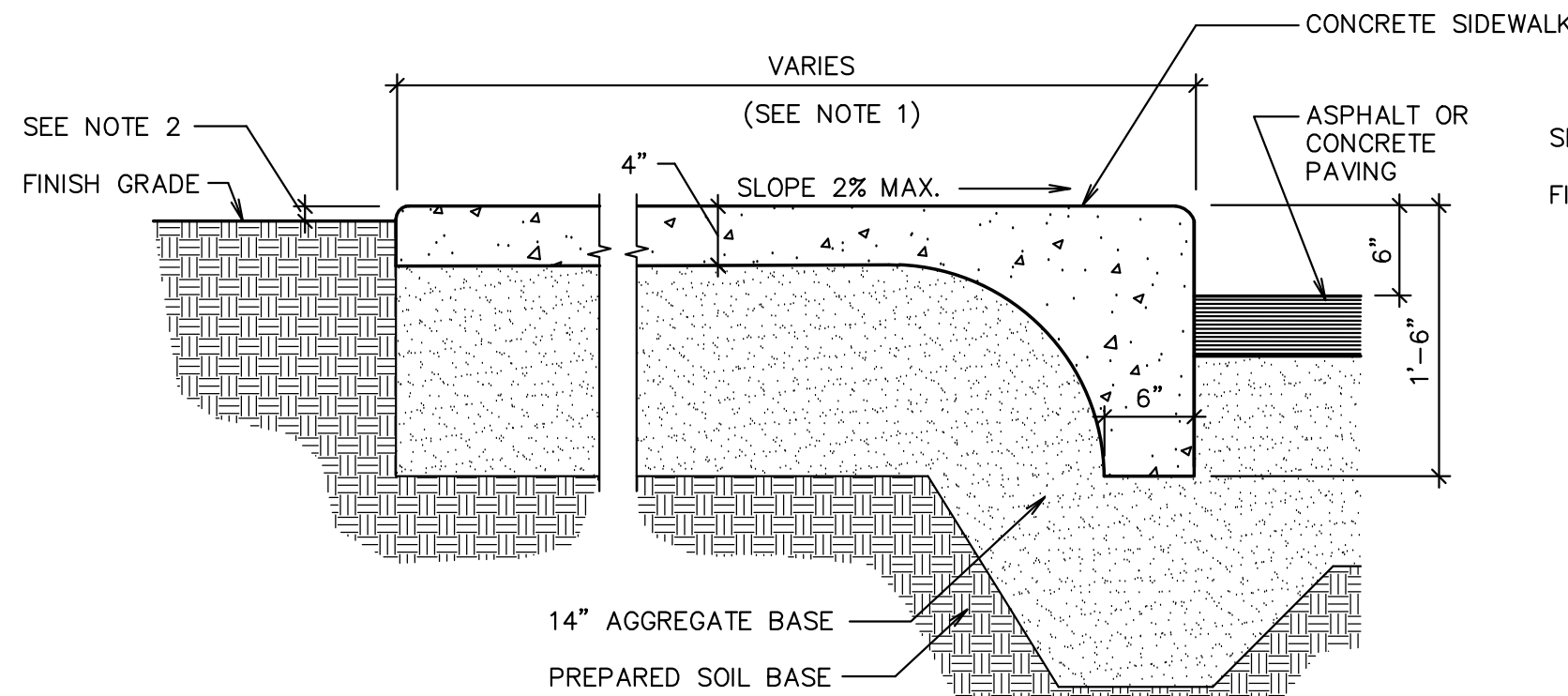
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Plan Series: HER-TRA-98-20
Property Number: 501-1850

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HORIZONTAL  
CONTROL

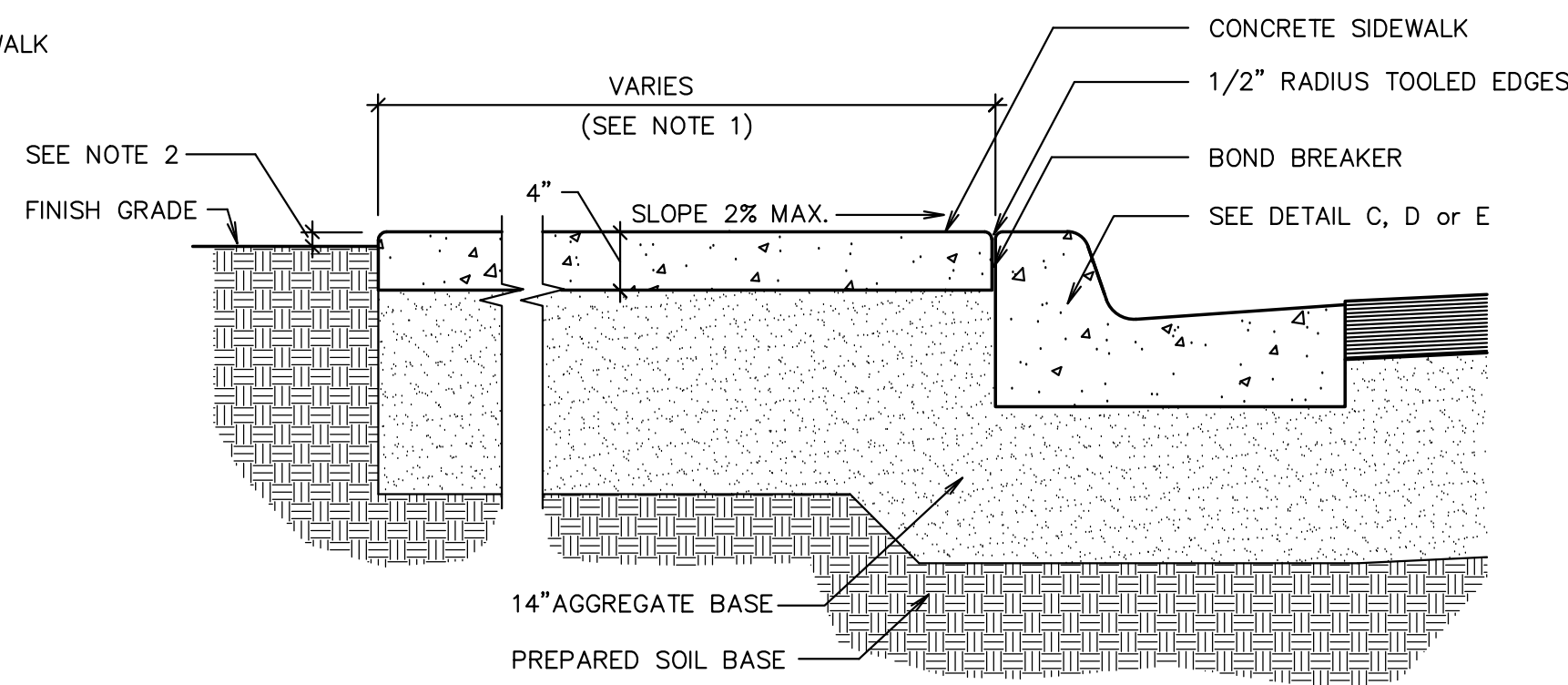
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## GENERAL NOTES

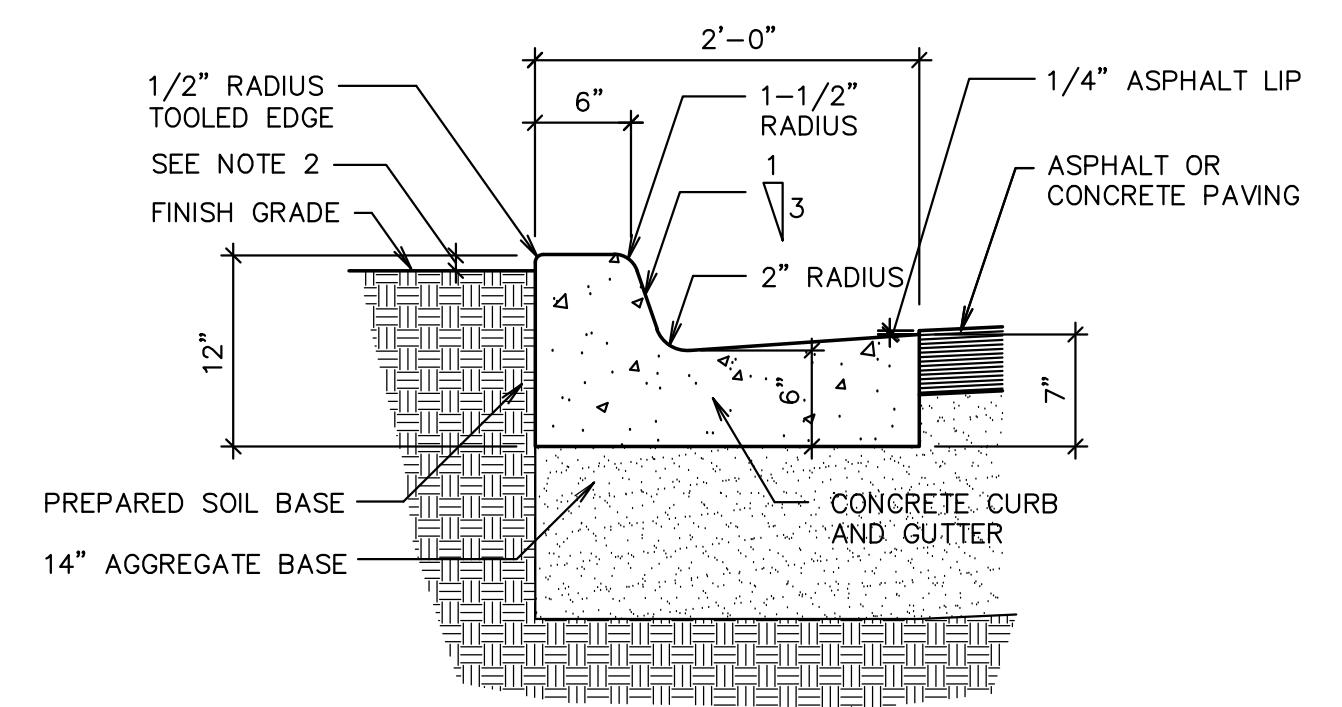
- SEE SITE PLAN FOR APRON, MOW STRIP AND SIDEWALK LOCATIONS AND WIDTHS.
- 1" PRIOR TO SEEDING, 2" PRIOR TO SODDING AND 4" IN PLANTING AREAS.
- EXPANSION JOINT MATERIAL SHALL BE RECESSED 1/4" WHERE SEALANT IS NOT APPLIED, AND 1/2" WHERE SEALANT IS APPLIED.
- EXTERIOR CONCRETE - USE 4,500 PSI. MIN. TYPE D IF EXPOSED TO FREEZING AND/OR DE-ICERS, 3,000 PSI. MIN. TYPE A OTHERWISE.
- CONTRACTOR TO INSTALL EXPANSION AND CONTRACTION JOINTS AS REQUIRED PER THE SPECIFICATIONS.
- ALL AGGREGATES SHALL SATISFY ASTM AND DEPARTMENT OF TRANSPORTATION STRENGTH AND DURABILITY REQUIREMENTS. GRANITE AGGREGATES ARE PREFERRED BUT HIGH QUALITY LIMESTONE AGGREGATES ARE ACCEPTABLE. SEE SPECIFICATION



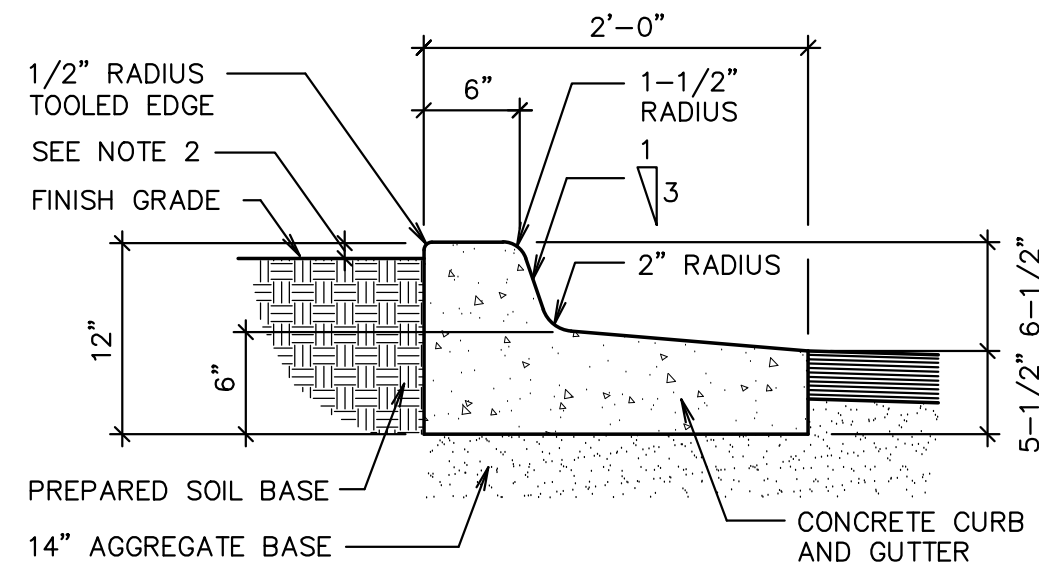
**A** INTEGRAL SIDEWALK & CURB  
1" = 1'-0"



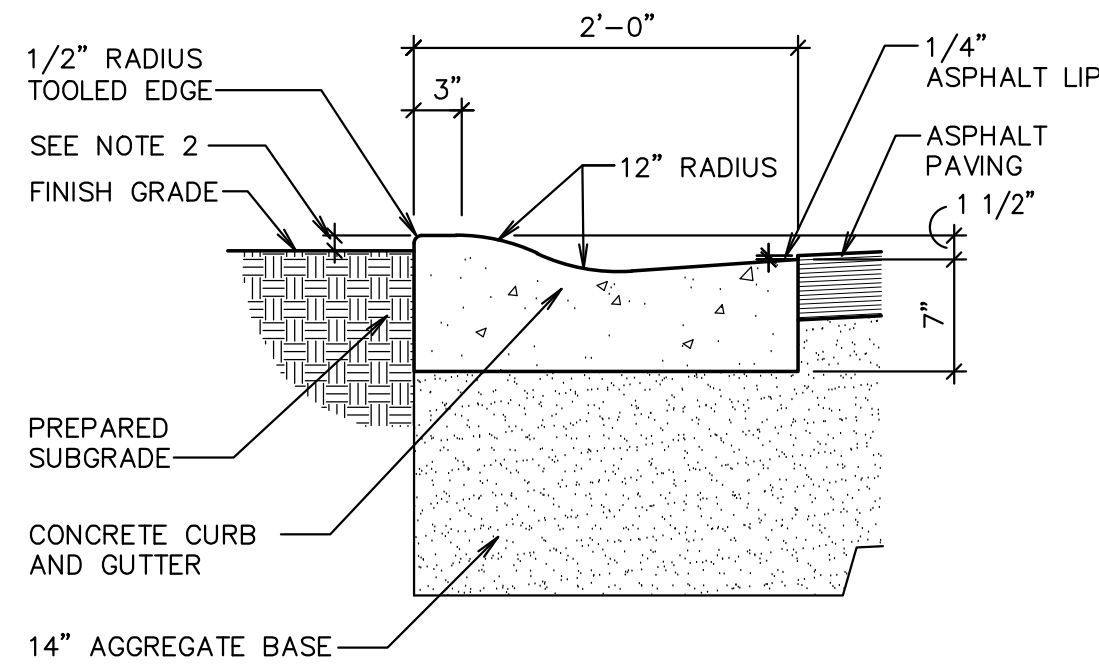
**B** SIDEWALK, CURB AND GUTTER  
1" = 1'-0"  
AT SHED



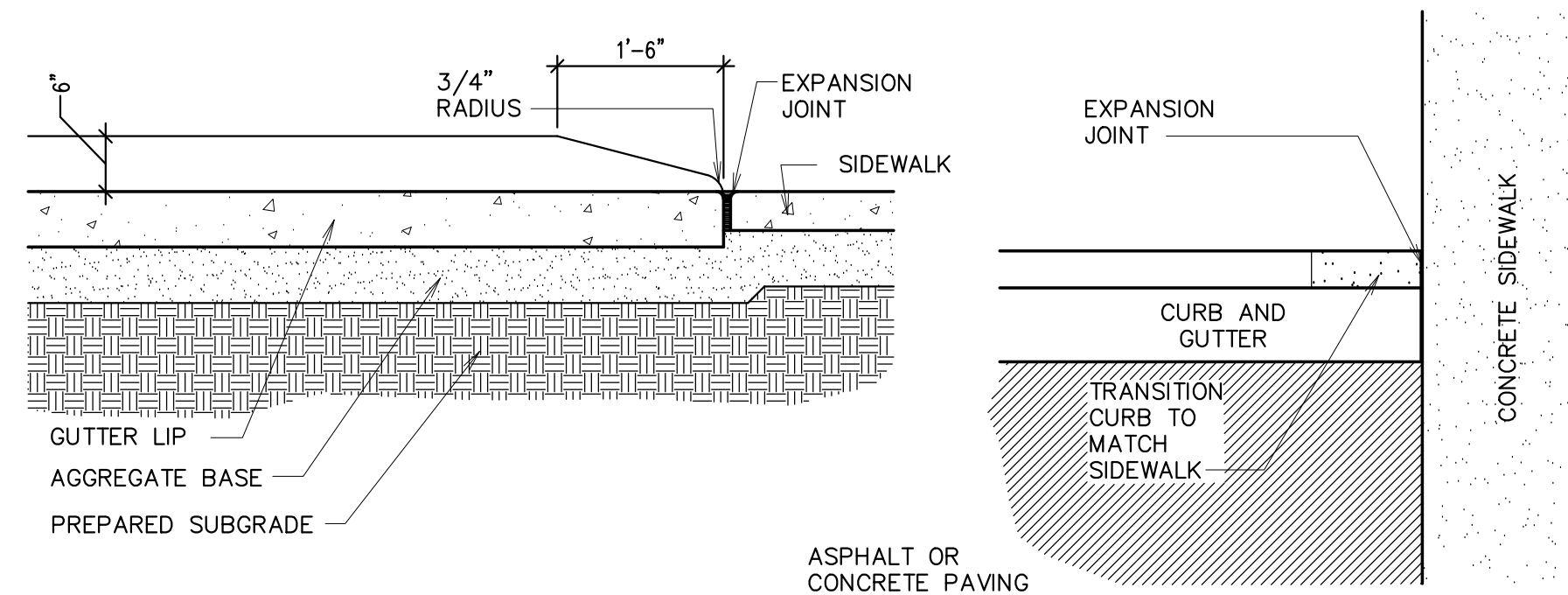
**C** CURB AND GUTTER  
1" = 1'-0"  
FOR USE WHERE WATER DRAINS TOWARD CURB



**D** OPEN FACE CURB AND GUTTER  
1" = 1'-0"  
FOR USE WHERE WATER DRAINS AWAY FROM CURB

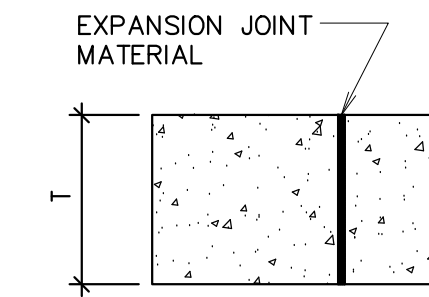


**E** ROLL BACK CURB AND GUTTER  
1" = 1'-0"

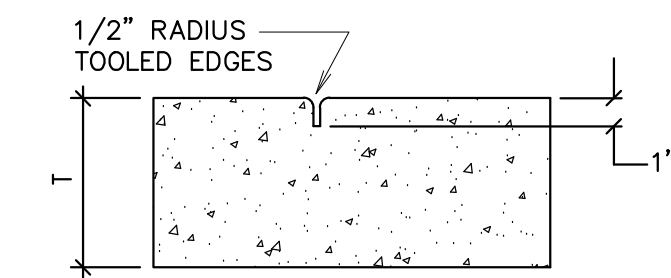


**F** SECTION

**F** PLAN



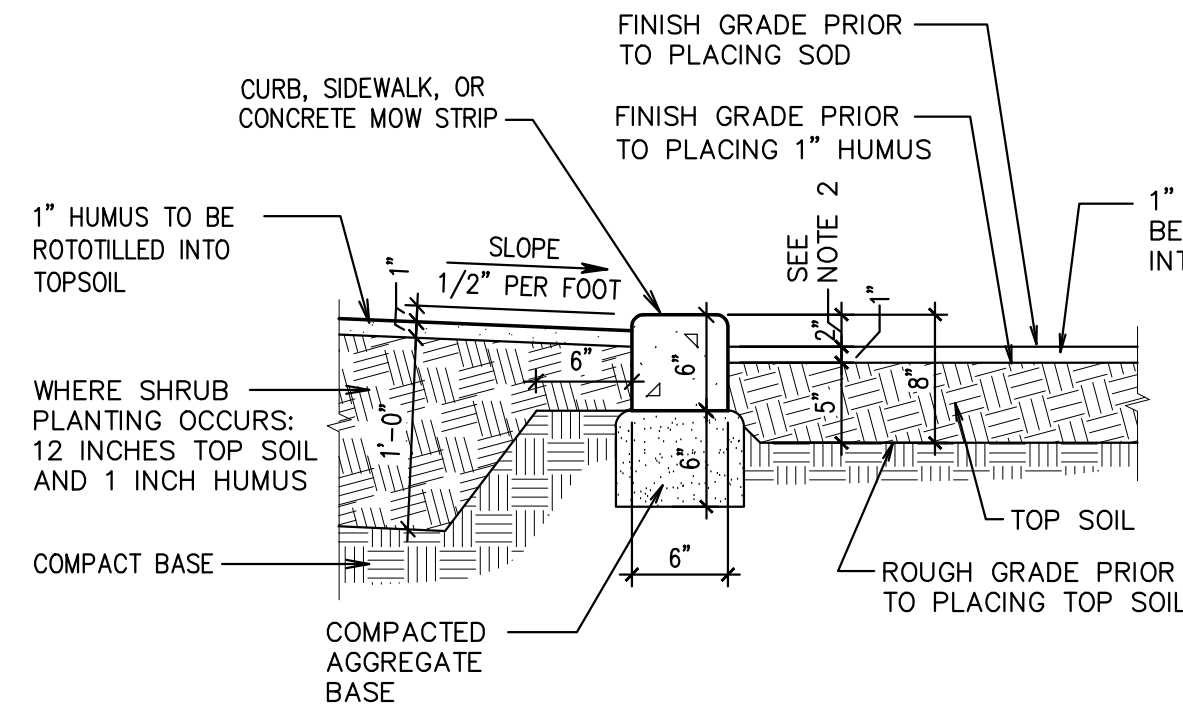
**G** TYPICAL EXPANSION JOINT  
(SIDEWALK, CURB AND GUTTER, MOWSTRIP, APRON AND FLAT DRAINAGE STRUCTURES)



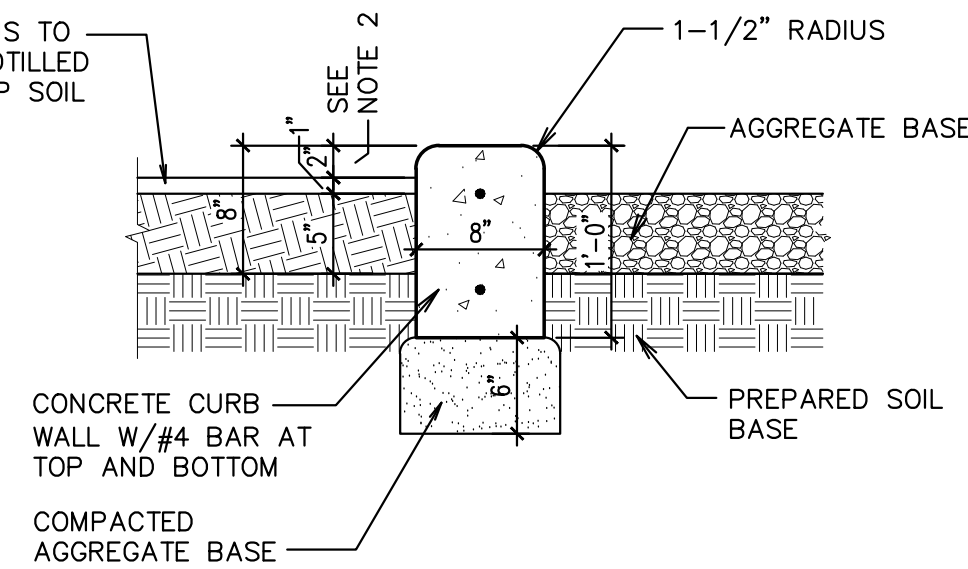
**H** TYPICAL CONTROL JOINT  
(SIDEWALK, CURB AND GUTTER, MOWSTRIP, APRON AND FLAT DRAINAGE STRUCTURES)

**F** CURB TRANSITION  
Not to Scale

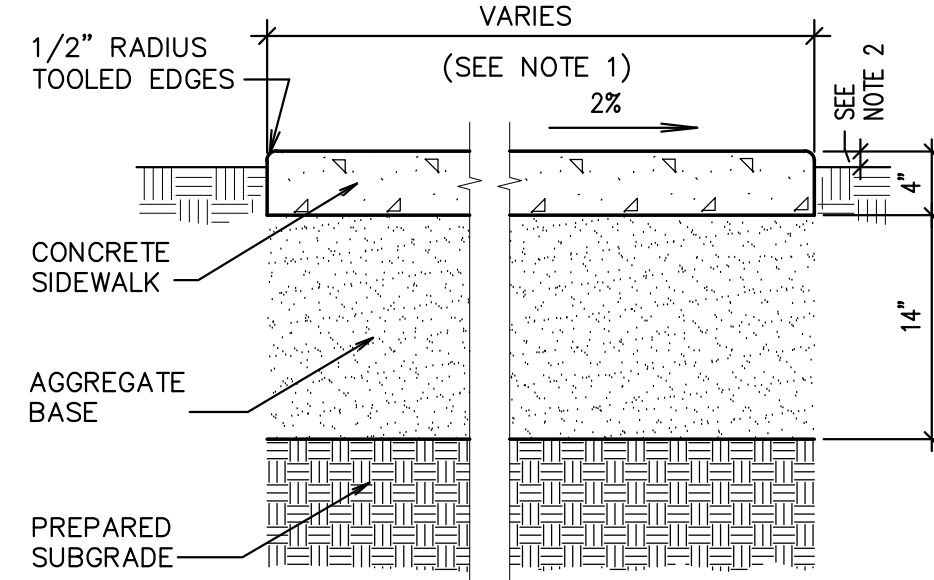
**G** EXPANSION AND CONTROL JOINT  
Not to Scale



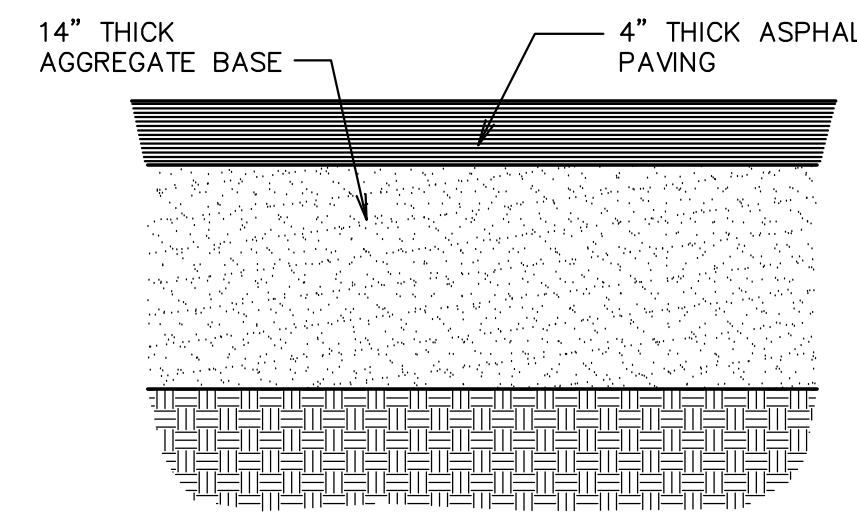
**H** SHRUB PLANTING AREAS - SOIL PROFILE  
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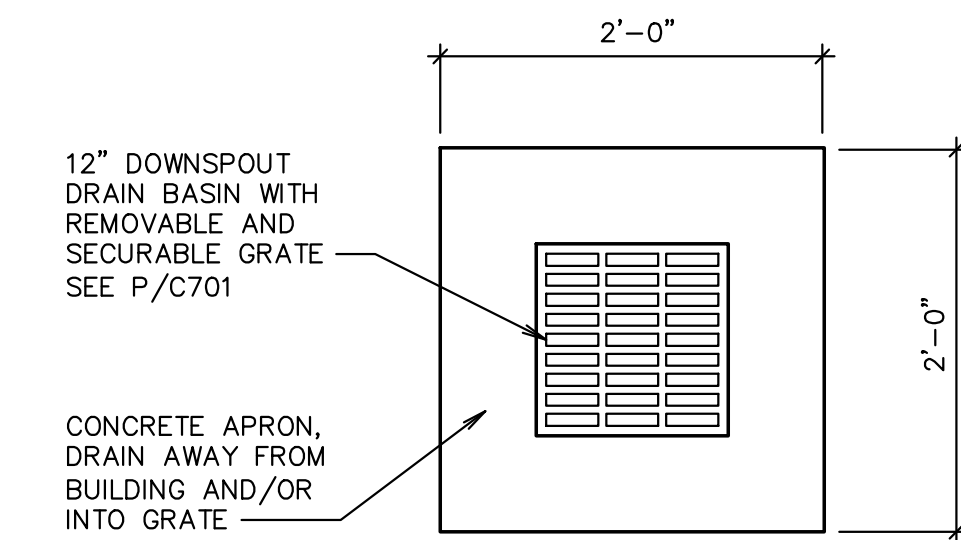
**J** CURB WALL  
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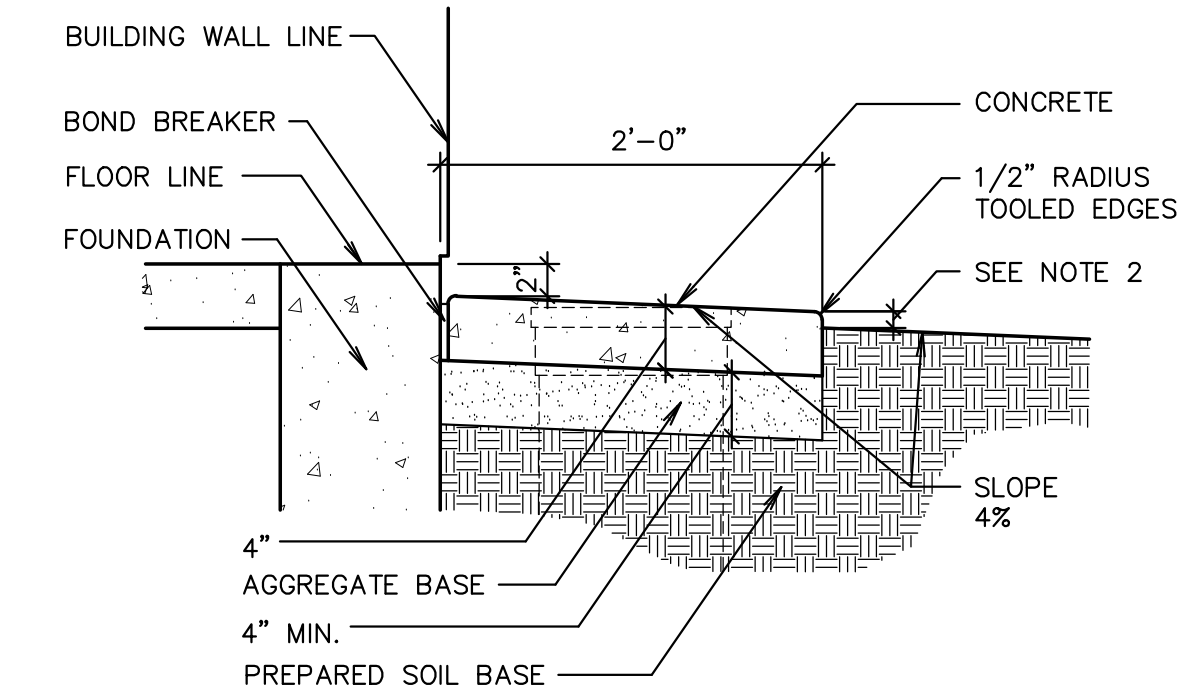
**K** SIDEWALK DETAIL  
1" = 1'-0"



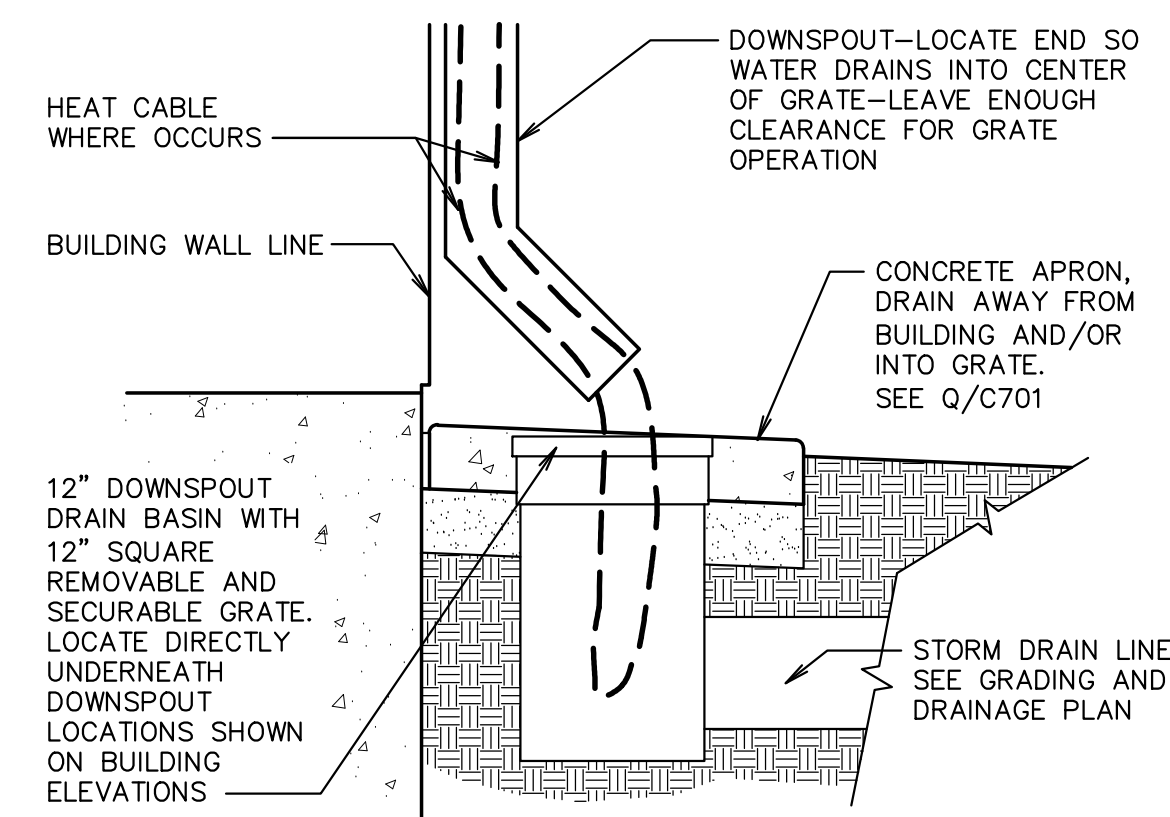
**L** ASPHALT PAVING  
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**M** PLAN VIEW



**N** SECTION



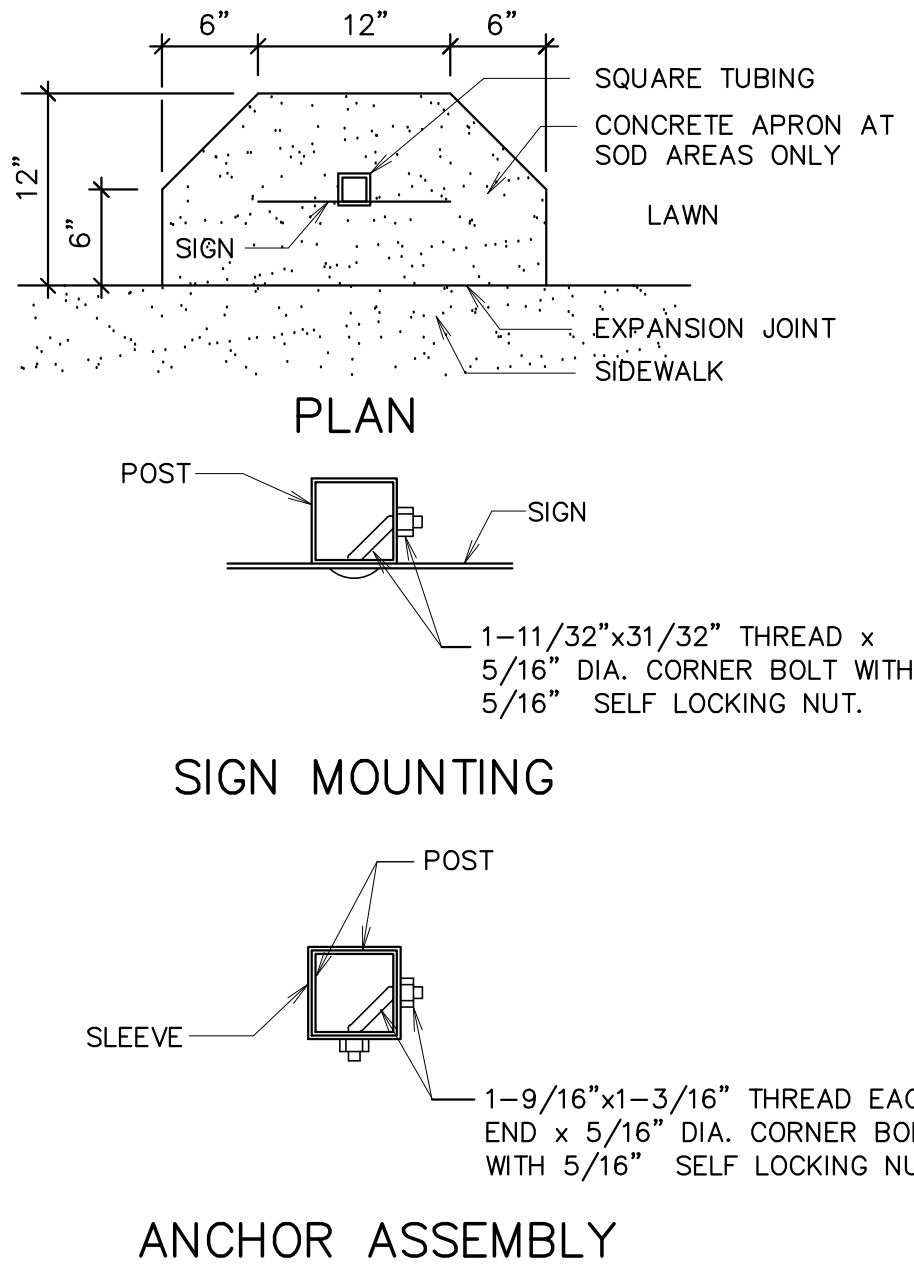
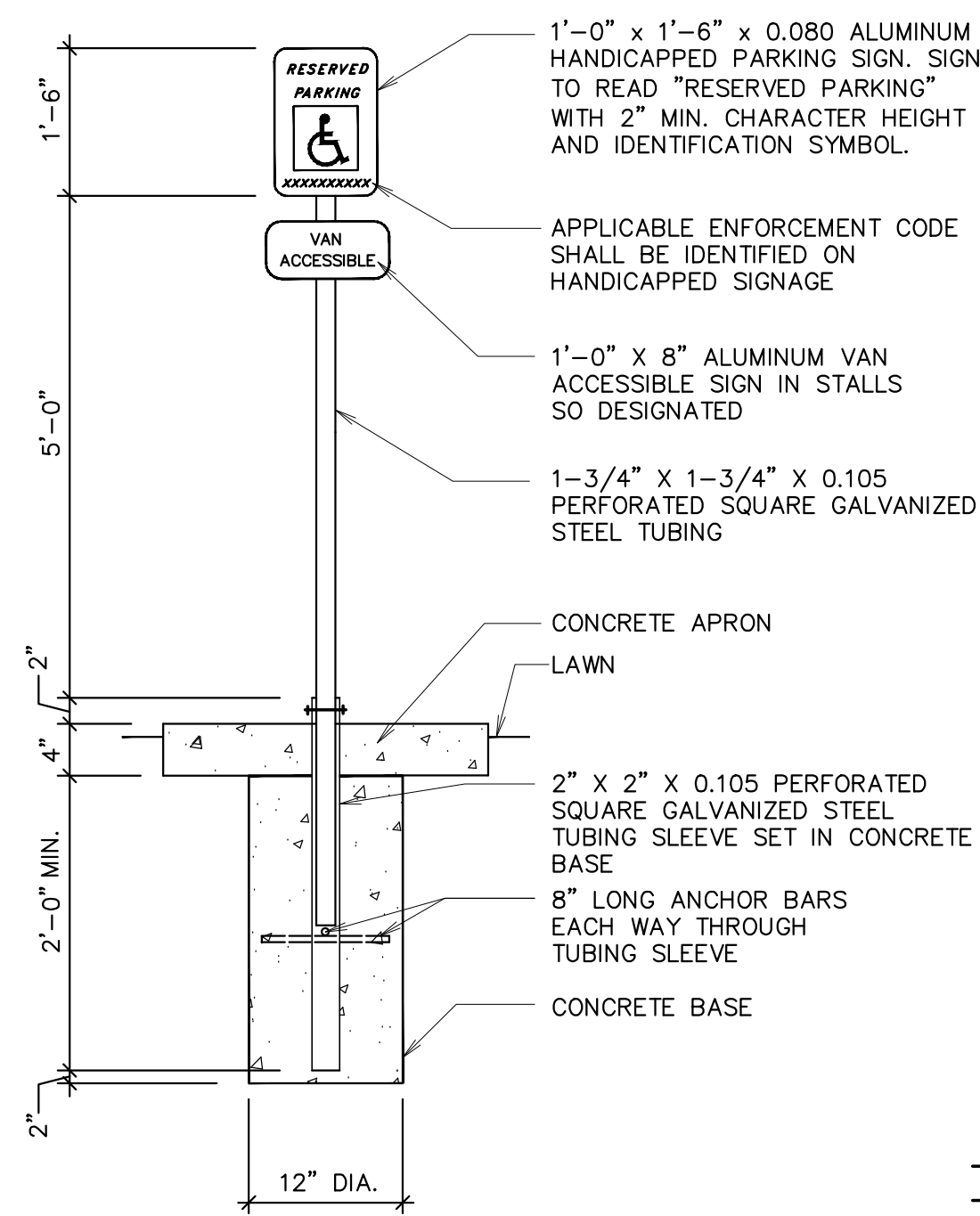
**P** DOWNSPOUT AND CATCH BASIN DETAIL  
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**Q** CATCH BASIN CONCRETE COLLAR  
1" = 1'-0"

**M** MOW STRIP  
1" = 1'-0"

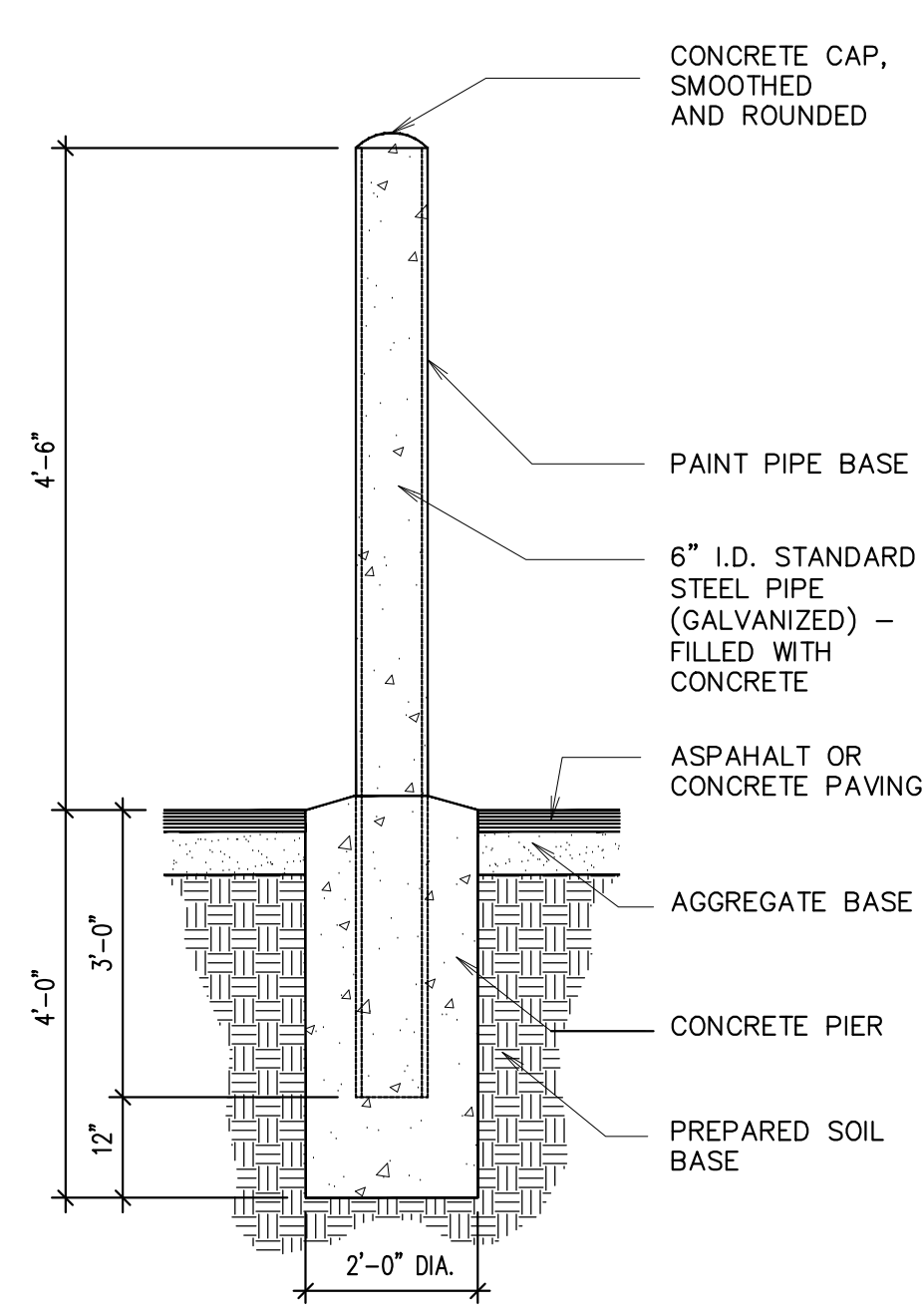
**N** ENTRY STOOP  
1" = 1'-0"



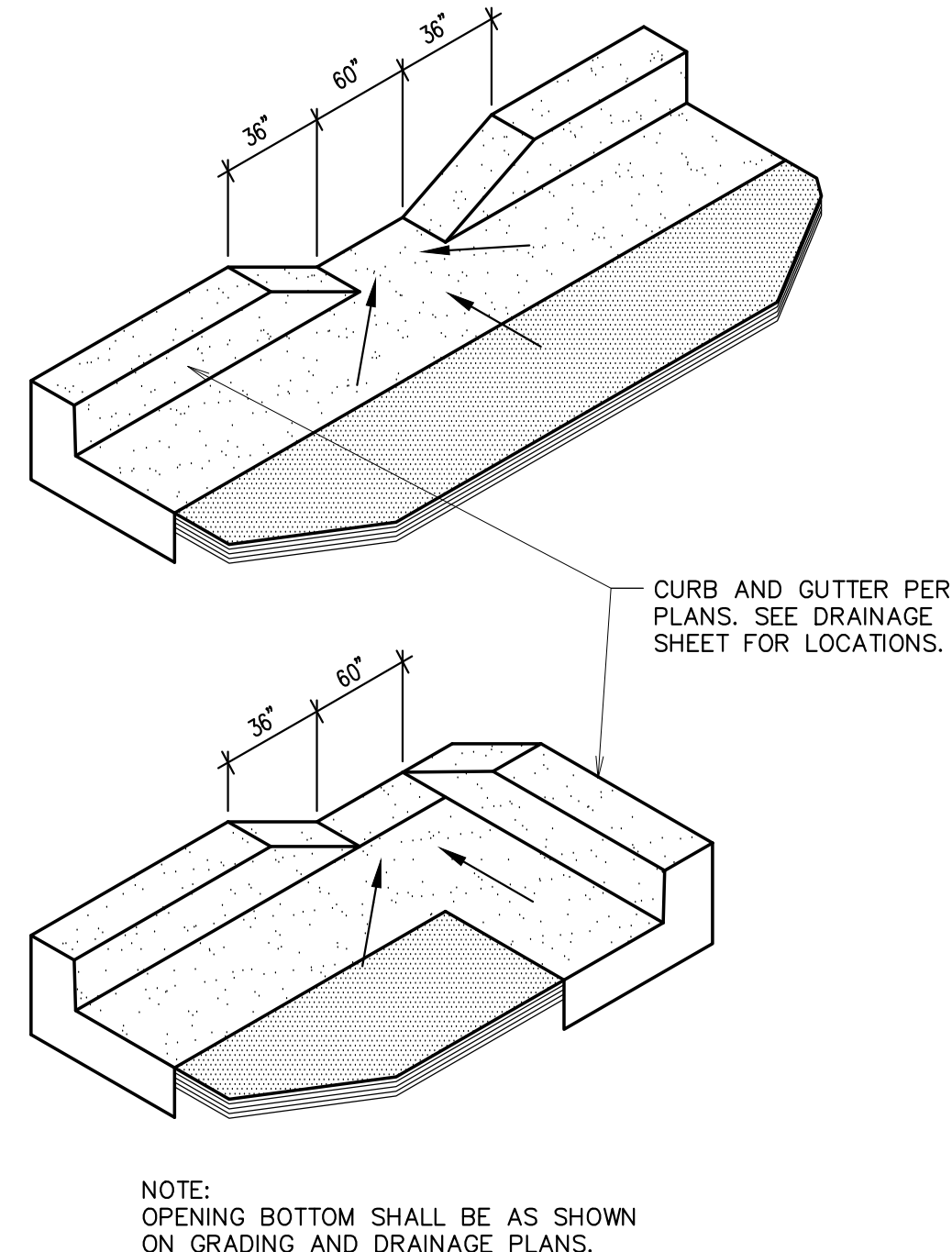


TYPICAL HANDICAPPED PARKING SIGN MOUNTING AND ANCHOR

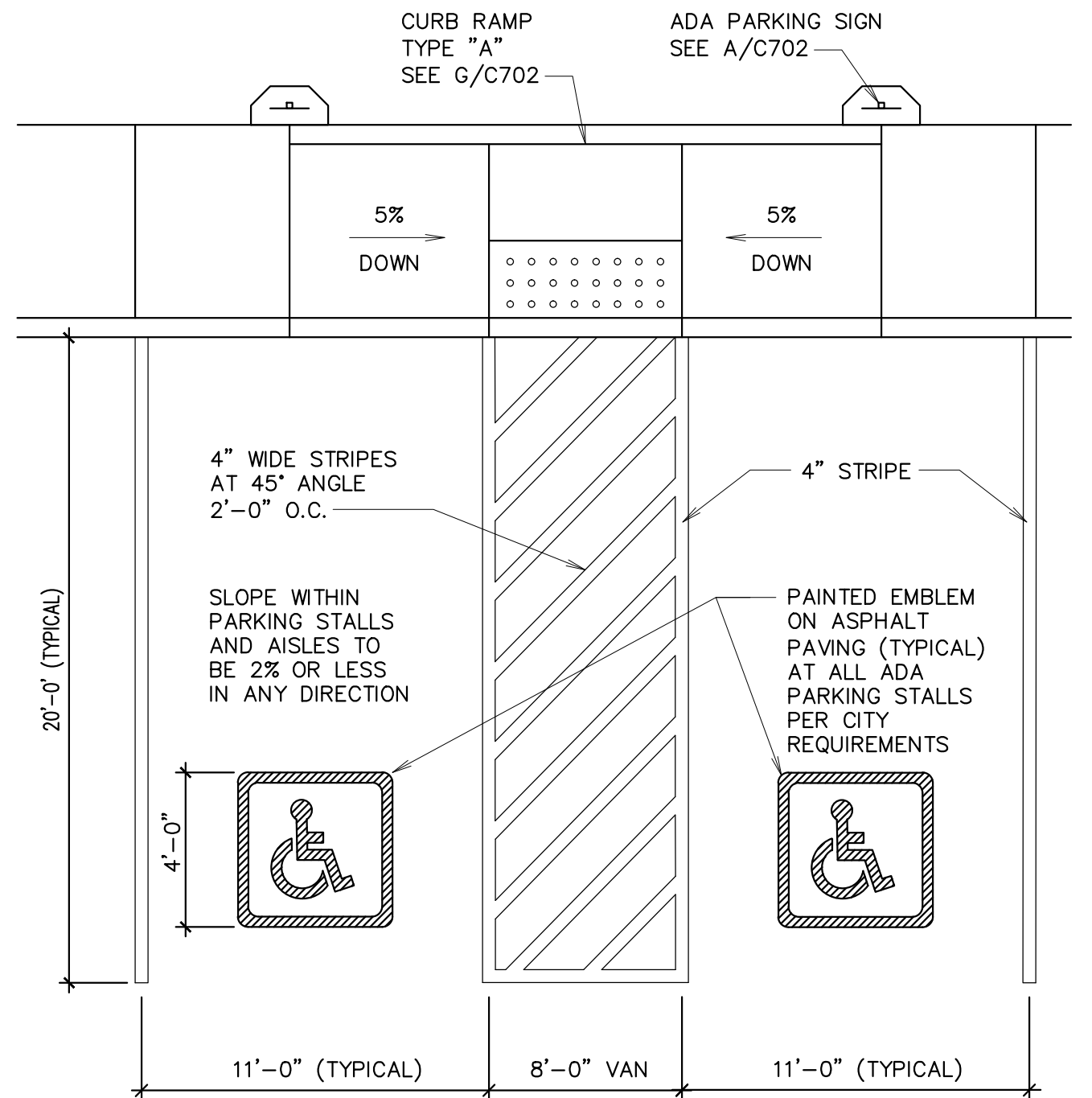
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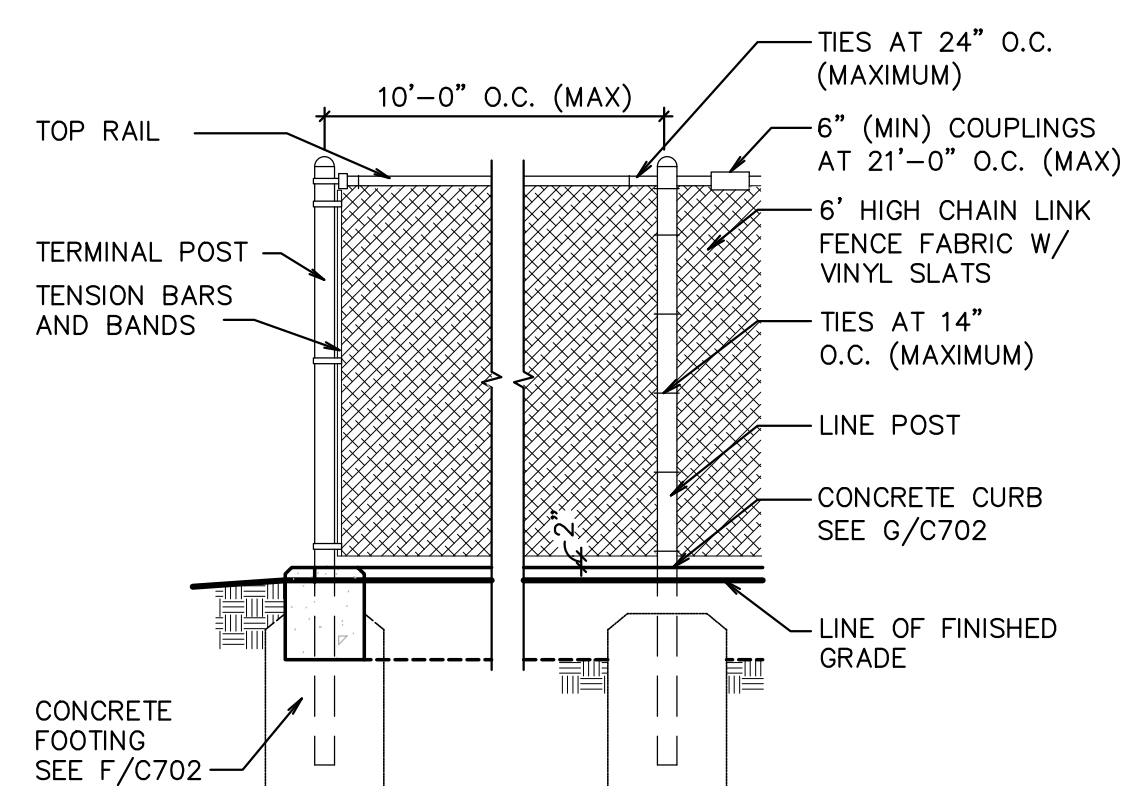
B CONCRETE BOLLARD  
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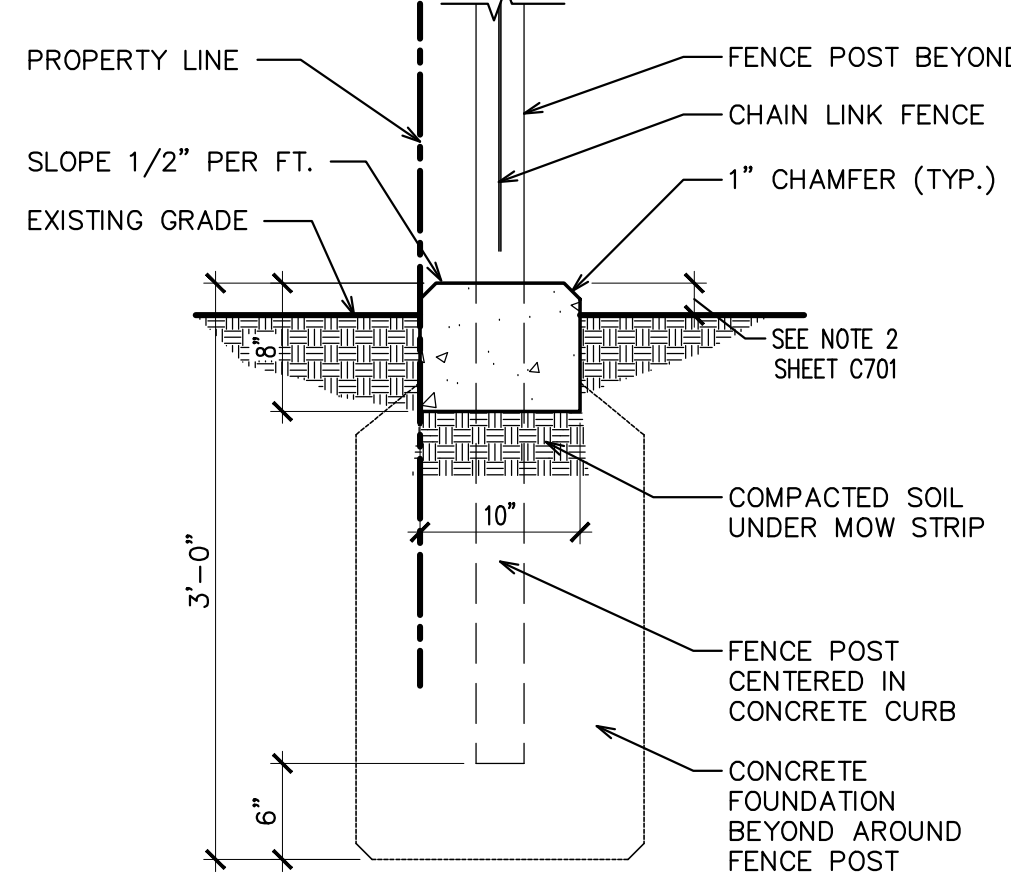
C CURB OPENING  
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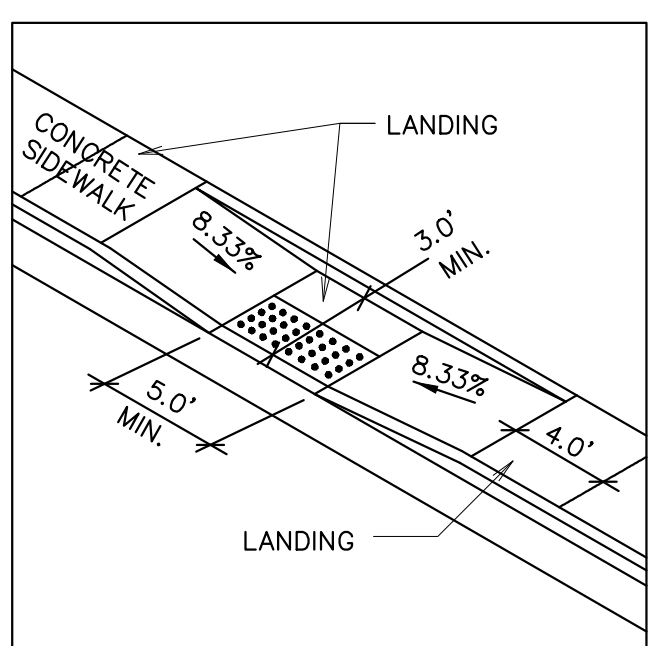
D ACCESSIBLE PARKING  
Not to Scale (SEE ANSI A117.1)



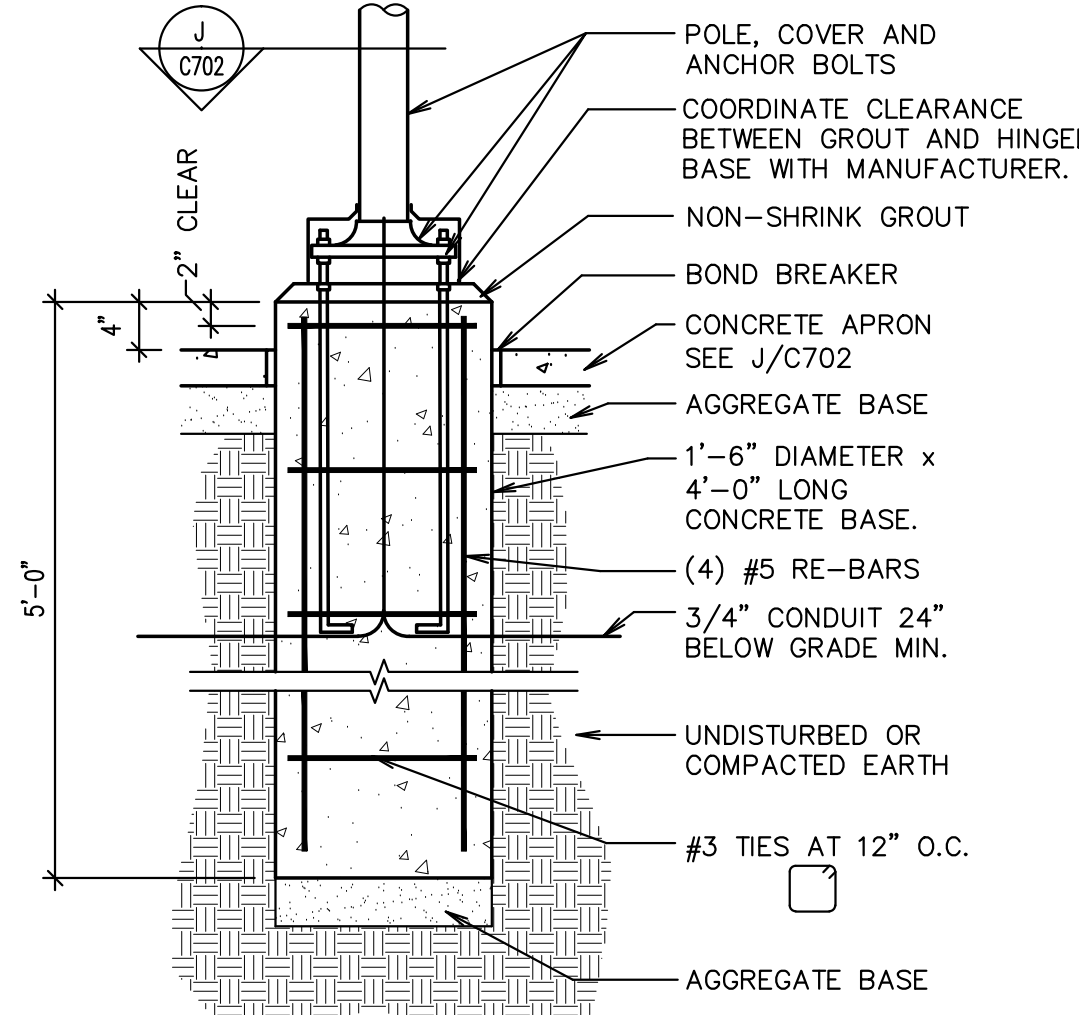
E FENCE DETAIL  
Not to Scale



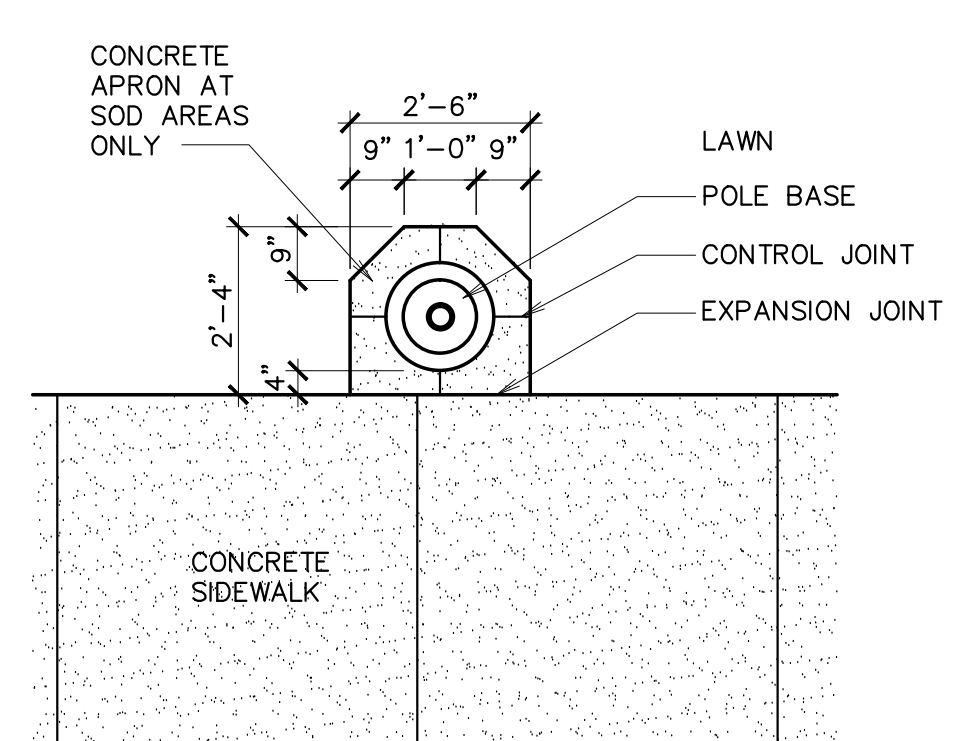
F MOW STRIP AT FENCE DETAIL  
1" = 1'-0"



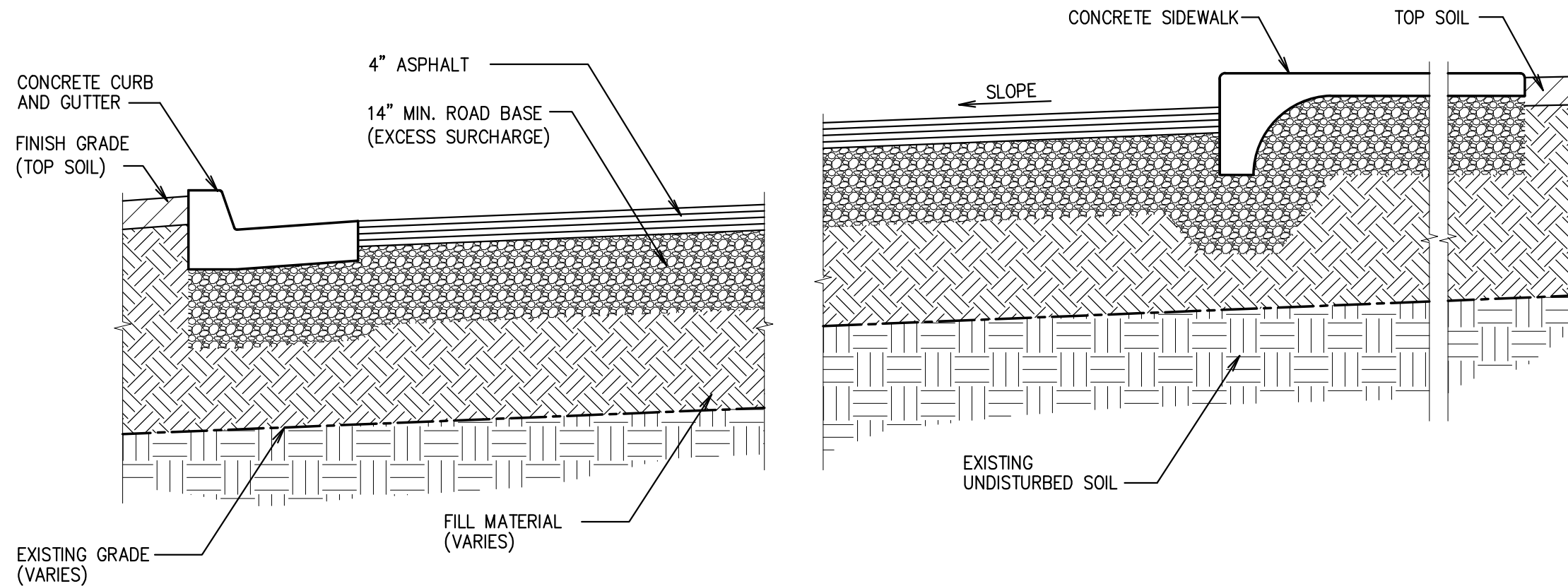
G CURB RAMP  
Not to Scale



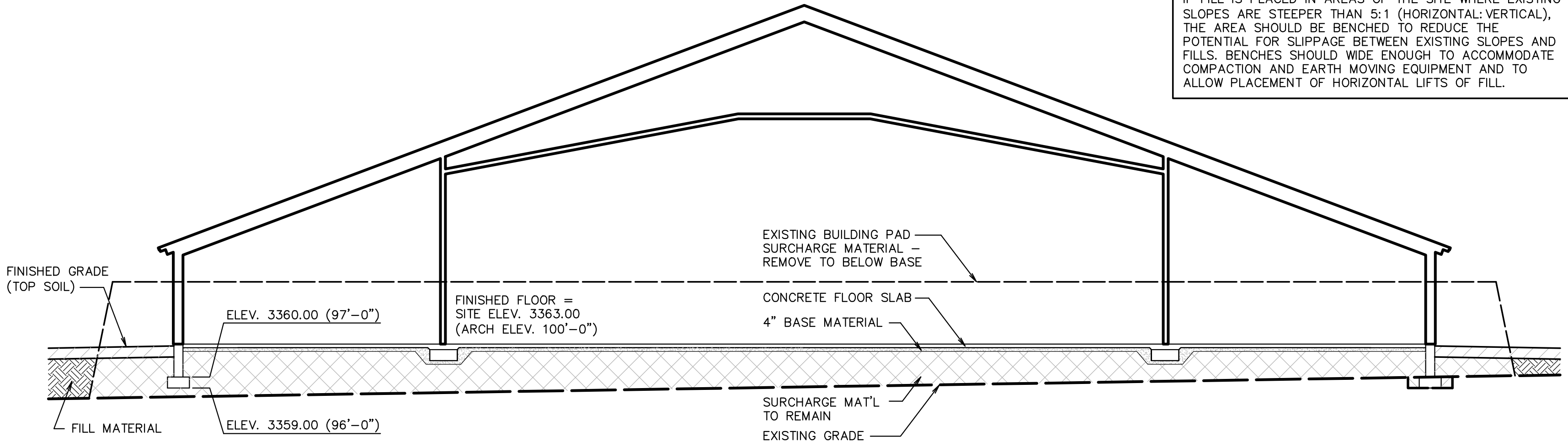
H SIDEWALK AREA POLE BASE  
3/4" = 1'-0"



J POLE BASE & APRON  
3/8" = 1'-0"



K TYPICAL PARKING LOT SECTION  
1/2" = 1'-0"



L TYPICAL BUILDING SUBGRADE SECTION  
N.T.S.

IF FILL IS PLACED IN AREAS OF THE SITE WHERE EXISTING SLOPES ARE STEEPER THAN 5:1 (HORIZONTAL:VERTICAL), THE AREA SHOULD BE BENCHED TO REDUCE THE POTENTIAL FOR SLIPPAGE BETWEEN EXISTING SLOPES AND FILLS. BENCHES SHOULD WIDE ENOUGH TO ACCOMMODATE COMPACTION AND EARTH MOVING EQUIPMENT AND TO ALLOW PLACEMENT OF HORIZONTAL LIFTS OF FILL.

Architect / Engineer:

**nbw architects p.a.**

ARCHITECTURE / PLANNING / INTERIORS

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PROFESSIONAL ARCHITECT

STATE OF MONTANA

0-20016

9-20016

Billings Sweet Grass Creek Heritage 98

Billings Montana Stake

2620 54th Street W.

Billings Montana 59106

Project for:

THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS

Mark	Date (m.d.y.)	Description

Project Number: 15047

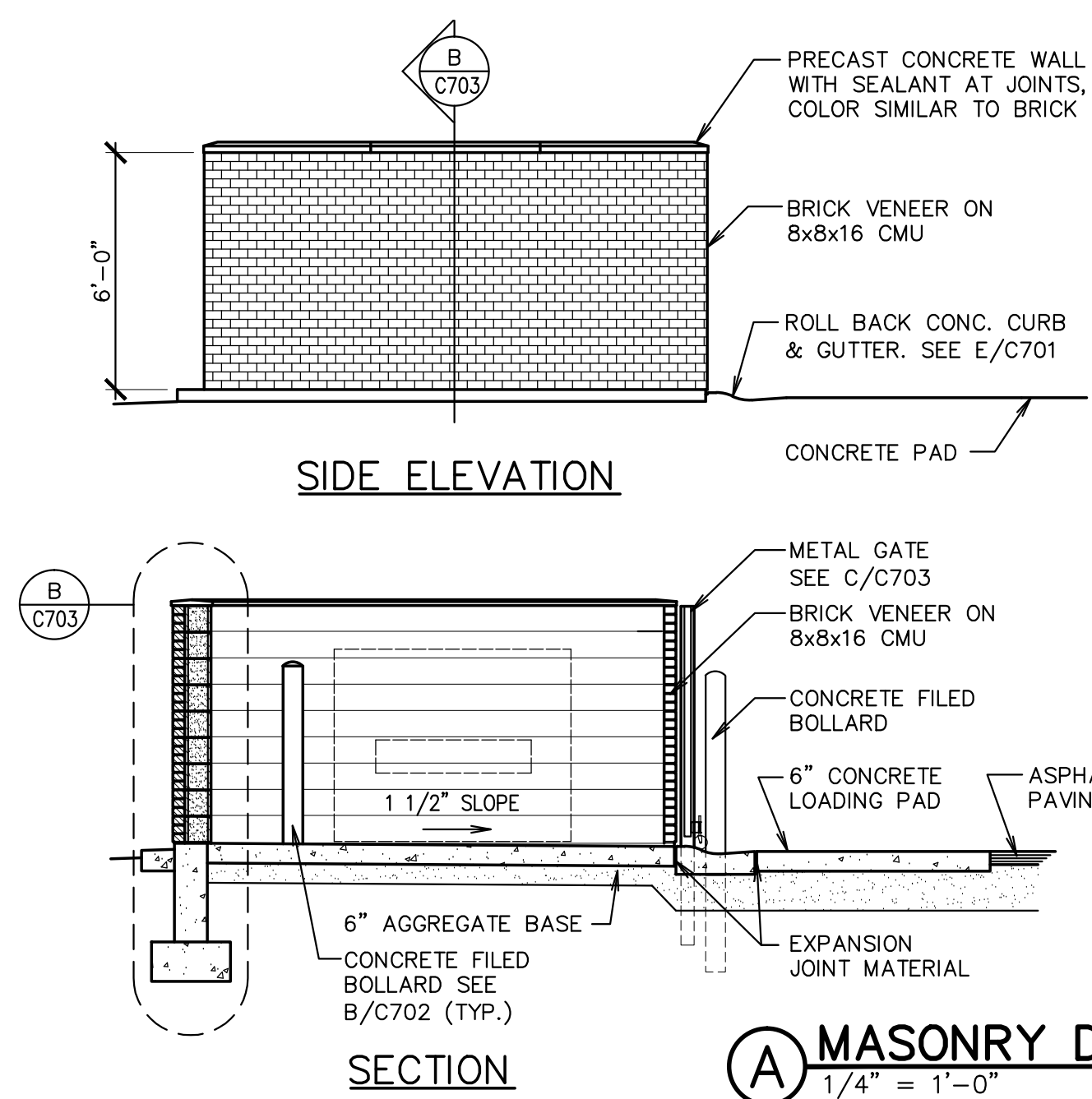
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Property Number: 501-1850

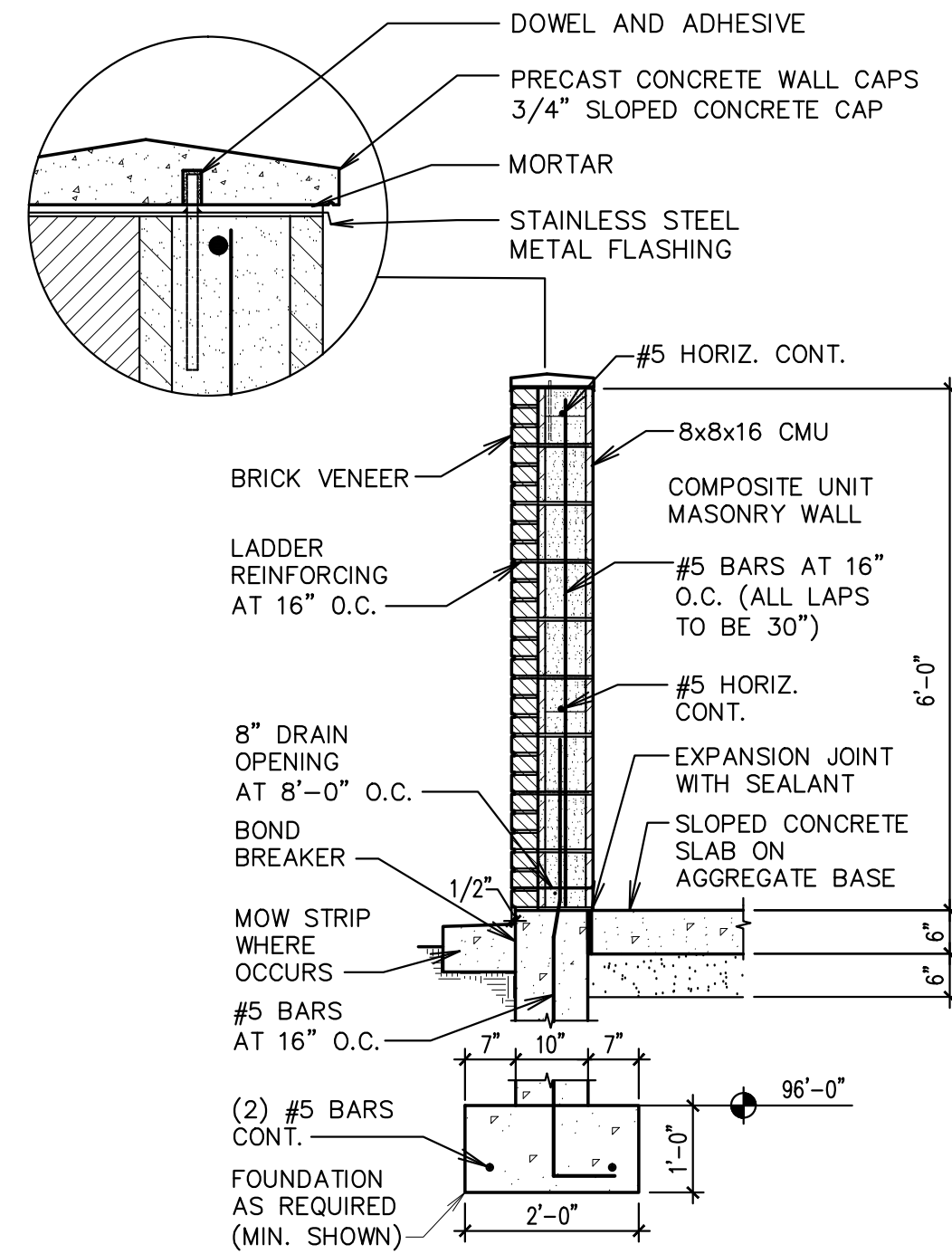
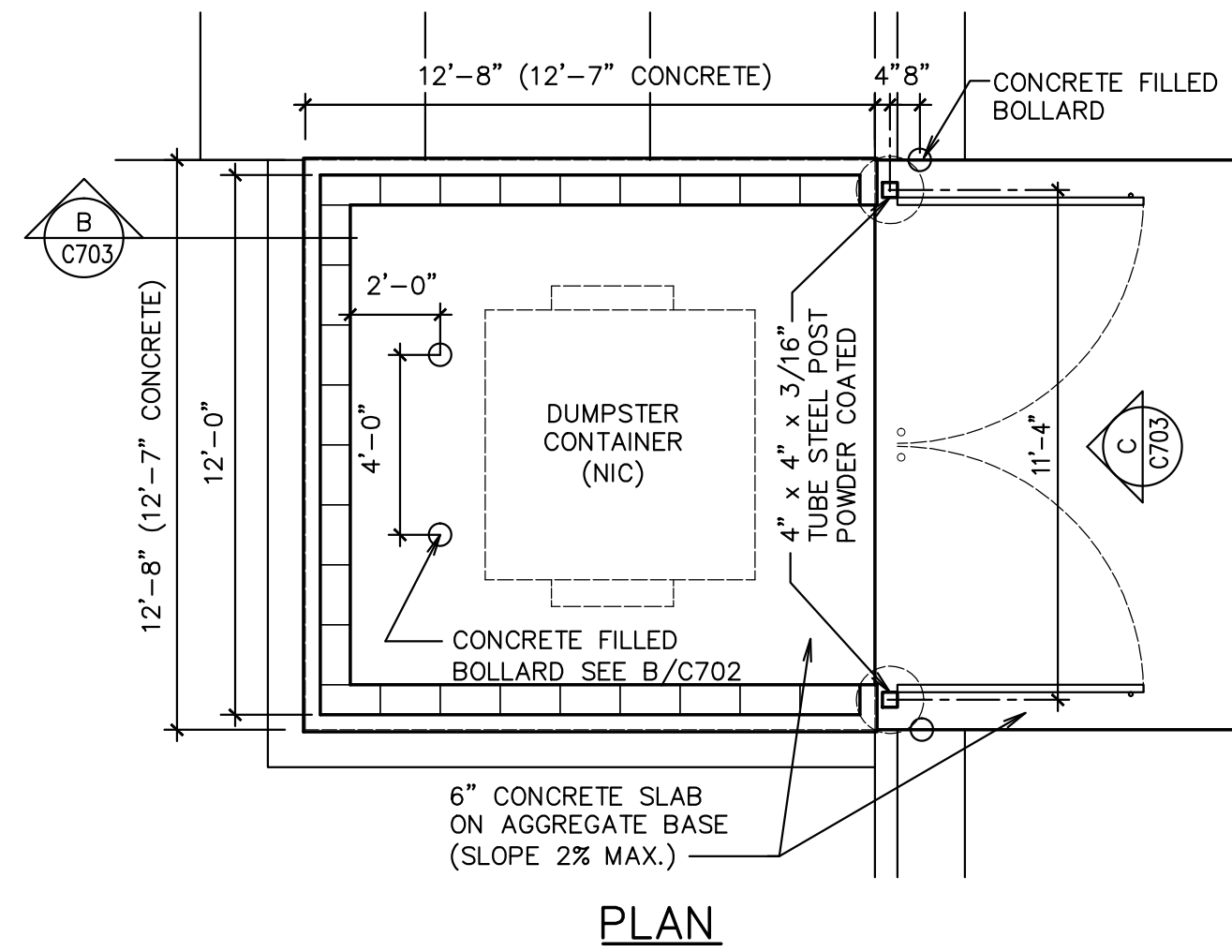
Sheet Title: SITE CIVIL DETAILS

Sheet:

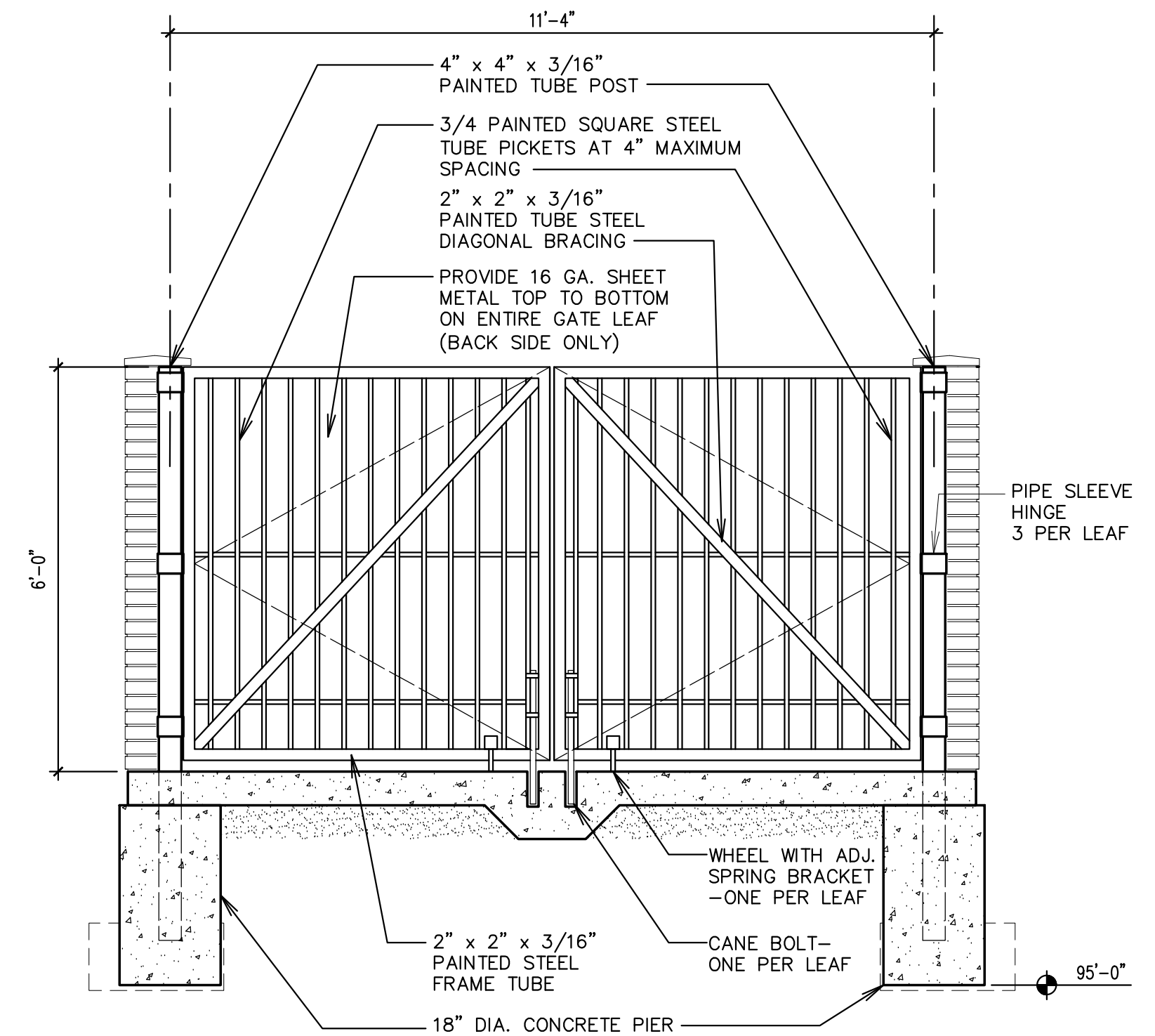
**C702**



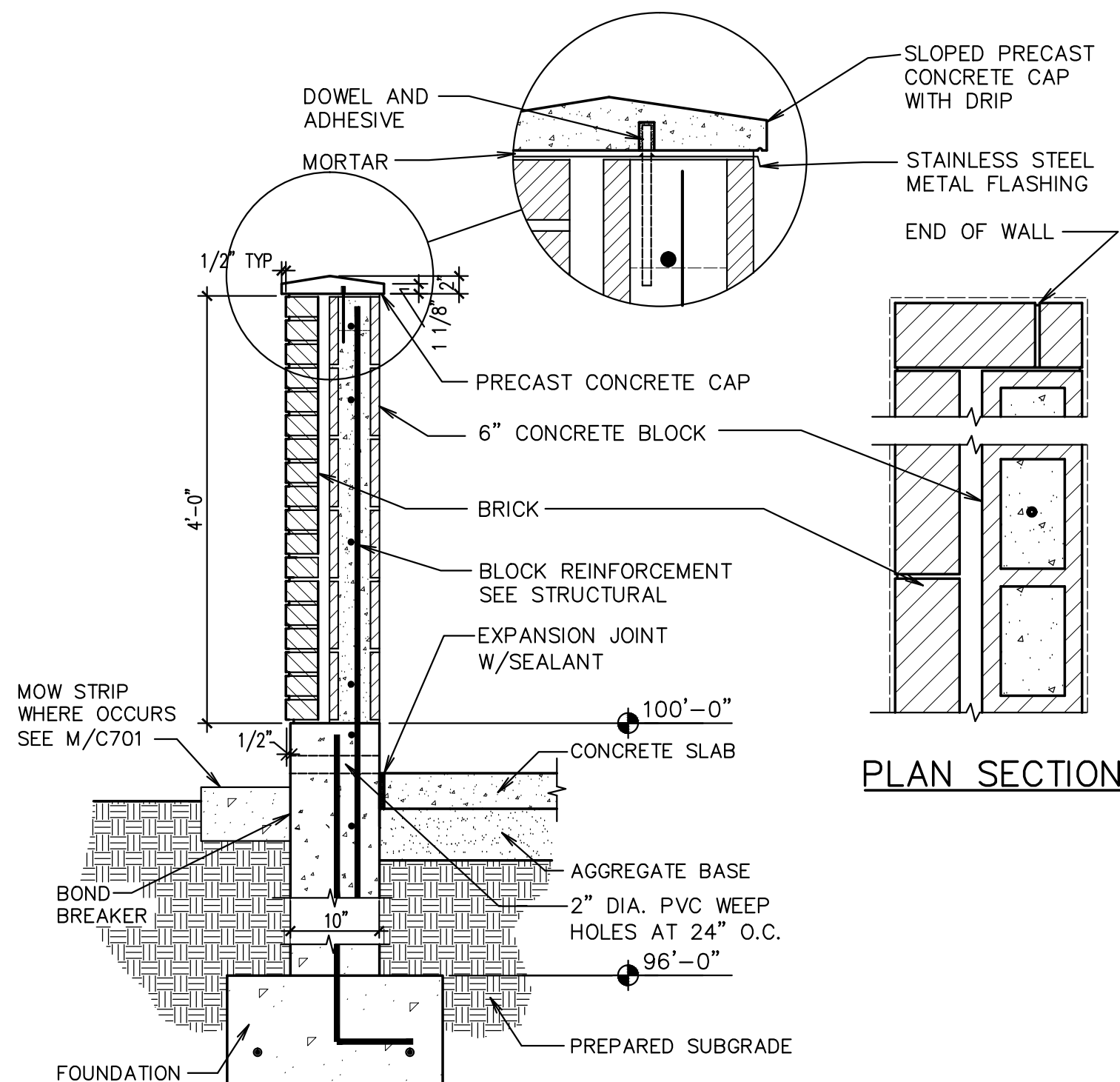
**A MASONRY DUMPSTER ENCLOSURE**



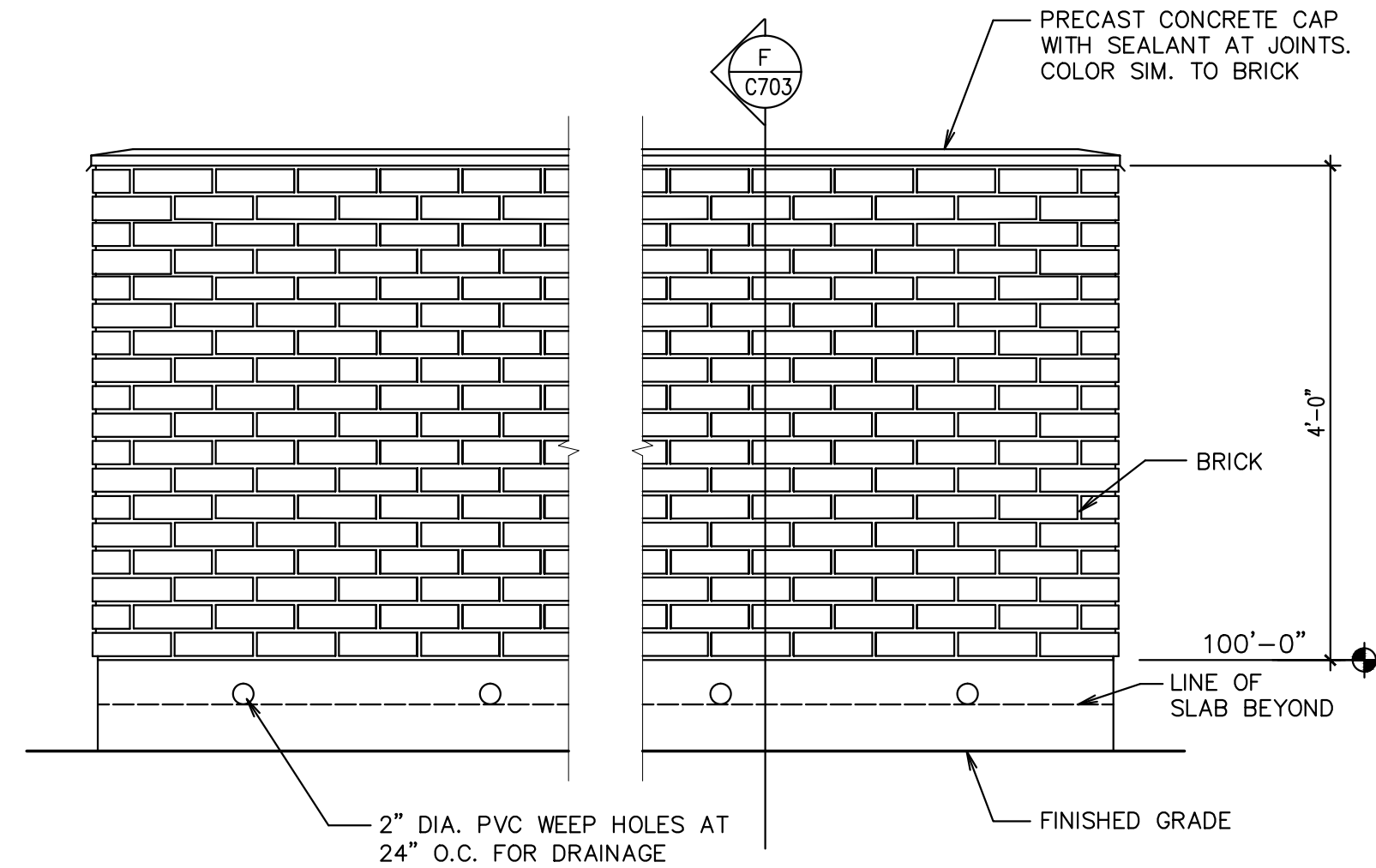
**B MASONRY WALL AT DUMPSTER ENCLOSURE**



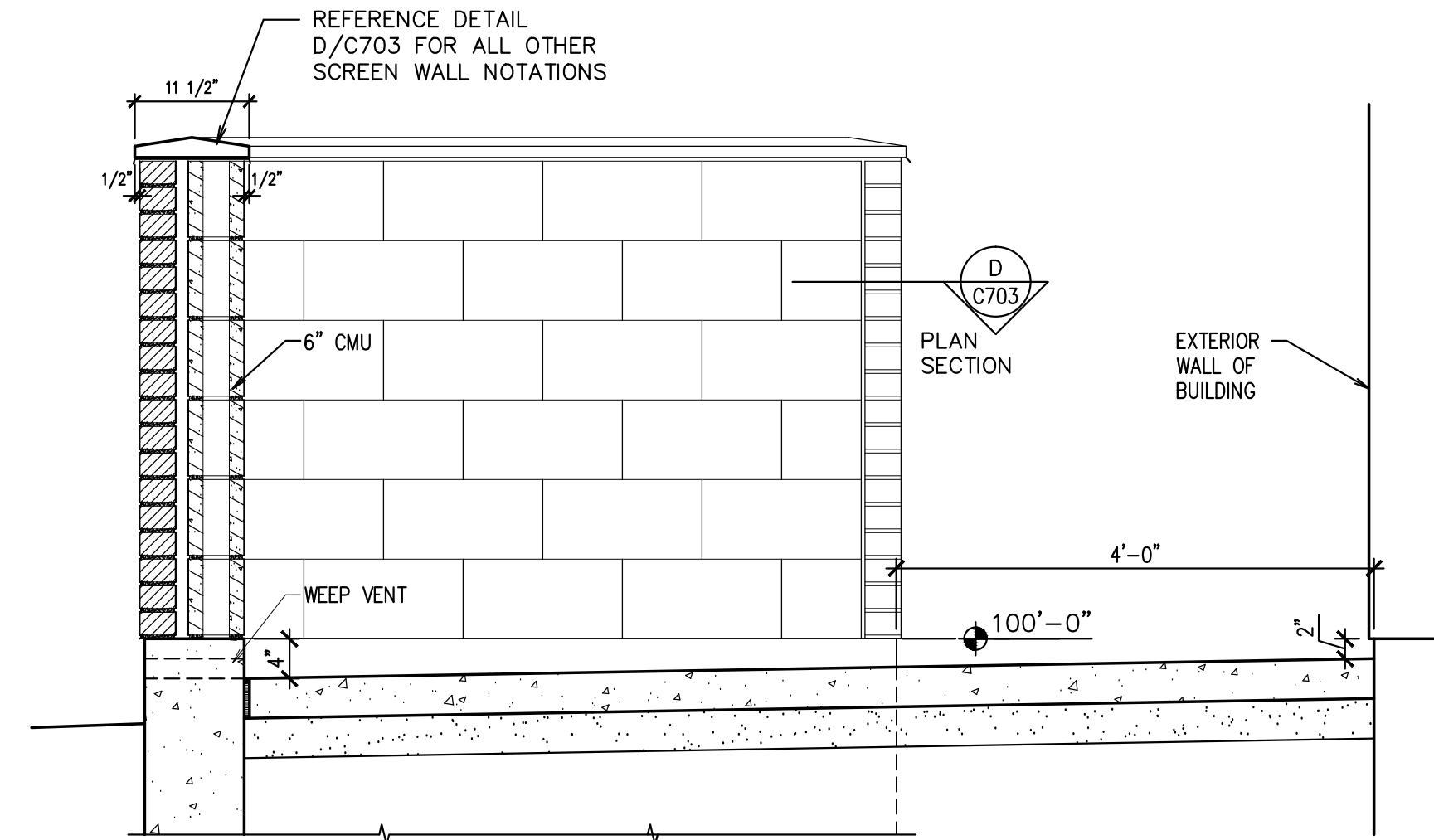
**C METAL DUMPSTER GATE**



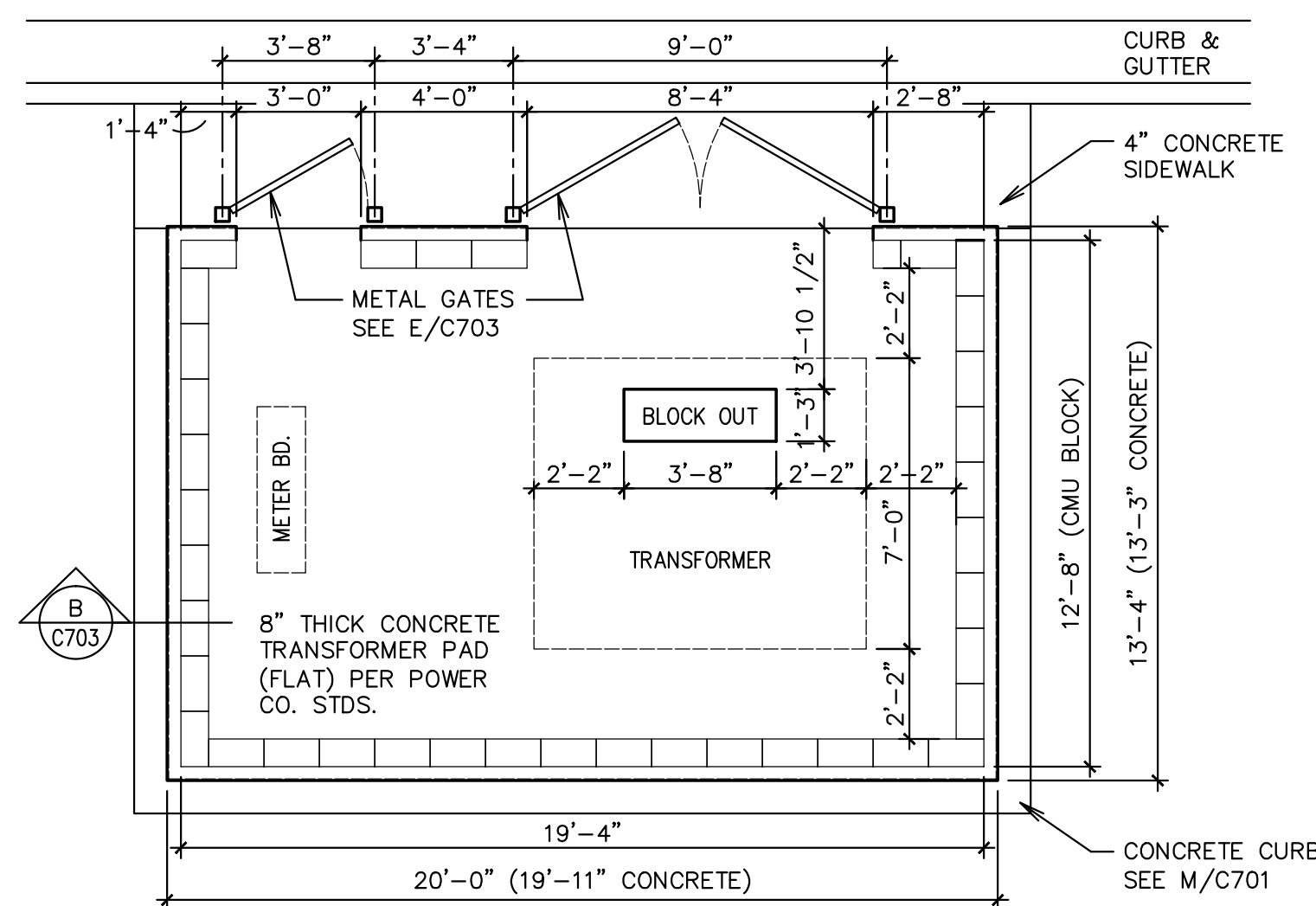
**D SCREEN WALL SECTION**



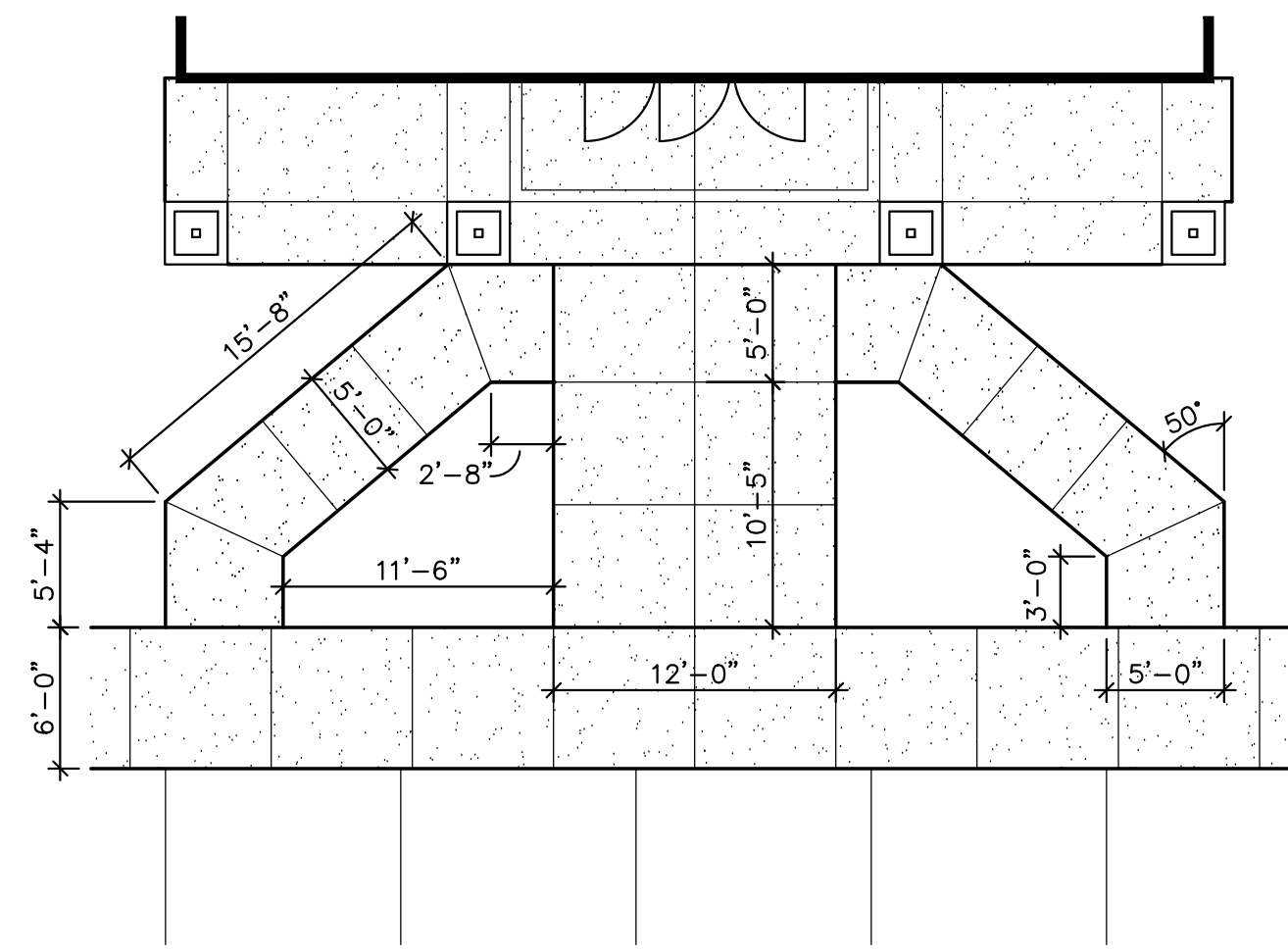
**E ENCLOSURE ELEVATION**



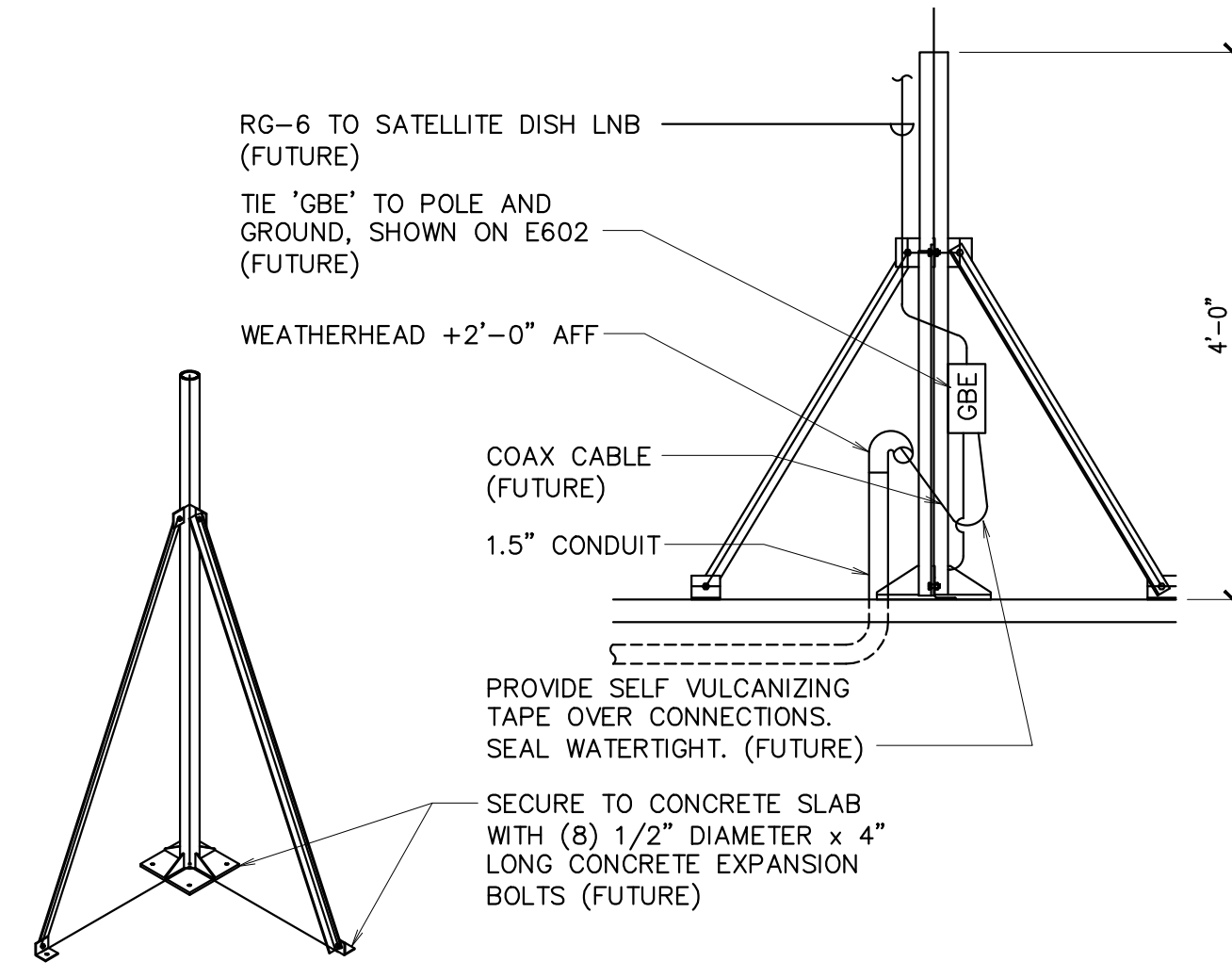
**F SCREEN WALL SECTION**



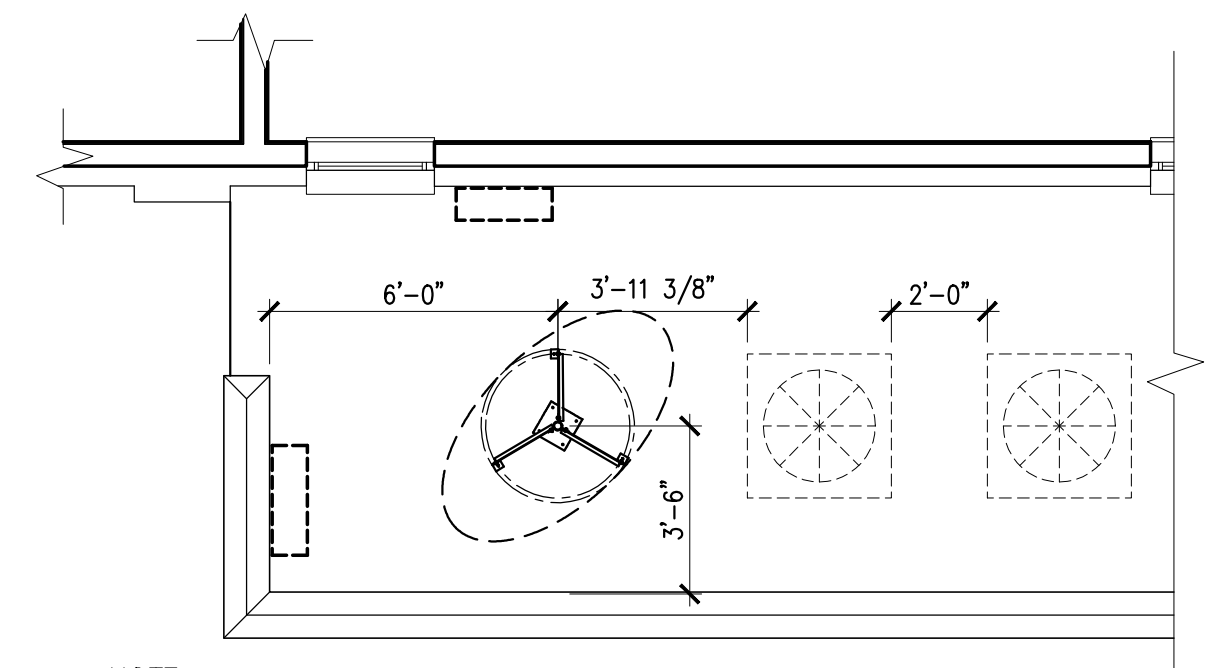
**G TRANSFORMER ENCLOSURE**



**H ENLARGED ENTRY WALK**



**I 1.8m Ku-BAND ANTENNA**



**J Ku-BAND SUGGESTED PLACEMENT IN MECH. PAD**

Architect / Engineer:

**nbw architects p.a.**

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Professional Engineer

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2620 54th Street W. Billings Montana 59106

Project for:

**THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS**

Project Number: 15047

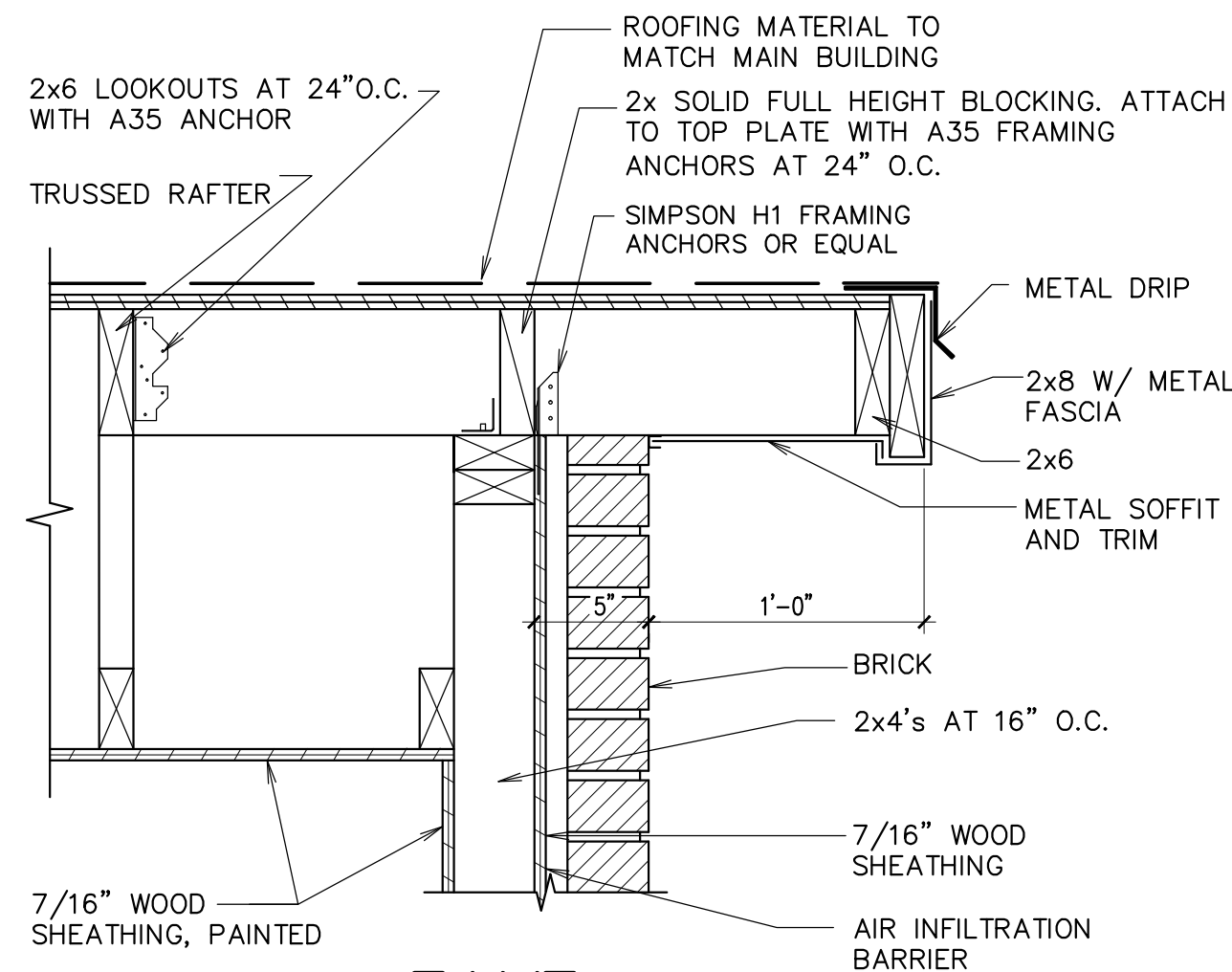
Plan Series: HER-TRA-98-20

Property Number: 501-1850

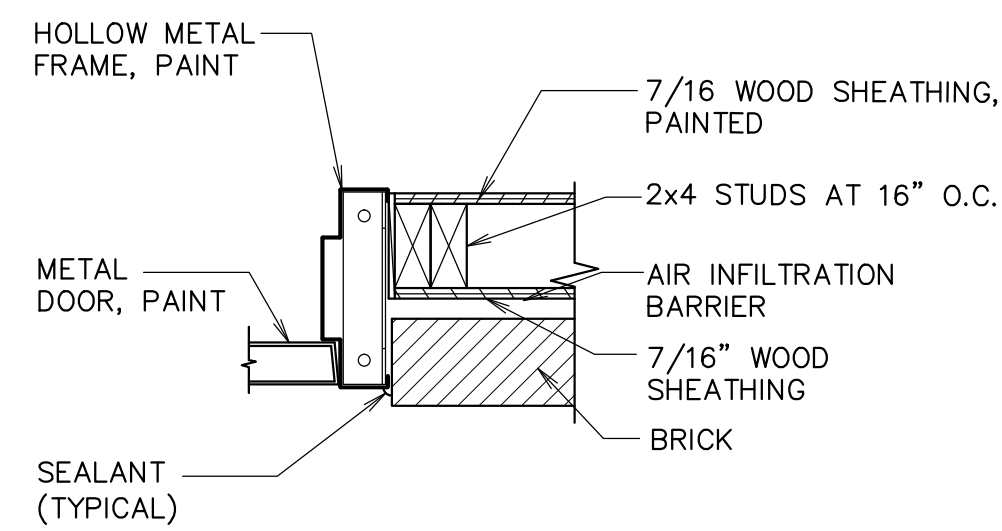
Site Title: SITE CIVIL DETAILS

Sheet: C703

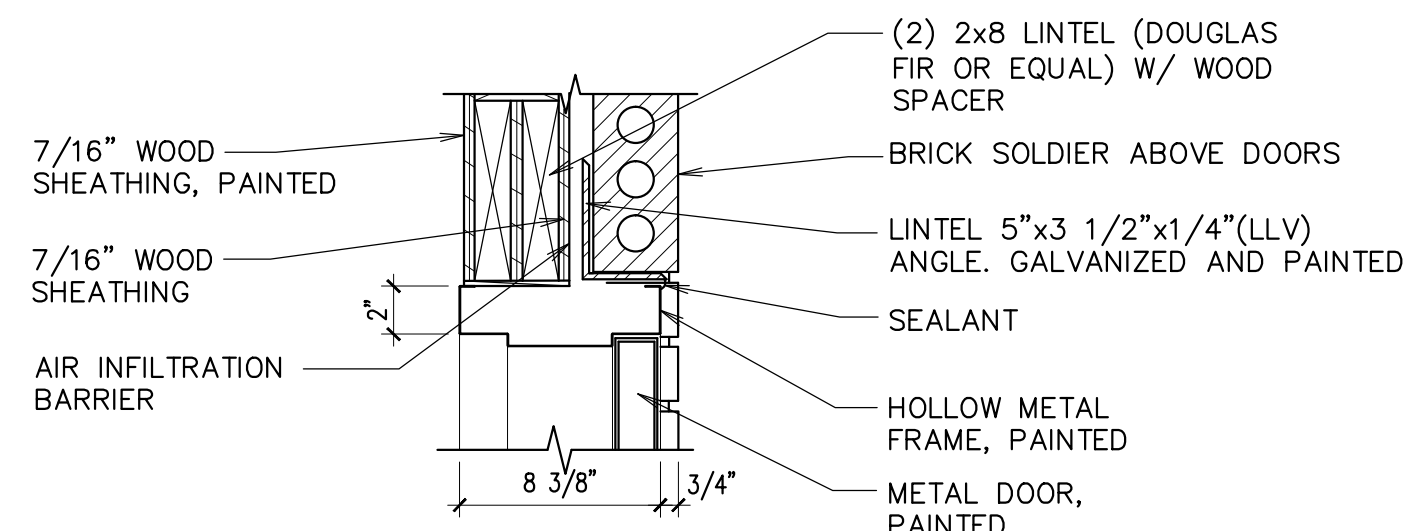




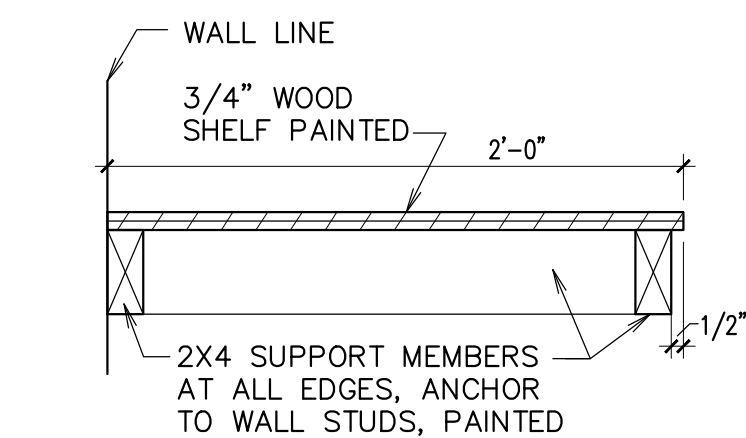
**A EAVE**  
1 1/2" = 1'-0"



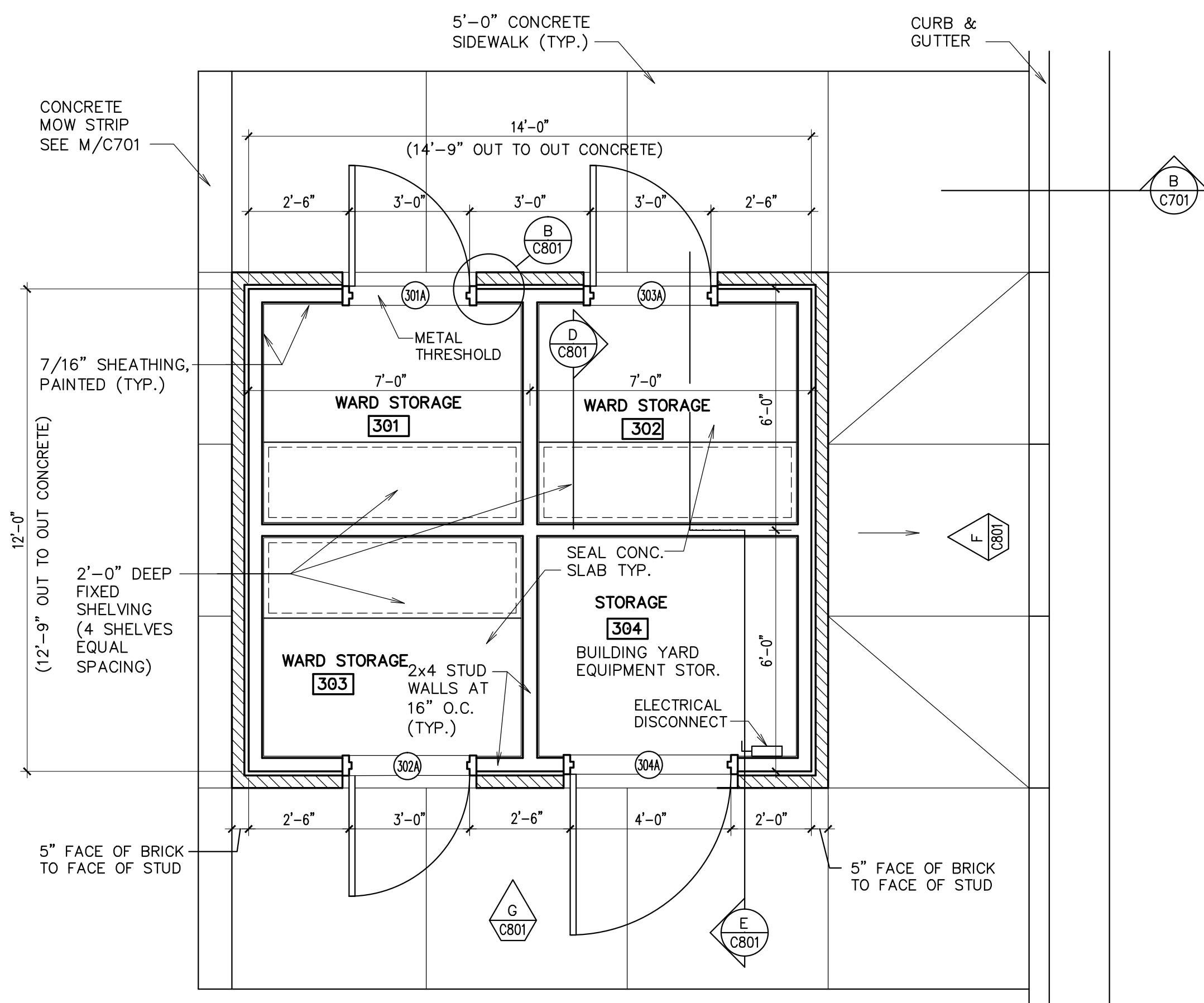
**B JAMB**  
1 1/2" = 1'-0"



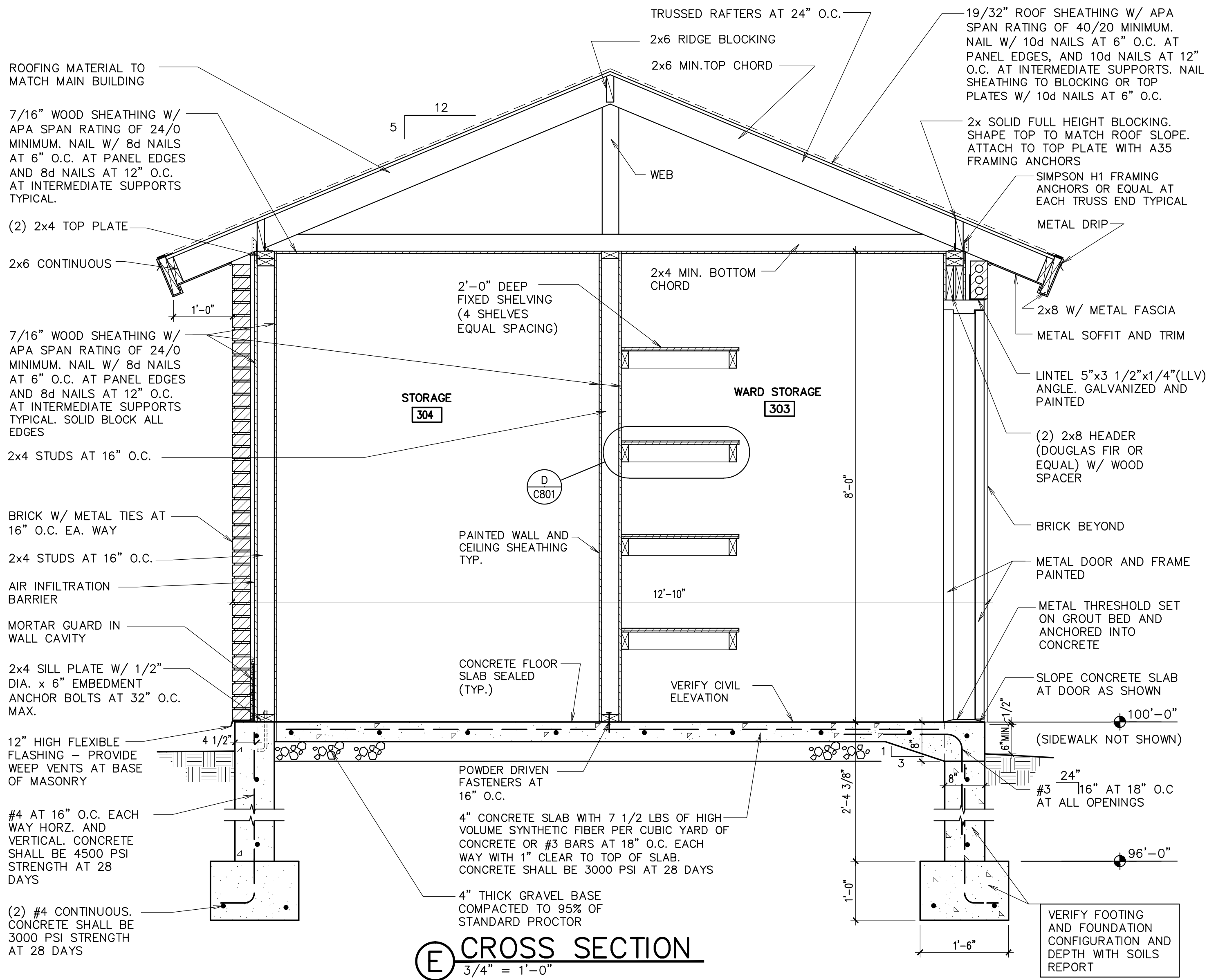
**C HEAD**  
1 1/2" = 1'-0"



**D SHELF SECTION**  
1 1/2" = 1'-0"

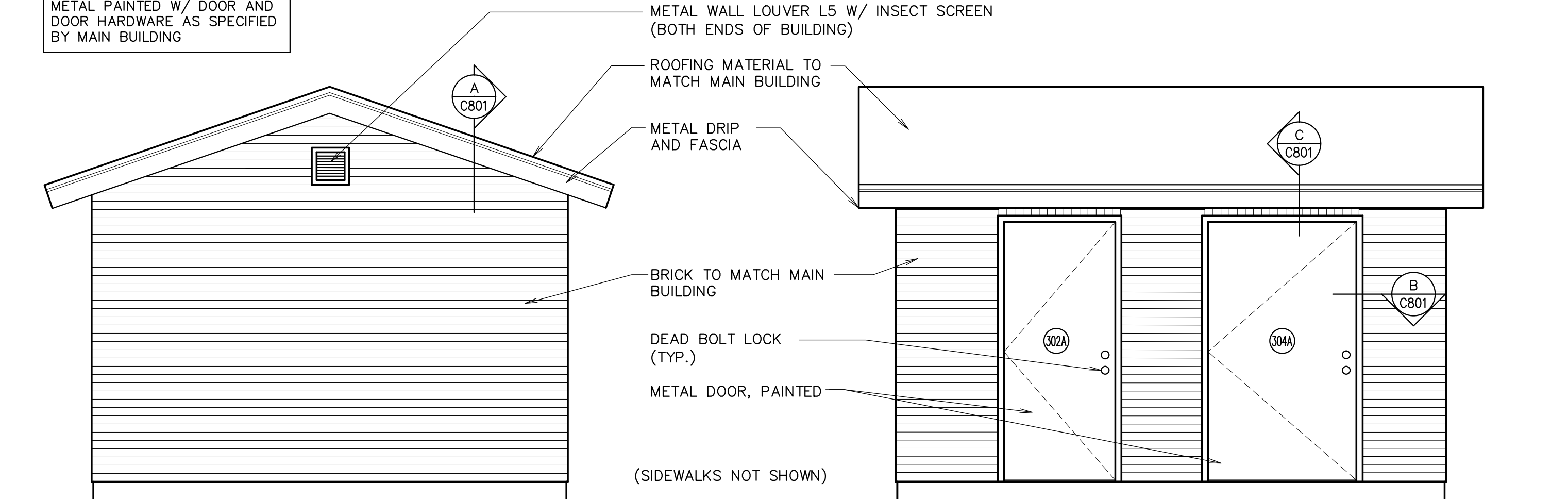


**1 FLOOR PLAN**  
3/8" = 1'-0"



**E CROSS SECTION**  
3/4" = 1'-0"

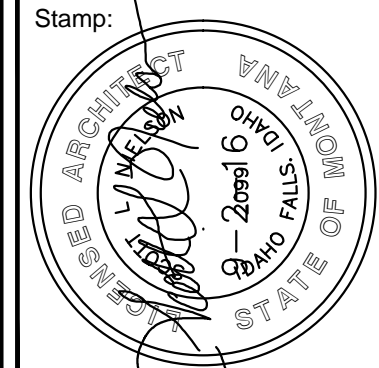
NOTE: SINGLE DOORS SHALL BE 3'-0"x7'-0"x1 3/4" AND 4'-0"x7'-0"x1 3/4" HOLLOW METAL PAINTED W/ DOOR AND DOOR HARDWARE AS SPECIFIED BY MAIN BUILDING



**F ELEVATION**  
3/8" = 1'-0"  
(OPPOSITE END SIMILAR)

**G ELEVATION**  
3/8" = 1'-0"  
(OPPOSITE SIDE SIMILAR)

Architect / Engineer:  
**nbw architects p.a.**  
ARCHITECTURE / PLANNING / INTERIORS  
SCOTT L. NIELSEN, AIA, KEVIN R. BOOBY, AIA, JAMES H. WYATT, AIA,  
BRIAN J. BOOBY, AIA, JAMES H. WYATT, AIA, JAMES H. WYATT, AIA,  
BRIAN J. BOOBY, AIA, JAMES H. WYATT, AIA, JAMES H. WYATT, AIA,  
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Project for:  
**THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS**  
Billings Sweet Grass Creek Heritage 98  
Billings Montana Stake  
2620 54th Street W.  
Billings Montana 59106

Project Number:  
15047  
Plan Series:  
HER-TRA-98-20  
Property Number:  
501-1850

Mark	Date (m.d.y.)	Description

Sheet Title:  
**STORAGE BUILDING AND DETAILS**

Sheet:  
**C801**

**nbwarchitects p.a.**  
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Heritage 98  
Billings Montana Stake**

2620 54th Street W.  
Billings Montana 59106

Project for:

**THE CHURCH OF  
JESUS CHRIST  
OF LATTER-DAY SAINTS**

[illegible]

Project Number: 15047
Plan Series: HER-TRA-98-20
Property Number: 501-1850

Sheet Title:  
**EXISTING  
TOPOGRAPHY  
& DEMO PLAN**

# C1.0

**SANDERSON  
STEWART**

---

[www.sandersonstewart.com](http://www.sandersonstewart.com)

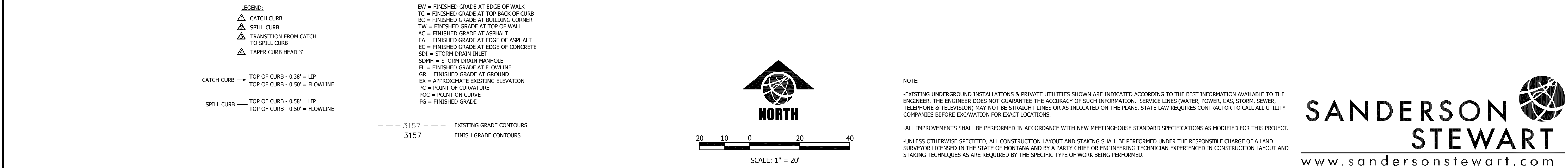
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Sheet: C4.1

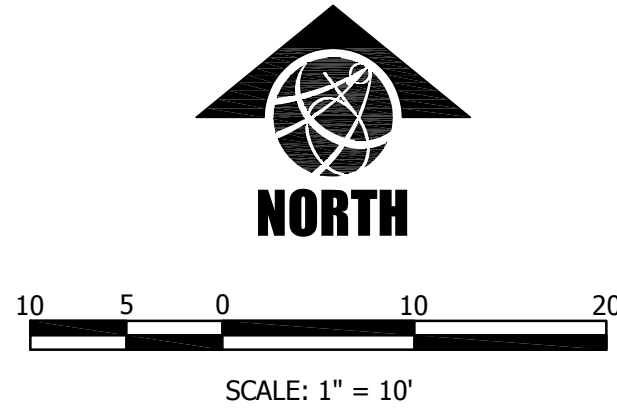
Sheet:

C4.1









-UNLESS OTHERWISE SPECIFIED, ALL CONSTRUCTION LAYOUT AND STAKING SHALL BE PERFORMED UNDER THE RESPONSIBLE CHARGE OF A LAND SURVEYOR LICENSED IN THE STATE OF MONTANA AND BY A PARTY CHIEF OR ENGINEERING TECHNICIAN EXPERIENCED IN CONSTRUCTION LAYOUT AND STAKING TECHNIQUES AS ARE REQUIRED BY THE SPECIFIC TYPE OF WORK BEING PERFORMED.

**SANDERSON  
STEWART**

---

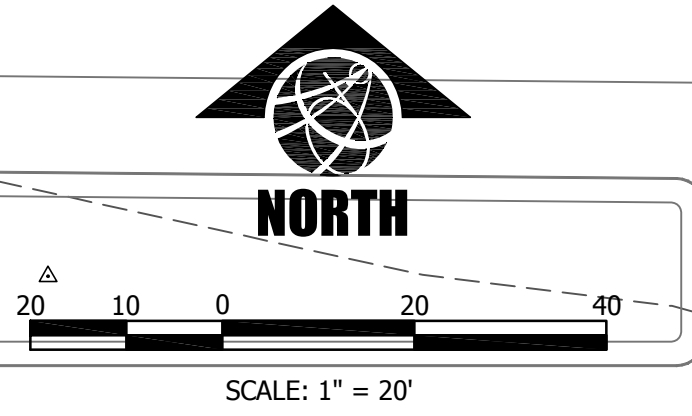
[www.sandersonstewart.com](http://www.sandersonstewart.com)

#70026.14 70026.14 GRADING\_PROD.DWG ATV

### C4.3

EW = FINISHED GRADE AT EDGE OF WALK  
TC = FINISHED GRADE AT TOP BACK OF CURB  
BC = FINISHED GRADE AT BUILDING CORNER  
TW = FINISHED GRADE AT TOP OF WALL  
AC = FINISHED GRADE AT ASPHALT  
EA = FINISHED GRADE AT EDGE OF ASPHALT  
EC = FINISHED GRADE AT EDGE OF CONCRETE  
SDI = STORM DRAIN INLET  
SDMH = STORM DRAIN MANHOLE  
FL = FINISHED GRADE AT FLOWLINE  
GR = FINISHED GRADE AT GROUND  
EX = APPROXIMATE EXISTING ELEVATION  
PC = POINT OF CURVATURE  
POC = POINT ON CURVE  
FG = FINISHED GRADE

--- 3157 --- EXISTING GRADE CONTOURS  
 ——— 3157 ——— FINISH GRADE CONTOURS



-EXISTING UNDERGROUND INSTALLATIONS & PRIVATE UTILITIES SHOWN ARE INDICATED ACCORDING TO THE BEST INFORMATION AVAILABLE TO THE ENGINEER. THE ENGINEER DOES NOT GUARANTEE THE ACCURACY OF SUCH INFORMATION. SERVICE LINES (WATER, POWER, GAS, STORM, SEWER, TELEPHONE & TELEVISION) MAY NOT BE STRAIGHT LINES OR AS INDICATED ON THE PLANS. STATE LAW REQUIRES CONTRACTOR TO CALL ALL UTILITY COMPANIES BEFORE EXCAVATION FOR EXACT LOCATIONS.

~~ALL IMPROVEMENTS SHALL BE PERFORMED IN ACCORDANCE WITH NEW MEETINGHOUSE STANDARD SPECIFICATIONS AS MODIFIED FOR THIS PROJECT~~


UNLESS OTHERWISE SPECIFIED, ALL CONSTRUCTION LAYOUT AND STAKING SHALL BE PERFORMED UNDER THE RESPONSIBLE CHARGE OF A LAND SURVEYOR LICENSED IN THE STATE OF MONTANA AND BY A PARTY CHIEF OR ENGINEERING TECHNICIAN EXPERIENCED IN CONSTRUCTION LAYOUT AND STAKING TECHNIQUES AS ARE REQUIRED BY THE SPECIFIC TYPE OF WORK BEING PERFORMED.

**SANDERSON  
STEWART**

[www.sandersonstewart.com](http://www.sandersonstewart.com)

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Stamp:



**Billings Sweet Grass Creek  
Heritage 98  
Billings Montana Stake**  
2620 54th Street W.  
Billings Montana 59106

Project for:

**THE CHURCH OF  
JESUS CHRIST  
OF LATTER-DAY SAINTS**

[illegible]

Project Number:  
15047

Plan Series:  
HER-TRA-98-20

Property Number:  
501-1850

Sheet Title:  
**UTILITY PLAN**

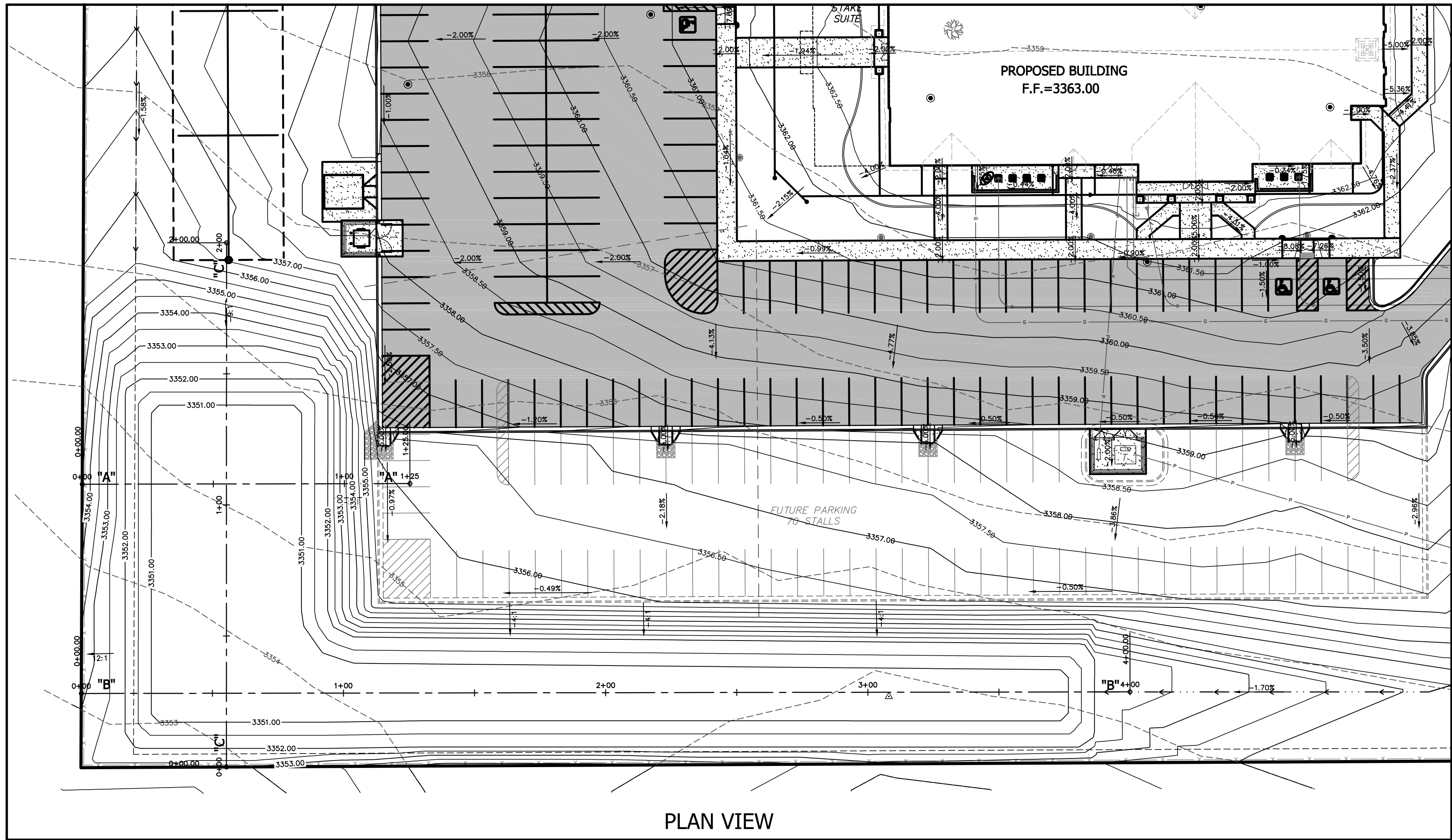
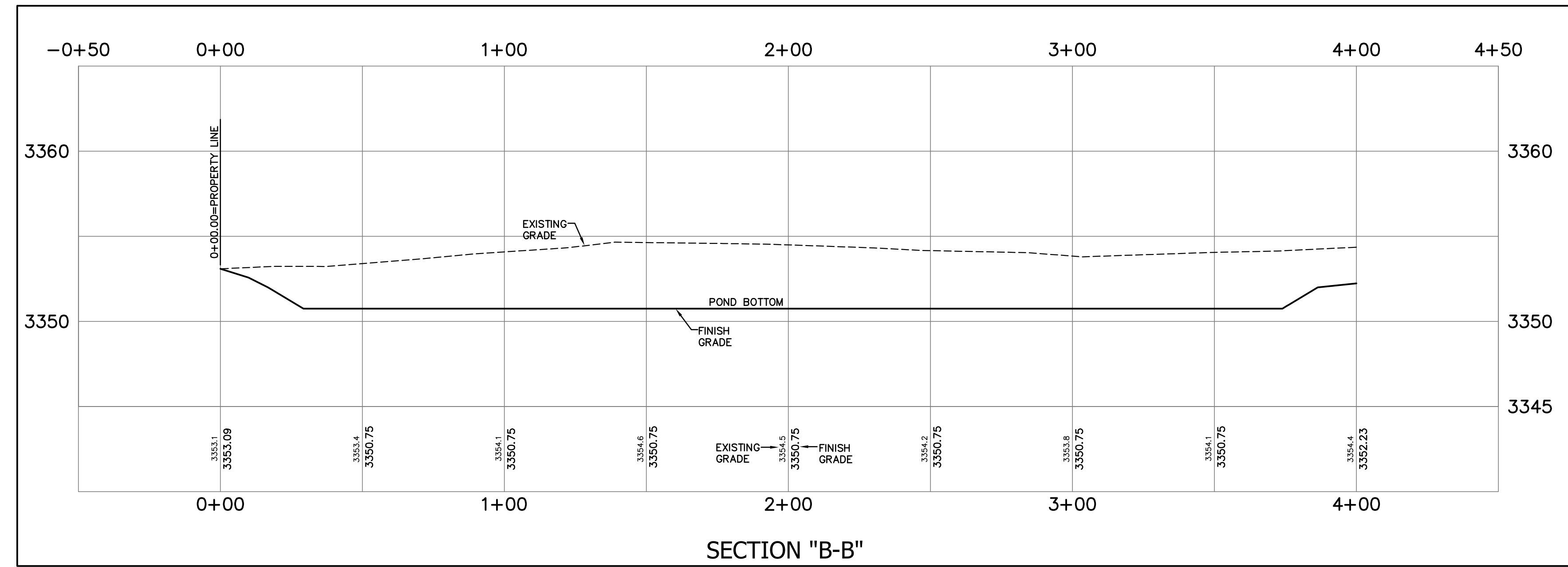
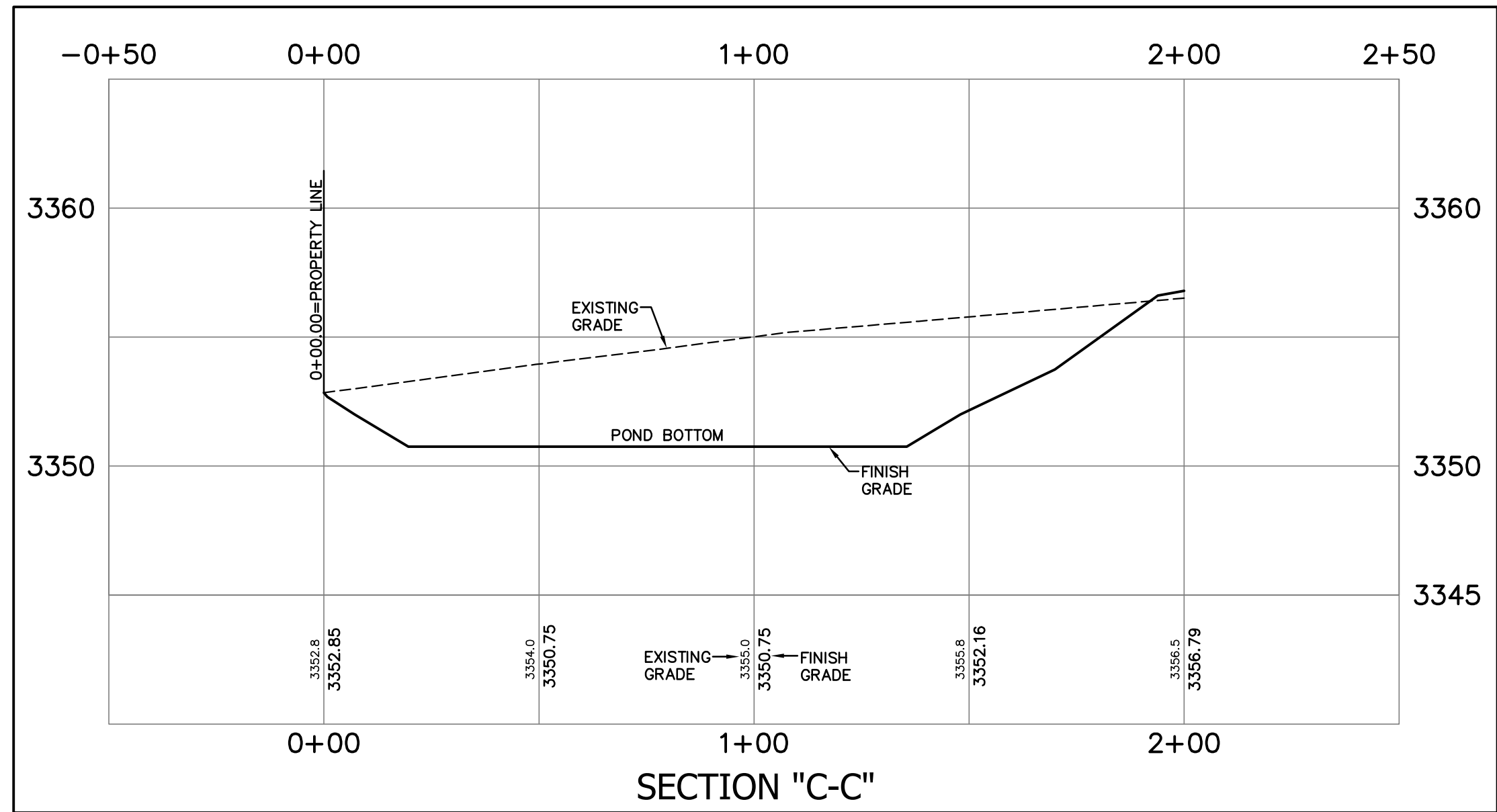
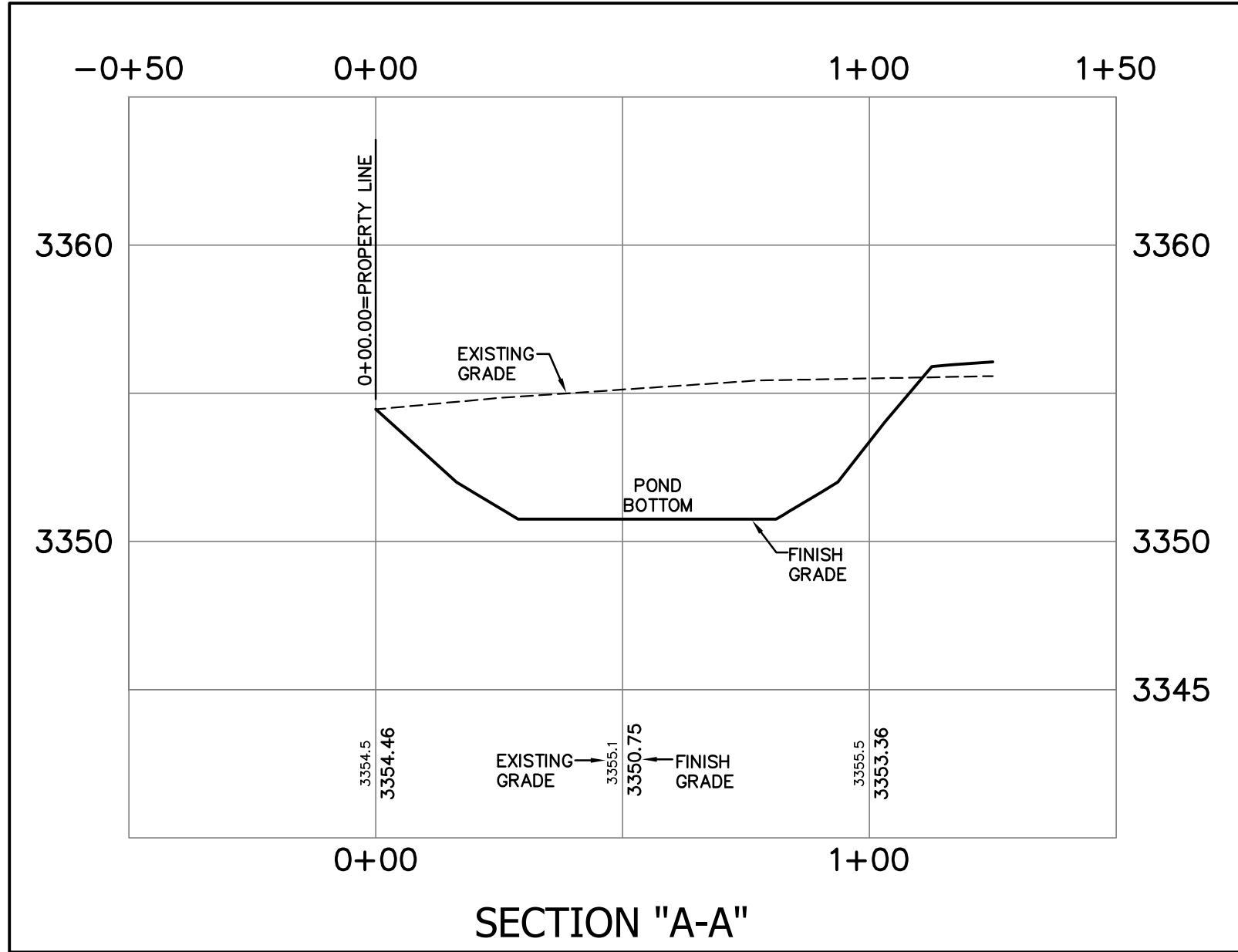
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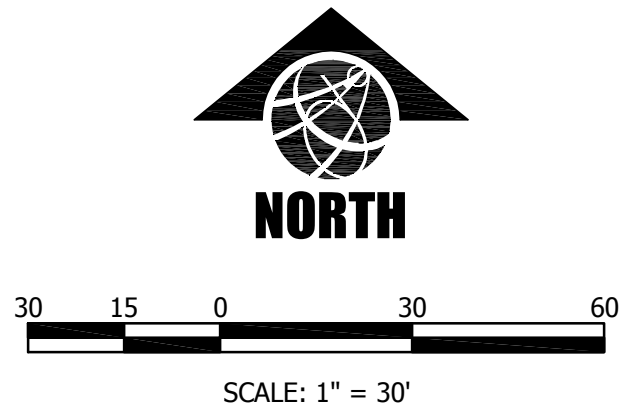
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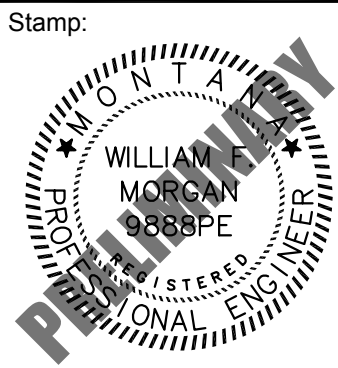
SCALE  
PLAN : 1" = 30'  
PROFILE  
HORIZ. : 1" = 30'  
VERT. : 1" = 5'



NOTE:  
-EXISTING UNDERGROUND INSTALLATIONS & PRIVATE UTILITIES SHOWN ARE INDICATED ACCORDING TO THE BEST INFORMATION AVAILABLE TO THE ENGINEER. THE ENGINEER DOES NOT GUARANTEE THE ACCURACY OF SUCH INFORMATION. SERVICE LINES (WATER, POWER, GAS, STORM, SEWER, TELEPHONE & TELEVISION) MAY NOT BE STRAIGHT LINES OR AS INDICATED ON THE PLANS. STATE LAW REQUIRES CONTRACTOR TO CALL ALL UTILITY COMPANIES BEFORE EXCAVATION FOR EXACT LOCATIONS.  
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www.sandersonstewart.com  
#70026.14 70026\_14\_DETAILS.DWG ATV

Architect / Engineer:  
**nbwarchitects p.a.**  
ARCHITECTURE / PLANNING / INTERIORS  
SCOTT L. NELSON, AIA, KEVIN R. BOOBY, AIA, JAMES H. WYATT, AIA.  
901 JOHN BURNS PARKWAY, P.O. BOX 2212 - IDAHO FALLS, IDAHO 83402-2212  
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2620 54th Street W.  
Billings Montana 59106

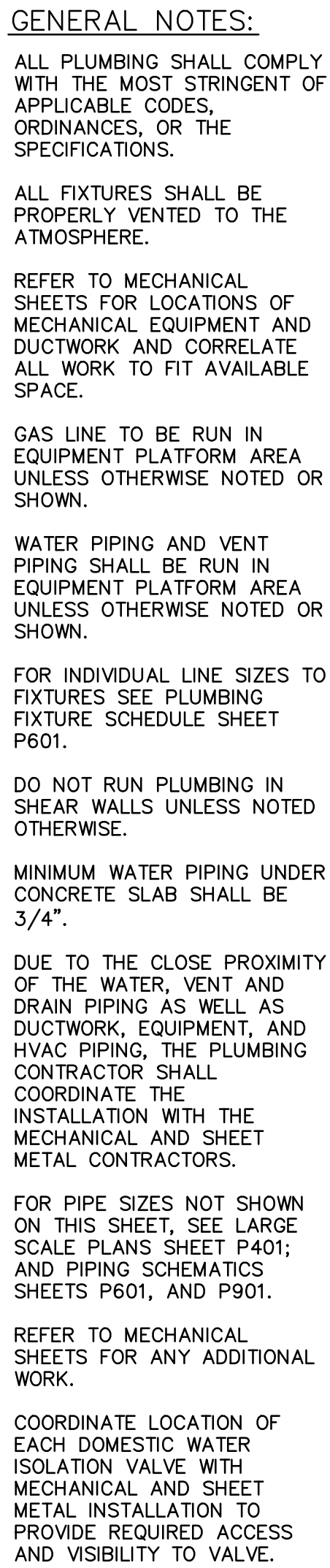
Project for:  
**THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS**

Mark	Date (o.k.v.)	Description

Project Number:  
15047  
Plan Series:  
HER-TRA-98-20  
Property Number:  
501-1850

Sheet Title:  
POND DETAILS

Sheet:  
C6.2



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amp:

Billings Sweet Grass Creek  
Heritage 98  
Billings Montana Stake  
2620 54th Street W.  
Billings Montana 59106

Project for:

**THE CHURCH OF  
JESUS CHRIST  
OF LATTER-DAY SAINTS**

[illegible]

Project Number:  
5047

Plan Series:  
ER-TRA-98-20

Property Number:  
01-1850

# MAIN FLOOR LUMBING PLAN



Sheet:

# P101

F:\5\5001 LDS Billings Herq8\5001-PI01.DWG Sep 15, 2016 - 7:55am

PLUMBING FLOOR PLAN  
SCALE: 1/8"=1'-0"



L E G E N D					
M E A N I N G	SYMBOL OR ABBREVIATION	M E A N I N G	SYMBOL OR ABBREVIATION	M E A N I N G	SYMBOL OR ABBREVIATION
HOT WATER LINE	——— — — ———	CONDENSATE DRAIN	——— D ———	WALL CLEANOUT	WCO
COLD WATER LINE	——— — ———	UNION	—— + ——	CLEANOUT	CO
VENT LINE	—————	SECONDARY CONDENSATE DRAIN	——— SD ———	CLEANOUT TO GRADE	COTG
WASTE LINE	—————	BALL VALVE	———  ———	FLOOR CLEANOUT	FCO
GAS LINE	———  ———			VENT THRU ROOF	VTR

ORIGINAL DRAWING SIGNED BY: DWAYNE C. SUDWEEKS  
DATE ORIGINAL SIGNED: Sep 15, 2016  
ORIGINAL ON FILE AT ENGINEERED SYSTEMS ASSOCIATES  
1355 EAST CENTER, POCA TELLO, IDAHO 83201



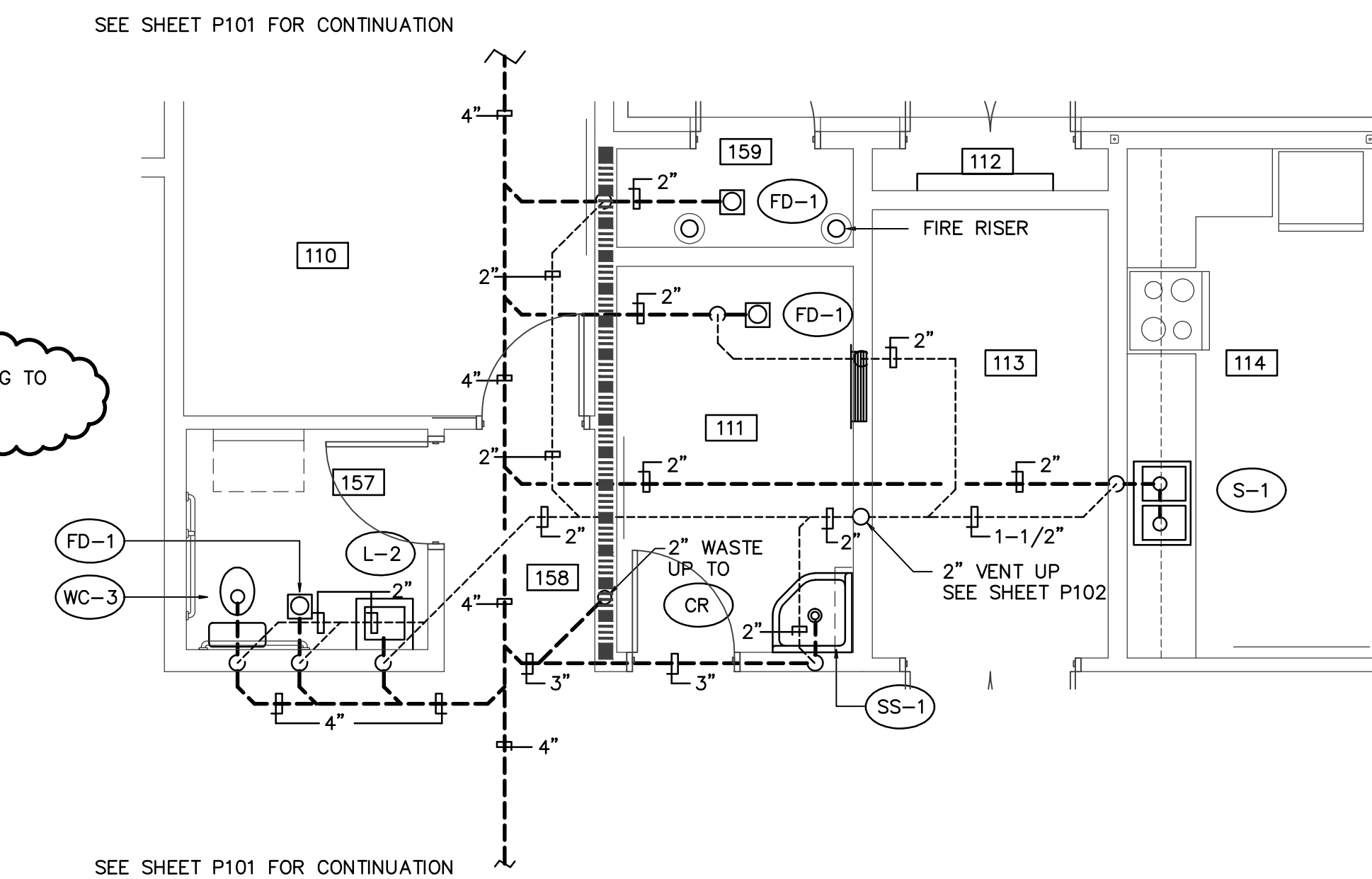
**Engineered  
Systems  
Associates**

1355 EAST CENTER  
POCATELLO, IDAHO 83201  
PHONE: (208) 233-0501  
FAX: (208) 233-0529  
EMAIL: esa@engsystems.com  
ESA JOB NUMBER: 15001

ESA JOB NUMBER: 15001

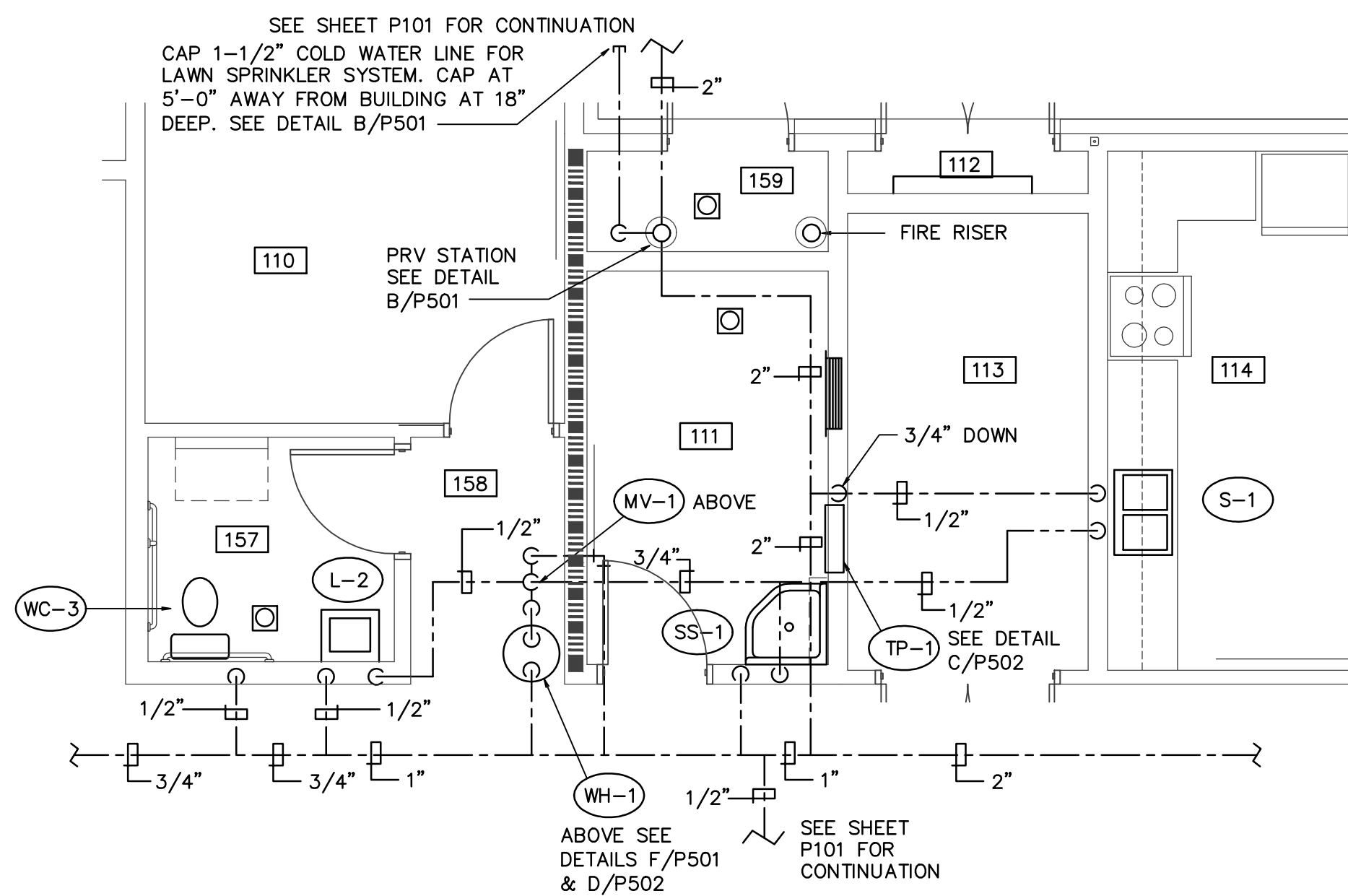


F:\1515001 LDS Billings Her-98\15001-P401.DWG Sep 15, 2016 - 1:51am



RESTROOM/CUST. 157 111 AND 114 PLUMBING

SCALE: 1/4" = 1'-0"

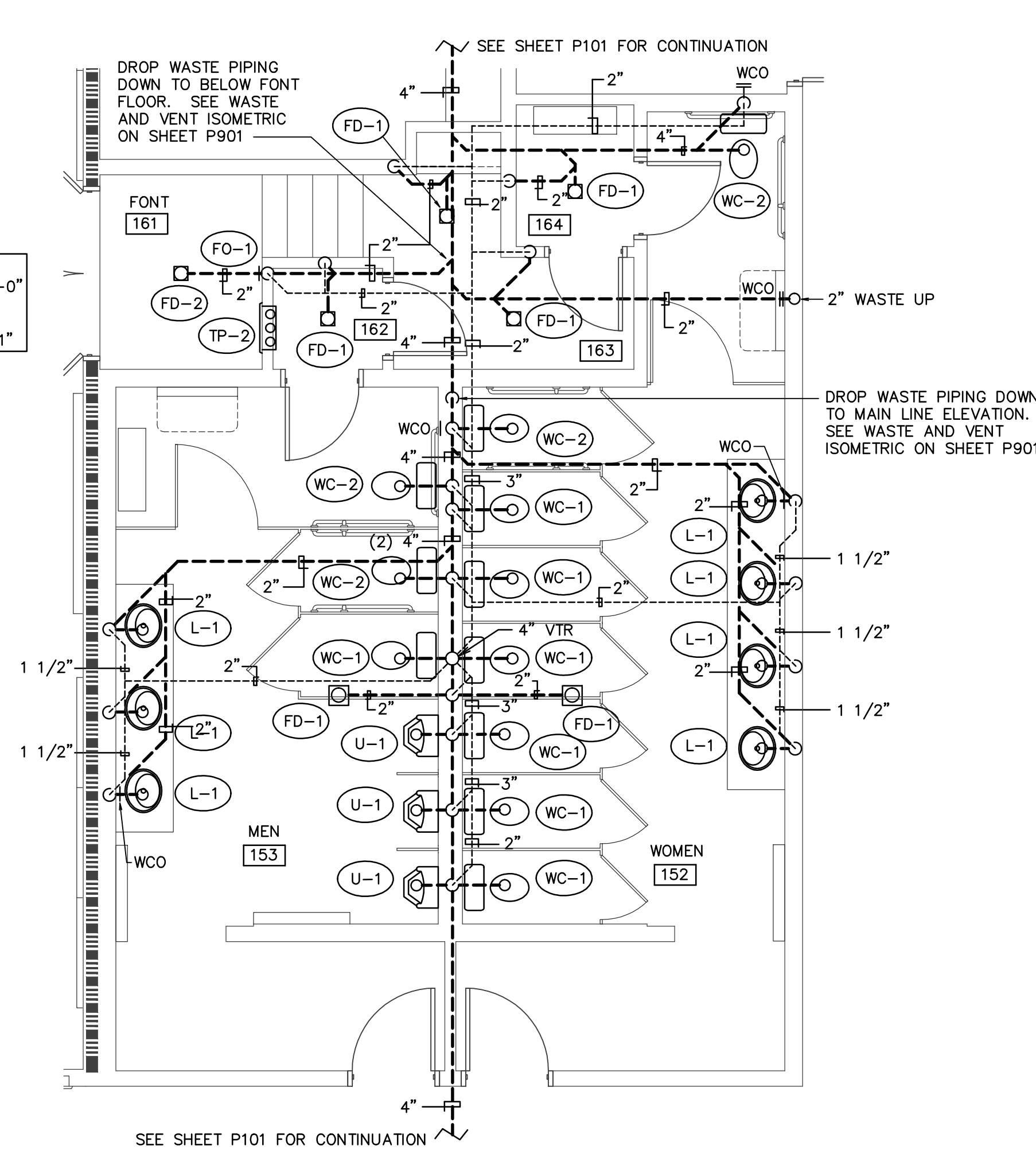


RESTROOM/CUST. 157 111 AND 114 SUPPLY

SCALE: 1/4" = 1'-0"

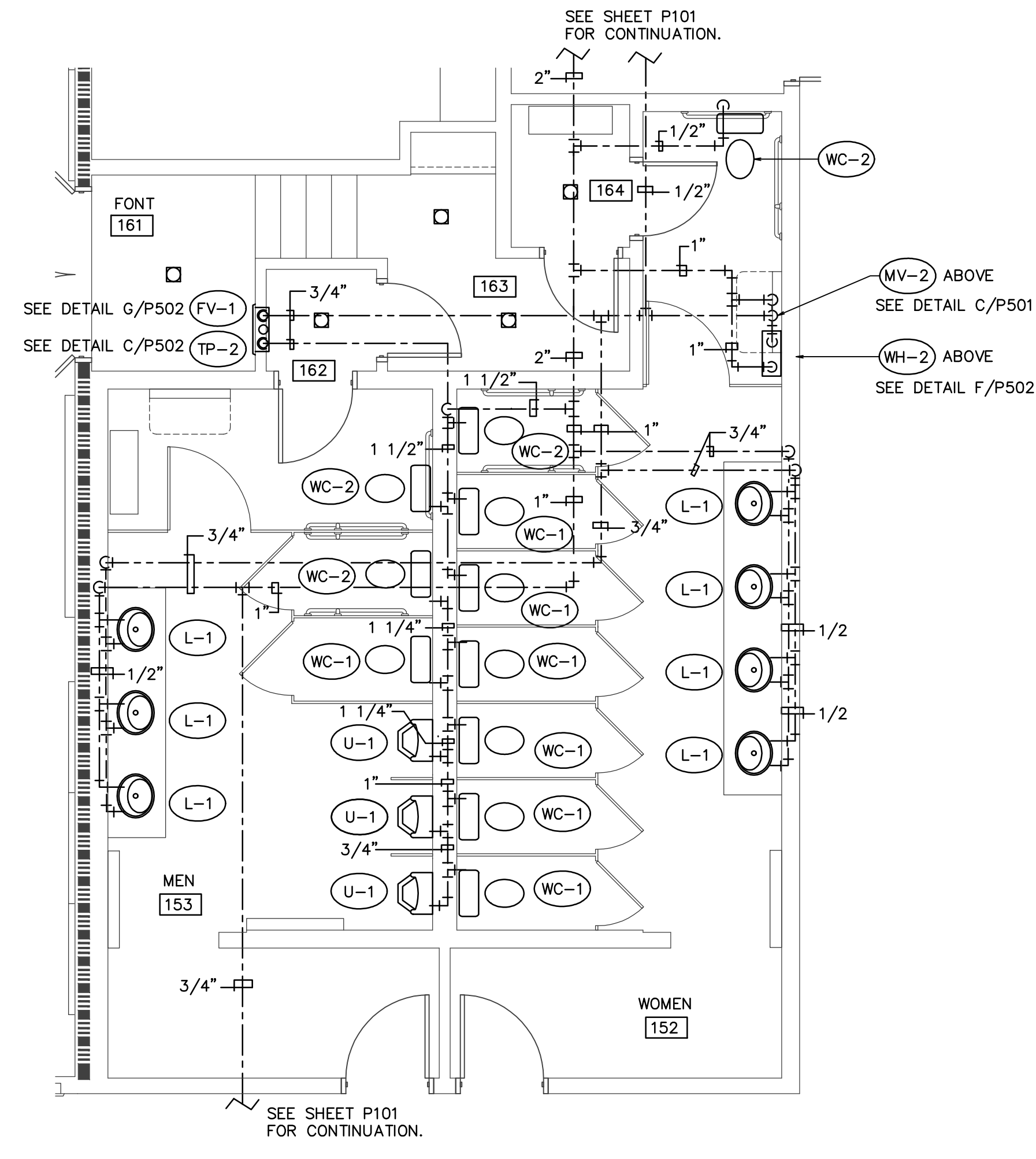


CHANGED DIRECTION OF WASTE PIPING TO DRAIN OUT SOUTH SIDE OF BUILDING.



RESTROOMS 152 AND 153 PLUMBING

SCALE: 1/4" = 1'-0"

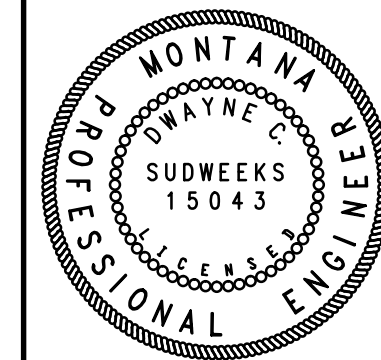


RESTROOMS 152 AND 153 WATER SUPPLY

SCALE: 1/4" = 1'-0"



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DATE ORIGINAL SIGNED: Sep 15, 2016  
ORIGINAL ON FILE AT ENGINEERED SYSTEMS ASSOCIATES  
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**Engineered Systems Associates**  
1355 EAST CENTER  
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EMAIL: esa@engsystems.com  
ESA JOB NUMBER: 15001

Architect / Engineer:  
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Heritage 98  
Billings Montana Stake  
2620 54th Street W.  
Billings Montana 59106

Project for:  
**THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS**

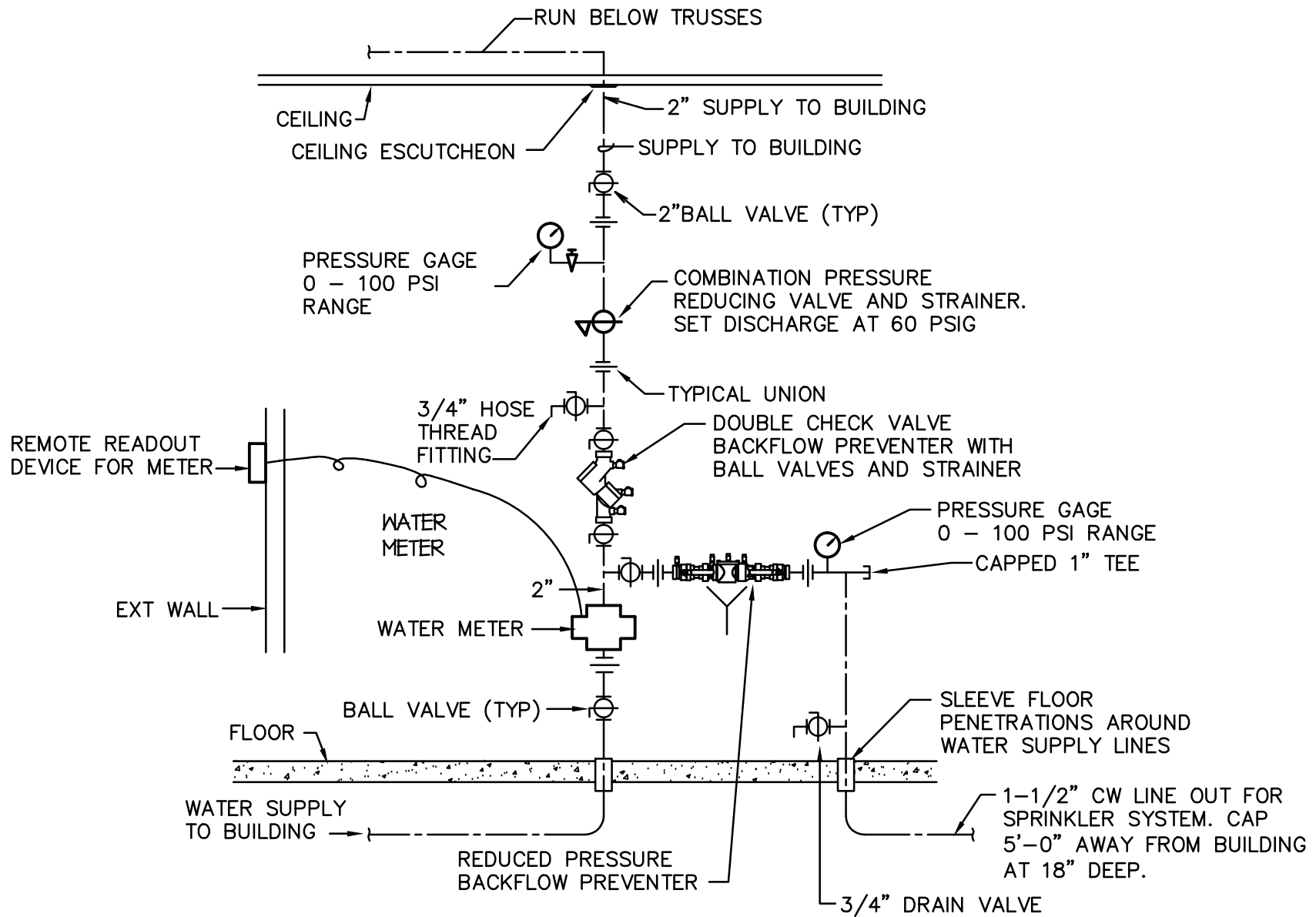
Mark	Date (m/d/y)	Description

Project Number:  
15047  
Plan Series:  
HER-TRA-98-20  
Property Number:  
501-1850

Sheet Title:  
**LARGE SCALE PLUMBING PLANS**

Sheet:

**P401**



## VERTICAL WATER PRESSURE REDUCING STATION DETAIL

(B)

SCALE: NONE

