



Draft

Standard Specifications and Drawings

Prepared by
Santaquin City Engineering and Public Works.
(Portions of text and Unaltered Drawings
Provided by J-U-B Engineers, Inc.)

**Approval by the Santaquin City Council
December 19, 2023**

This Manual Updated Yearly

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Chapter 4

Standard Specifications

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2023 Standard and Specifications and Drawings Updates

Errata for

Changes made to the Santaquin City Standard Specification and Drawings

Division 1

- The proposed change is to update the pre-construction meeting location.

Section 1.05.

A pre-construction meeting with the Developer, Developer's Engineer, the Contractor(s) involved in the subdivision construction, ~~and with~~ representatives of all utility companies that will provide service to the development invited shall be held with the Public Works Representative/Engineer, Public Works Inspector, and any other City Personnel deemed necessary prior to commencement of any work. The meeting will not be conducted until payment has been made for all fees, street lights, and traffic signs. The location of the meeting shall be at the Santaquin City Community Development Office, ~~110 South Center Street~~^{275 West Main Street}, Santaquin, Utah 84655 or at another location determined by the Public Works Representative/Engineer. The date and time of the conference shall be ~~set up~~^{up determined} by the Developer and the Public Works Representative/Engineer.

Division 2

- The proposed change updates the pipe embedment material to match American Public Works Association (APWA) specifications.

Section 2.07, Subsection A:

i. Bedding and Initial Backfill Material:

~~a. Ductile iron pipe One hundred percent (100%) less than two inch (2") and maximum of five percent (5%) passing a No. 200 sieve.~~

~~b. PVC or polyethylene pipe One hundred percent (100%) less than three quarter inch (3/4") and maximum five percent (5%) passing a No. 200 sieve.~~

~~c. Concrete pipe Refer to Section 4.06 (Concrete Pipe / Pipe Bedding) One Hundred percent passing the #4 sieve and less than 15 percent passing the #200 sieve.~~

Division 3A

- The proposed change requires that if a Culinary Water service meter box ring & lid is located within a concrete surface (i.e., not in a landscaped area) the ring and lid must be a larger diameter to allow for public works crews to access the meter for servicing

Section 3A.05 Subsection E:

- If a meter box is located within a ~~drive approach concrete surface~~ the standard meter box shall be replaced with an H-20 or HS-20 load traffic rated box and a 2 foot diameter traffic rated lid and associated ring.

Standards Drawing

- ST1 – Standard Street Cross section update
 - Added note: “As approved by City Council on March 1, 2022, this is the required minimum cross section for all local streets/roads approved for development prior to December 19, 2023.
 - Removed 26' rural private lane cross section
 - Relocated 5 lane/no parking 90' Arterial cross section from ST2

- ST2 – Standard Street Cross section update
 - Added New 58'2 lane local road cross section. This addresses the maximum asphalt width of 32' as required by Utah State Code.
 - Relocated 5 lane/no parking 90' Arterial cross section to ST1

CHAPTER 4

STANDARD SPECIFICATIONS

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DIVISION 1

GENERAL REQUIREMENTS

Section 1.01 PURPOSE OF DOCUMENTS

The purpose of these Standard Specifications and Standard Drawings is to govern any work done or improvements installed in Santaquin City. Construction work shall comply with the Santaquin City Management Code and the Santaquin City Subdivision Regulations. Developers/Contractors should thoroughly read and understand these specifications and standards before constructing public improvements.

The Developer/Contractor shall contact Public Works/Engineering at the Santaquin City Community Development Office, 275 West Main Street, Santaquin, Utah 84655 for all matters dealing with construction work within a City right-of-way or with any work connecting to a City utility. **SPECIAL PERMITS AND BONDING ARE REQUIRED FOR ALL SUCH WORK.**

Section 1.02 DEFINITIONS

Public Works Project: Refers to a project requiring the construction of any infrastructure that will be owned, maintained or operated by Santaquin City.

Public Works Representative/Engineer: Refers to the City Engineer, Public Works Director, Public Works Inspector, and Public Works staff or others as designated by the City Engineer/Public Works Director.

Developer/Contractor: Refers to the Individual or group of individuals that will be planning, constructing, working or having an effect on any infrastructure that will be owned, maintained or operated by Santaquin City.

Section 1.03 EXCAVATION PERMIT, FEES AND BONDING REQUIRED

It shall be unlawful to do any construction, excavation work on any street, curb, gutter, sidewalk, sewer line, water line, pressure irrigation line, storm drain or other infrastructure addition or improvement in the City of Santaquin without an Excavation Permit to work in the public Right-of-Way from the City to do so. The City of Santaquin and all utility companies are bound by these standard specifications. No work shall be started until a permit is secured. In order to obtain an Excavation Permit, the Developer's/Contractor's authorized signature is required. If a contract to do such work for the City has been finalized, the contract fulfills the permit requirement.

Sub-Section A. Permit Application:

All Excavation permit applications shall include:

- 1) Start and completion dates of the project.
- 2) The exact address or location of the work to be done.
- 3) The type of work to be done.
- 4) A request to locate water and sewer lines (at least 48 hours previous to start date of work).
- 5) A request for all utility companies to be contacted through Blue Stakes 1-800-662-4111.

Sub-Section B. Fee Assessment:

Before a permit is issued, a permit fee and an inspection fee shall be paid to the City. These fees will be set by Council resolution. Fees shall be assessed on the following items:

- 1) Sewer and water lateral installation inspection
- 2) Pressure irrigation service connection.
- 3) Re-inspection (When an inspection has been requested, the inspection is performed and the work is not complete, a re-inspection fee shall be assessed.)
- 4) Barricades (provided by, or called out by the City)

Sub-Section C. Bonding:

Before a permit is issued all bonding shall be paid to the city. Bonding amount will be determined by the Public Works Representative/Engineer.

For work to be done under contract with the city the bonding requirements are as follows

- 1) Contractor shall maintain a \$2,000 dollar bond. Bond is used to guarantee the following
 - a. Construction work is completed.
 - b. Final inspection is conducted.
 - c. Repairs and/or replacement of required public improvements are finished and accepted.
- 2) Bonds shall be in the form of an irrevocable line of credit from a lending institution or a cash bond paid directly to the city.
- 3) No bonds shall be released until all the improvements are completed and the City has inspected and accepted the improvements.

For installation of new infrastructure to serve a new development:

- 1) Bonding shall follow the requirements contained within Santaquin City ordinance Title 11 Chapter 11.

Section 1.04 CONTRACTOR AND CONSTRUCTION PLAN APPROVAL

Before a Contractor performs any work within the City, the City shall approve the Contractor. Approval is granted for a period of one (1) year upon submission of the following:

- a) A current Utah State E100 General Engineering Contractor's License. Work will be restricted to that authorized by the license.
- b) Proof of comprehensive general liability insurance. Bodily injury insurance will be in an amount of not less than three hundred thousand dollars (\$300,000.00) for any one occurrence. Property damage insurance will be in an amount of not less than two hundred thousand dollars (\$200,000.00) for any one occurrence and shall include underground exposure. Combined liability insurance will be in an amount of not less than five hundred thousand dollars (\$500,000.00) for any one occurrence.
- c) A two thousand dollar (\$2,000.00) guarantee bond owing to the City, that will be in effect for a period of one (1) year, or one (1) year after the completion of work performed by the contractor, whichever is greater.

The Public Works Representative/Engineer shall approve improvement drawings and cut sheets before any work begins. Developers/Contractors proceeding with work without such approvals shall have the project shut down until such approvals are obtained. Repeated offenses may result in the Contractor losing the pre-qualification to perform work in the City and action against his/her state license. Review time for improvement drawings and cut sheets requires **72 hours** from the time submitted to when the Developer/Contractor may pick them up and begin work. Cut sheets may be submitted once **Finalized Plans** have been stamped and initialed.

Section 1.05 PRE-CONSTRUCTION CONFERENCE

A pre-construction meeting with the Developer, Developer's Engineer, the Contractor(s) involved in the subdivision construction, and representatives of all utility companies that will provide service to the development shall be held with the Public Works Representative/Engineer, Public Works Inspector, and any other City Personnel deemed necessary prior to commencement of any work. The meeting will not be conducted until payment has been made for all fees, street lights and traffic signs. The location of the meeting shall be at the Santaquin City Community Development Office, 110 South Center Street, Santaquin, Utah 84655, or at another location approved by the Public Works Representative/Engineer. The date and time of the conference shall be set up by the Developer and the Public Works Representative/Engineer. A minimum of **72** hours prior to the date and time of the meeting are required to permit notification of all participants. The following items shall be furnished at the meeting:

- a) A detailed outline showing the sequences of construction of principle items of work. The outline shall show the beginning and ending dates of the major items of work on the Project.
- b) A list of names, titles, addresses, and telephone numbers of the Developer/Contractor's responsible personnel, indicating those who may be reached outside normal working hours.
- c) A list of Sub-Contractors and Materials Suppliers to be involved with the project and the items of work they are going to perform or furnish materials for. The City will notify the Developer/Contractor of any concerns or pre-qualification deficiencies of the companies they plan to use.

- d) Drawings from each utility company showing the location and time schedule in which their improvements will be completed. It shall be the Developer's responsibility to follow-up with the utility companies to see that their drawings are at the conference.
- e) The Developer is responsible to see that Developers Engineer, the Contractor(s), and representatives of each utility company are notified of the date, time and place of the pre-construction conference.

Other items may be discussed at this pre-construction conference as determined by the Public Works Representative/Engineer. Official minutes of this meeting as prepared by the Public Works Representative/Engineer shall become part of the project file for the project.

Section 1.06 TIMELY COMPLIANCE WITH THE ISSUED PERMIT

The Developer/Contractor shall perform in accordance with the terms of the permit and the Standard Specifications and Standard Drawings in effect at the date of the permit. The work shall be done in a timely manner. Time limits may be a condition of the permit and may be shortened because of safety concerns. Permits may be suspended if compliance is not met.

Sub-section A. Inspections:

All work covered by a Public Works permit shall be inspected by a Public Works Representative prior to the following:

- 1) Backfilling and compacting.
- 2) Placing concrete and asphalt
- 3) Placing any underground piping
- 4) Making any connection into a City utility line
- 5) Other work done in a public right of way.

Public Works shall also be notified prior to starting any Public Works project.

Sub-section B. Notification of Needed Inspections:

- 1) Inspection performed during regular working hours requires at least twenty-four (24) hours' notification.
- 2) Inspections needed on the weekend or City holidays, require that notification be given by 1:00 p.m. on the preceding Friday or day preceding holiday.
- 3) A charge shall be assessed for inspection call backs.

Sub-section C. Responsibility of the Developer:

The Developer is responsible for the complete development, including construction of the entire subdivision, until it is finalized and accepted by the City.

Sub-section D. Conflict:

These Standard Specifications and Standard Drawings are the minimum requirements of the City of Santaquin. In the event that any provisions herein conflict with general industry standards, or with other requirements specified by the City, the more stringent of the standards will apply.

Section 1.07 ELECTRONIC AND RECORD DRAWINGS

When the Developer's Engineer has the capability, plat and improvement drawings shall be furnished electronically in MicroStation Format (.dgn), AutoCAD format (.dwg) or Data Exchange Format (.dxf). These electronic files shall be provided to the City after completion of all the improvements and final acceptance of the work by the City. A final bond release shall not be made to the Developer until these electronic files are received and reviewed by the Public Works Representative/Engineer. The Developer shall be responsible for all costs associated with the preparation of these electronic "Record Drawings."

In addition to the electronic files, after completion of all public works improvements the Developer shall provide the City with two sets of mylar "Record Drawings" which have been corrected to show the constructed improvements.

Final payment from the bond shall not be made until these records are received.

Section 1.08 TEMPORARY SERVICES

Any temporary services and utilities such as telephone, electrical, water, toilet facilities, etc., shall be the responsibility of the Developer/Contractor.

Section 1.09 CODES AND STANDARDS

Where codes and standards are referred to they shall be current, approved copies. It shall be the duty of the supplier of any material on this work to submit evidence, if requested, that its material is in compliance with the applicable codes and standards.

If there is a specified standard (i.e. APWA, Santaquin City Standards, Subdivision Geotechnical report...) the more stringent requirement shall apply.

Section 1.10 STATE AND LOCAL LAWS

The Developer/Contractor shall conform to all applicable state and local laws in carrying out its obligations for the Development or under the Contract.

This shall include, but is not limited to, compliance by the Developer/Contractor with the requirements of Chapter 30, of Title 34, of the Utah Code Annotated, 1953 as Amended. If the provisions of Section 34-30-1, of the Utah Code Annotated, 1953 as amended, are not complied with, further construction of improvements shall stop until compliance is met.

Section 1.11 COMPLIANCE WITH GOVERNMENTAL REGULATIONS

The Developer/Contractor's personnel, equipment, and operations shall comply fully with all applicable standards, regulations, and requirements of existing Federal, Utah State, and Local governmental agencies. This shall include, but not necessarily be limited to, the following:

Sub-section A. United States Occupational Safety and Health Administration Regulations:

Title 29 of the Code of Federal Regulations, Part 1926 (29 CFR Part 1926), Safety and Health Regulations for Construction.

Sub-section B. Utah State Industrial Commission Regulations:

The Utah Occupational Safety and Health Act (1973) and Employer-Employee Safe Practices for Excavations and Trenching Operations (Jan. 1, 1974), as published by the Utah State Industrial Commission, including any and all amendments or revisions effective prior to performance of the work.

Sub-section C. City Codes and Ordinances:

The Developer/Contractor shall be required to comply with all Santaquin City Codes and Ordinances. This shall include, but not be limited to, International Building Code, International Plumbing Code, International Residential Code, International Mechanical Code, International Fire Code, and National Electrical Code – each the latest edition.

Sub-section D. UDOT Requirements:

When crossing or working within Utah Department of Transportation (UDOT) rights-of-way the Developer/Contractor shall be responsible to obtain all necessary permits and comply with all appropriate UDOT regulations including applicable sections in "Utah Department of Transportation Standard Specifications," latest edition.

Sub-section E. Permits:

The Developer/Contractor is responsible to obtain all required business licenses and building permits applicable to this project. Developer/Contractor shall be subject to the conditions of all permits and agreements between the Owner and the permitting agencies. See Division 14, Utah Department of Transportation Rights-of-Way.

Section 1.12 FEDERAL, STATE, AND LOCAL INSPECTING AGENCIES

The site of construction is to be open at all reasonable times and places for periodic observation by accredited representatives of the Federal, State, and local agencies who have regulatory or supervisory authority over any part of the work proposed or regulated thereto.

Section 1.13 PUBLIC SAFETY AND CONVENIENCE

The convenience of the general public and the protection of persons and property is of prime importance and shall be provided for by the Developer/Contractor during this project. The Developer/Contractor shall use every reasonable precaution to safeguard persons and property. Failure of the Owner or the Public Works Representative/Engineer to notify the Developer/Contractor of any deficiencies in providing for public safety and convenience shall not relieve the Developer/Contractor from its responsibility. The Developer/Contractor shall be required to comply with the requirements of the **Manual on Uniform Traffic Control Devices (MUTCD)**.

Sub-section A. Compliance with Rules and Regulations:

The Developer/Contractor shall comply with all rules and regulations of the City, County, and State authorities regarding the closing of public streets, or highways, to the use of public traffic. If conditions justify, the Public Works Representative/Engineer may authorize the Developer/Contractor to close general traffic to not more than one (1) City block at any given time. No such closure shall be made without authorization of the Public Works Representative/Engineer. Closure of streets or highways shall be in conformance with the MUTCD.

Sub-section B. Road Closures and Obstructions:

No road shall be closed by the Developer/Contractor to the public except by express permission of the Public Works Representative/Engineer. The Developer/Contractor shall, at all times, conduct its work so as to insure the least possible obstruction to traffic and normal commercial pursuits.

Sub-section C. Protection of the Traveling Public:

All obstructions within traveled roadways shall be protected by signs, barricades, and lights where necessary for the safety of the traveling public. All barricades and obstructions shall be protected at night by signal lights that shall be suitably distributed across the roadway and kept burning from sunset to sunrise. Barricades shall be of substantial construction. Failure of the Owner or the Public Works Representative/Engineer to notify the Developer/Contractor to maintain barricades, barriers, lights, flares, danger signals, or guards shall not relieve the Developer/Contractor from its responsibility.

Sub-section D. Hazardous Conditions:

Whenever the Developer/Contractor's operations create a hazardous condition, it shall furnish flaggers and guards to give adequate warning to the public of any dangerous conditions to be encountered. It shall furnish, erect, and maintain fences, barricades, signs, lights, and other devices that may be necessary to prevent injury and damage to persons and property. Flaggers and guards shall be UDOT trained and shall hold current certification and shall be equipped with signs, flags, etc. as required by the UDOT regulations.

Sub-section E. Dust and Debris Control:

The Developer/Contractor shall control dust and debris that originates in the construction right-of-way or site. Dust, trash, and other debris shall be controlled on a daily basis by methods that shall include, but not be limited to, the use of a dust settling spray, a "pick-up broom" or street sweeper and trash disposal. Dust shall be controlled such that there will not be unnecessary dust blown into adjacent neighborhoods. The Developer/Contractor shall maintain on the project site a water truck with a minimum two thousand (2,000) gallon capacity. The Developer/Contractor shall be responsible to secure a source of water and shall obtain the necessary permission for its use. Failure by the Developer/Contractor to adequately control dust and debris may result in the Owner initiating dust and debris control measures and deducting the cost from payment due to the Developer/Contractor.

Section 1.14 CONFINEMENT OF WORK AND ACCESS TO RIGHT-OF-WAY AND EASEMENTS

The Developer/Contractor will be required to confine construction operations within the dedicated right-of-way for public thoroughfares or within areas for which construction easements have been obtained unless it has made special arrangements with the affected property owners in advance. The Developer/Contractor will be required to protect surface improvements located adjacent to the proposed construction site or replace damaged landscaping (see Division 10). During construction operations, the Developer/Contractor shall construct and maintain such facilities as may be required to provide access by all property owners to their property. No person shall be cut off from access to their residences or places of business for a period exceeding eight (8) hours, unless the Developer/Contractor has made special arrangements with the affected persons prior to commencing work in the area.

Section 1.15 NOTIFICATION OF RESIDENTS

All property owners and residents adjacent to the streets or easements affected by the construction shall be notified by the Developer/Contractor at least forty-eight (48) hours in advance of time construction begins. The Developer/Contractor can satisfy this requirement by placing a written notice on the door of each residence or business reading "Notice of Construction Operation. (Developer/Contractor) will be working on the construction of street improvements on your street starting about _____ and ending about _____. The Developer/Contractor shall provide a copy of the notification form at the pre-construction meeting and the method to be used (hang on door, etc.)

Section 1.16 WEATHER CONDITIONS

In the event of temporary suspension of work, or during inclement weather, the Developer/Contractor will, and will cause its SubDeveloper/Contractors to, protect any project work or materials against damage from the weather. If, in the opinion of the Public Works Representative/Engineer, any Project work or materials become damaged, such work or materials shall be removed and replaced at the expense of the Developer/Contractor.

Section 1.17 LAND MONUMENTS

The Developer/Contractor shall preserve existing City, County, State, and Federal land monuments whenever possible. When these monuments cannot be preserved, the Developer/Contractor shall notify the Public Works Representative/Engineer at least two (2) weeks in advance of the proposed construction in order that the Public Works Representative/Engineer will have ample opportunity to reference these monuments for later replacement.

Section 1.18 SOURCE OF MATERIALS

All materials furnished or incorporated into this work shall conform to the requirements of these Specifications.

The Developer/Contractor shall acquire the necessary rights, at its own expense, to take material from aggregate sources and to use properties for plant site, hauling roads, and other purposes.

The Developer/Contractor may select areas for disposal of surplus materials; however, the Developer/Contractor will be responsible for acquiring the necessary right, at its own expense, to use the property for such purpose. Areas within the City are subject to review and approval by the Development Review Committee (DRC), who may require a site restoration plan.

Section 1.19 CONSTRUCTION WATER

It is the responsibility of the Developer/Contractor to make arrangements for water needed during construction. Water may be needed for moisture conditioning of soil and/or granular materials that are to be compacted, flushing lines of various types, and filling and testing pressure lines. Water to be used in filling, testing and flushing culinary water lines shall come from Santaquin City's culinary water system or other approved potable water source. The Developer/Contractor shall not obtain water from or operate any fire hydrant on the City's culinary water system without first obtaining approval from Santaquin City's Water Department. They shall comply with all requirements of the City including metering or load counts and the time of day water can be taken.

Section 1.20 OPERATION AND MAINTENANCE MANUALS

The Developer/Contractor shall furnish the Public Works Representative/Engineer with two (2) sets of all operation and maintenance manuals, improvement drawings, diagrams, etc., for all pumps, motors, control panels, valves, meters, etc., for use in the Operation and Maintenance Manual.

Section 1.21 INTERFERING STRUCTURES, UTILITIES AND FACILITIES

The Developer/Contractor shall exercise all possible caution to prevent damage to existing structures and utilities, whether above ground or underground. While these structures and utilities may be shown on the improvements plans, the information has been compiled from the best available sources, its completeness and accuracy cannot be guaranteed, and it is presented simply as a guide to possible difficulties. The Developer/Contractor shall notify all utility offices concerned at least forty-eight (48) hours in advance of construction operations in which a utility agency's facility may be involved. Notification to blue stakes does not necessarily cover all buried lines. This shall include, but not be limited to, irrigation, water, telephone, electric, sewer, storm drain, gas, and cable television. The Developer/Contractor shall be responsible for any and all changes to, relocation of, or re-connection to public utility facilities encountered or interrupted during the prosecution of the work, and all costs relating thereto shall be at the Developer/Contractor's expense. The Developer/Contractor shall contract with and pay Public Utility Agencies for work required in connection with all utility interference's and handle all necessary notifications, scheduling, coordination and details.

It shall be the responsibility of the Developer/Contractor to relocate and expose all existing underground structures and utilities in such a manner as to prevent damage to the same. Any structure or utilities damaged by the Work shall be repaired or replaced at the Developer/Contractor's expense.

If the Developer/Contractor encounters existing structures that will prevent construction, it shall notify the Public Works Representative/Engineer before continuing with the construction in order that the Developer's Engineer or Public Works Representative/Engineer may make such field revisions as necessary to avoid conflict with the existing structures.

Section 1.22 MATERIAL AND COMPACTION TESTING

During the course of the work, a Geotechnical Engineer/Testing Company approved by the City, shall perform such tests as are required to identify materials, to determine gradation, to determine compaction characteristics, to

determine moisture content, to determine density of trench backfill and fills in place, to determine density of imported granular material and road base, to determine concrete strength, to determine density and mixture of asphalt. These tests will be used to verify that the construction conforms to the requirements of the specifications. Such tests are not intended to provide the Developer/Contractor with the information required by it for the proper execution of the work and their performance shall not relieve the Developer/Contractor of the necessity of completing the construction in accordance with these specifications and Standard Drawings.

The estimated cost of such testing will be included in the Developer's bond posted with the City. The City shall contract with a geotechnical or certified testing company to perform the necessary tests. The Developer shall pay the actual cost of testing prior to final release of the bond. Copies of the tests will be furnished to the Public Works Representative/Engineer. Developer/Contractor will get copies of the test results from the company performing the tests. Before final release of the bond, the Geotechnical Engineer/Testing Company shall furnish the Public Works Representative/Engineer with a letter certifying that the test results have been in compliance with these Standard Specifications and Drawings and that the recommendations set forth in the geotechnical report were carried out. "Open tests" shall have been retested and/or the resolution thereof specifically addressed in the letter.

Section 1.23 TESTING AND PROCESS CONTROL

The Developer/Contractor has the responsibility to adequately test native materials and construction materials, and to furnish the City with manufacturer's certifications of material quality.

Sub-section A. Quality Assurance:

The Developer/Contractor shall be responsible for all sampling, delivery of samples to a qualified testing agency, testing, and delivery of test results or materials certifications to City at no charge to the City. Testing and certifications reports shall be approved by the City as to conformance to City standard specifications prior to final inspection and/or acceptance by the City of any materials or workmanship.

Sub-section B. Submittals:

Submittals shall consist of two types:

- 1) Field Test Report: When possible submit original report immediately to Public Works Representative/Engineer, but in no case later than end of following day.
- 2) Laboratory Test Report: Submit original report to Public Works Representative/Engineer within 48 hours after test results are determined.

Sub-section C. Sampling:

- 1) Sampling of materials shall be as specified in each test.
- 2) The Public Works Representative/Engineer may require that sampling be performed in their presence, in which case the Developer of Contractor shall be notified of this requirement in writing at the time the building permit is issued, or at the Preconstruction meeting, or when construction drawings are released by the City for construction, as applicable.
- 3) The presence of a Public Works Representative/Engineer shall not relieve the Developer/Contractor of any requirements in this Section.
- 4) Each sample or test shall be accompanied by the following written data, which shall be reported to the City with test results:
 - a) Name of Project
 - b) Name of Developer/Contractor
 - c) Project Street Address
 - d) Appropriate Test Name
 - e) Date of Sampling
 - f) Sample Number (if more than one sample per day)
 - g) Name of technician who performed the testing

- h) Location of sample

Sub-section D. Soil Classification Test:

- 1) The soil classification test shall be conducted to determine the suitability of native soils for road sub-grade and building foundations.
- 2) The soil shall be classified according to the Unified Soil Classification System and/or AASHTO soil classifications
- 3) The AASHTO soil classification test shall conform to AASHTO M-145 of latest revision
- 4) One soil classification test shall be required for each test area. A test area shall be limited to one parcel of one soil type, a maximum 1,000 feet long and maximum 5 acres. The Public Works Representative/Engineer may modify this requirement on a case by case basis.
- 5) The soil sample shall be taken from a test area at a minimum depth of 24-inches below the future design grades, of native soil, and shall be free from foreign material, asphalt, concrete, ice or manmade materials.
- 6) Where deep footings or pile foundations are proposed, soil classification tests at several depths may be required in each test area.
- 7) The results of all determinations shall be reported to the City in the form of a Geotechnical Report. The geotechnical report shall be certified by a Licensed Professional Engineer qualified in these types of investigations. The geotechnical report shall include, with additions as deemed necessary by the Public Works Representative/Engineer, the following information:
 - a) A plot plan showing the location of all test borings and excavations.
 - b) Descriptions and classifications of the materials encountered.
 - c) Elevations of the water table, if encountered and an opinion of the seasonal fluctuation of the level.
 - d) Evaluation of the subsurface soil conditions at the site.
 - e) Assess the appropriate engineering characteristics of the subsurface soils.
 - f) Provide geotechnical recommendations for general site grading, the design and construction of foundations, basements, concrete floor slabs, and asphalt pavement sections. The report shall include soil strength, bearing capacity, and provisions to mitigate the effects of expansive soils, collapsible soils, liquefaction, and adjacent loads.
 - g) Expected total and differential settlement.

Sub-section E. Compaction Test of Soil and Untreated Base Course:

- 1) Laboratory test to establish maximum laboratory density shall be determined in accordance with AASHTO T-180, Method D or ASTM D 1557.
- 2) Samples to determine laboratory density shall be taken from the stockpiled backfill or from the uncompacted base course in place.
- 3) The acceptance of soil and base course with respect to compaction shall be based upon the average density of all density tests made in a lot.
 - a) Field density tests shall be taken as specified in AASHTO T-191 or by use of a portable nuclear density testing device. Field density tests shall be taken at a depth equal to $\frac{1}{2}$ the maximum depth of the lift tested.
 - b) A lot shall equal the amount of soil or untreated base course compacted in each production day.
 - c) A test lot shall be divided into sub-lots and one density test shall be taken within each sub-lot.
 - d) The location of sampling sites within the sub-lot shall be chosen on a random basis by use of a suitable random number table or at the locations designated by the Public Works Representative/Engineer.
 - e) Each test lot shall have a minimum of two (2) sub-lots. A sub-lot shall be no larger than 1,000 cubic yards for embankment, no larger than 200 cubic yards for backfill over pipe or against structures and no larger than 500 tons for untreated road base.
- 4) The test results of all samples tested shall be reported to the City. A test lot shall be accepted when the average of the density determinations is not less than the density required for that improvement in these specifications and when no one density determination is less than 95% of the density required by these specifications.
- 5) Compaction test not meeting the required specifications may be rejected and re-compaction or related

construction efforts to obtain compaction shall be at the Developer/Contractor's expense.

- 6) All compaction testing must be completed no less than 24 hours prior to the placement of any asphalt or concrete within the roadway and sidewalk.

Sub-section F. Test Roll of Roadway Sub-grade:

- 1) Roll Test shall be performed to determine the structural integrity of the sub-grade and street section.
- 2) The Roll Test shall be performed as follows:
 - a) The Developer/Contractor shall provide a loaded 10 wheel dump truck or water truck to drive over the sub-grade material within the roadway.
 - b) The loaded truck shall be driven slowly over the sub-grade to locate soft spots in the sub-grade surface.
 - c) Soft spots in the sub-grade shall be identified and marked by the Public Works Representative/Engineer.
 - d) It shall be the Developer/Contractor's responsibility to remove the rejected sub-grade material to depth determined by Public Works Representative/Engineer. The rejected material shall be replaced with A-1-a granular backfill material approved by Public Works Representative/Engineer.

Sub-section G. Gradation Test of Untreated Base Course:

- 1) The gradation of untreated base course shall be determined in accordance with AASHTO T-27
- 2) The total amount of material passing the No. 200 sieve shall be determined by washing in water in accordance with AASHTO T-11.
- 3) The acceptance of road base with respect to gradation shall be based upon the average of all determinations in a lot. A lot shall be limited to one source of borrow and limited to one subdivision plat or one development. One sample shall be required for each 500 tons or any fraction thereof of untreated base course in a test lot. When the test lot is less than 100 tons, the requirement for the gradation test may be waived by the Public Works Representative/Engineer.
- 4) The location of sampling sites within the sub-lot shall be chosen on a random basis by use of a suitable random number table or at the locations designated by the Public Works Representative/Engineer.
- 5) All material not conforming to the specified gradations may be rejected and replaced with material conforming to the specified gradations at the Developer/Contractor's expense.

Sub-section H. Extraction – Gradation Testing of Bituminous Surface Course:

- 1) Samples of the bituminous surface course or asphalt concrete shall be tested with respect to gradation and bitumen content in accordance with Utah Department of Highways Test Procedure 8-946 and 8-947 if required by the Public Works Representative/Engineer.
- 2) Mix design shall be submitted to the Public Works Representative/Engineer for approval 5 working days before work is to begin.
- 3) Acceptance of bituminous surface course with respect to gradation and bitumen content shall be based upon the average of the determinations made in a lot.
 - a) A lot shall equal the amount of bituminous surface course placed in each production day.
 - b) When a lot exceeds 500 tons, a minimum of three (3) samples shall be taken in each lot.
 - c) When a lot is 500 tons or less, a minimum of two (2) samples shall be taken.
 - d) Samples shall be taken at the time of lay-down of bituminous surface course and before compaction. Samples shall be taken from the mat behind the lay-down machine.
 - e) Sampling shall be timed to represent the entire production day. The time of day, date or sample, station and offset location shall be clearly marked with the sample.
 - f) If the average asphalt is less than 2.5% of optimal content, the Contractor may be required to lay an additional lift, based on the Public Works Representative/Engineer recommendation.

Sub-section I. Compaction Testing of Bituminous Surface Course:

- 1) Laboratory tests to establish the maximum laboratory density of bituminous surface course shall be determined by the "Marshall Test" in accordance to ASHTM D-1559.
- 2) Samples to determine maximum laboratory density shall be taken at the time bituminous surface course is placed and before compaction.
- 3) Acceptance of bituminous surface course with respect to compaction shall be based upon the average determination of field density tests made in a lot.
 - a) Field density test shall be by laboratory density analysis of core samples.
 - b) A test lot shall be the quantity of surface course placed and compacted in each construction day.
 - c) The test lot shall be subdivided into sub-lot(s) of approximately equal size and no larger than 2,000 square yards in area.
 - d) The location of sampling sites within the sub-lot shall be chosen on a random basis by use of a suitable random number table or at the locations designated by the Public Works Representative/Engineer.
- 4) The test lot shall be accepted with respect to density when the average of all density determinations is not less than the density required by Division 11.
- 5) Core Tests.
 - a) Acceptance of the completed bituminous surface course with respect to thickness shall be based on the average thickness of a test lot.
 - 1) A test lot shall equal approximately 4,000 square yards of completed roadway.
 - 2) A lot shall be divided into sub-lots of approximately 2,000 square yards.
 - b) One thickness test, randomly selected by use of a random number table or at the locations designated by the Public Works Representative/Engineer, shall be taken within each sub-lot. A minimum of three core tests will be taken.
 - c) A lot shall be accepted when the average thickness of all sub-lots is less than 3/8-inch less than the total designated bituminous surface course thickness and when no individual sub-lot shows a deficient thickness of more than 1/2-inch.
 - d) Lots or sub-lots that are not acceptable because of deficient thickness shall be brought into compliance by placing additional surface course as directed by the Public Works Representative/Engineer.
 - e) The removed core will be replaced with hot asphalt or low strength concrete.

Sub-section J. Compressive Strength Testing of Concrete Cylinders:

- 1) Samples of concrete shall be taken at the construction site, molded in standard cylinder shapes, allowed to cure, and tested with respect to comprehensive strength.
- 2) All samples of concrete shall be taken in conformance to AASHTO T-141, latest revision.
- 3) Acceptance of concrete with respect to compressive strength shall be based upon the average determination of all "compressive strength tests" made in a lot.
 - a) A test lot shall be the quantity of concrete placed at one job in a construction day.
 - b) A minimum of one "compressive strength test" will be taken of three cylinders for each 50 cubic yards concrete in a test lot, or fraction thereof. If placement is less than 5 cubic yards, proceed as directed by the Public Works Representative/Engineer.
 - c) The making and curing concrete test specimens in the field shall conform to AASHTO T-23. Compressive strength of cylindrical concrete specimens shall conform to AASHTO T-22.
- 4) Concrete may be rejected if desired strengths are not obtained. The concrete for which the tests failed shall be removed and replaced at the Developer/Contractor's expense.

Sub-section K. Additional Concrete Testing:

- 1) Slump Test: Determine slump in accordance with AASHTO T-27, (ASTM C-143). Use one test for each 50 cubic yards or fraction thereof. Reject concrete failing slump test (see Division 8 Section 8.04, Sub-section B).
- 2) Air Test: Determine normal weight concrete air content using AASHTO T-152 (ASTM C-231) for

- each 50 cubic yards or fraction thereof. Light weight concrete air content use ASTM C-173.
- a) If an air test fails, immediately retest the same load (do not mix or add water between tests).
 - b) The concrete will be rejected if the second air test does not meet the specification.
 - c) If the second air test meets the specification, a third test will be performed to establish concrete acceptance or rejection.
- 3) When requested by Public Works Representative/Engineer, test in-place concrete by impact hammer, sonoscope, or other nondestructive device.
- a) To determine relative strengths in various locations in Work.
 - b) To aid in evaluating concrete strength.
 - c) To select areas to be cored.

Sub-section L. Certifications:

- 1) When requested by the Public Works Representative/Engineer the Developer/Contractor shall obtain a manufacture's certificate certifying conformance to the applicable requirements of these Standard Specifications. Certifications that may be requested are but are not limited to those listed below:
 - a) Valves: Gate, Butterfly, Specialty.
 - b) Reinforcing Steel.
 - c) Structural Steel.
 - d) Pipe: Ductile Iron, AWWA C 900 or 905 PVC, Polyvinyl Chloride (Gravity, SDR 35), Concrete, Polyethylene Corrugated, Polyethylene (CTS), and Type K Copper.
 - e) Fire hydrants.

Sub-section M. Summary Table of Tests and Certifications:

- 1) The following is a summary of the tests, number of samples per test, and certificates that are or may be required for construction work and developments in Santaquin City. This summary is provided as a reference guide. For details governing each item, refer to the appropriate test specification herein.

Test Subject	Specific Test	Number of Tests
Soil Classification	Unified Soil Classification System or AASHTO M-145	1 test per test area of uniform soil type and 5 acres maximum.
Compaction of Embankments, Soil, Trench Backfill and Base Course. Embankments, Soil, and Base Course field density. Trench Backfill field density.	Lab Density - AASHTO T-180 Method D or ASTM D-1557 as applicable. Portable Nuclear Equipment or AASHTO T-191 (ASTM D-2922-96) Portable Nuclear Equipment or AASHTO T-191 (ASTM D-2922-96)	As needed to establish laboratory density. 1 test per sub-lot plus minimum one test per 1,000 cu. Yards. 1 test per sub-lot plus minimum one test per 100 feet of trench.
Test Roll of Roadway Sub-grade	N/A	As required by Public Works Representative/Engineer.
Base Course Gradation	Sieve Analysis – AASHTO T-27 Passing No. 200 Sieve – AASHTO T-11	1 test per 500 tons.
Extraction-Gradation Test of Bituminous Surface Course	UDOT Test Procedure 8-946 & 8-947	If lot is > 500 tons, 3 tests per pavement construction day if lot is < 500 tons, 2 tests per pavement construction day.
Compaction of Bituminous Surface Course	Lab Density-Marshall Test, ASTM D-1559.	1 test per pavement construction day. 1 test per sub-lot (2,000 square yards).
Core Tests	4" Core Sample	1 test per pavement construction day. 1 thickness test per 2,000 square yards or 3 test minimum.

Test Subject	Specific Test	Number of Tests
Concrete Test Cylinders	AASHTO T-23 and AASHTO T-22	Minimum of one “compressive strength test” of 3 cylinders for each 50 cubic yards in a test lot, or fraction thereof.
Slump Test	AASHTO T-27 (ASTM C-143)	One test for each 50 cubic yards or fraction thereof.
Air Test	AASHTO T-152 (ASTM C-231)	One test for each 50 cubic yards or fraction thereof.
Specialty Valves (Pressure Reducing, Regulating Valves, etc)	Manufacture’s Certificate	1 for each valve.
Gate Valve	Manufacture’s Certificate	1 for each valve.
Butterfly Valves	Manufacture’s Certificate	1 for each valve.
Reinforcing Steel	Manufacture’s Certificate	1 for each 1,000 pounds of one grade.
Structural Steel	Manufacture’s Certificate	1 for each lot of one shape, one grade.
Pipe: Ductile Iron, AWWA PVC, Polyvinyl Chloride (SDR 25), Concrete, Polyethylene Corrugated	Manufacture’s Certificate	1 for each 500 lineal feet of one size, one class.
Polyethylene (CTS) and Type K Copper.	Manufacture’s Certificate	1 for each 500 lineal feet of one size, one class

Section 1.24 INSTALLATION OF UTILITY CONDUITS

Developers shall be responsible to install utility conduits at locations specified by utility companies and approved by the City.

- a) Excavation shall be at depth and standards of utility companies.
- b) Conduit Pipe shall be approved by each utility company. Utility company engineers shall establish the location of conduits. Conduits shall have bends attached to each end and placed vertically out of the ground for location verification. Conduits within street rights-of-way shall have a minimum of 18" cover below finished street grade. Mark location by stamping “X” in top of curb. If tunneled under existing sidewalk and less than 18” deep, mark the location with a glue-on identifier.

Section 1.25 PHOTOGRAPHS

It is recommended that the Contractor photograph existing surfaces along which Work may take place prior to construction in order to determine, after construction is completed, whether any damage of existing improvements existed prior to construction operations. The photographs will be an aid in determining the condition of existing facilities and the level of restoration to be made. If the contractor does not photograph existing conditions prior to construction, and facilities are damaged at the end of construction, the contractor will be responsible to repair or replace damaged facilities.

DIVISION 2

TRENCH EXCAVATION AND BACKFILL

Section 2.01 GENERAL

This section covers the requirements for trenching and backfilling for underground pipelines. Unless otherwise shown or ordered, pipe shall be laid in an open trench. All incidental clearing, preliminary grading, structure removal, and benching shall be considered a part of the trenching operation.

Section 2.02 BARRICADES

Barriers shall be placed at each end of all excavations, and at such places as may be necessary along excavations, to warn all pedestrians and vehicular traffic of such excavations. Lights shall also be placed along excavations from one hour before sunset each day to one hour after sunrise of the next day, until such excavations are entirely refilled, compacted, and surfaced or final graded. All excavations shall be barricaded in such a manner as to prevent persons from walking into, falling into, or otherwise entering those excavations.

Section 2.03 BLASTING

Blasting will not be allowed except by permission from the Public Works Representative/Engineer. The Developer/Contractor shall comply with all laws, regulations, ordinances, and safety codes relative to the handling, storage, and use of explosives. The Developer/Contractor shall be fully responsible for all damage to life and property attributable to its blasting operations. Excessive blasting or overshooting will not be permitted. The Developer/Contractor shall remove any material outside the authorized cross section, which may be shattered or loosened by blasting.

Section 2.04 SHEETING, BRACING AND SHORING OF EXCAVATIONS

Excavations shall be sheeted, braced, and shored as required to support the walls of the excavations. These measures shall be taken to protect the workers, the work in progress, existing utilities, structures, and improvements, from damage due to sliding and settling of trench walls. All such sheeting, bracing, and shoring shall comply with the regulations of the Utah State Industrial Commission, and accident prevention and safety provisions of the Contract.

The Developer/Contractor shall be fully responsible for the adequacy of methods and materials used in trench sheeting, bracing, shoring, and other systems provided to protect workers. Injury to or death of workers resulting from inadequate trench safety measures shall be the full and complete responsibility of the Developer/Contractor. All damages resulting from lack of adequate sheeting, bracing and shoring shall be the responsibility of the Developer/Contractor, and the Developer/Contractor shall affect all necessary repairs or reconstruction at its own expense resulting from such damage.

Sheeting or shoring that does not extend below the centerline of the pipe may be removed at the discretion and responsibility of the Developer/Contractor after the pipe embedment has been placed and compacted to a level twelve inches (12") above the top of the pipe. Following removal of the sheeting or bracing, the trench shall be immediately backfilled and compacted or consolidated.

Section 2.05 CONTROL OF GROUNDWATER

All trenches shall be kept free from water during excavation, fine grading, pipe laying and jointing, and pipe embedment operations. Where the trench bottom is mucky or otherwise unstable because of the presence of groundwater, and in all cases where the static groundwater is above the bottom of any trench or bell hole excavation, such groundwater shall be lowered to the extent necessary to keep the trench free from water and the trench bottom stable when the work within the trench is in progress. The discharge from excavation dewatering shall be conducted to natural drainage channels, gutters, drains, or storm sewers. Discharge must meet UPDES requirements before entering any natural channel or storm drain system. Such discharge shall be temporary in nature for the construction of the underground utilities. No sanitary sewer

shall be used for disposal of trench water. Surface water shall be prevented from entering trenches.

Section 2.06 TRENCH EXCAVATION

Excavation for pipelines shall be located as shown on the Improvement Drawings or as staked in the field. Trenches shall be excavated to the depths and widths required to accommodate the construction of the pipelines, as follows:

Sub-section A. Normal Excavation:

Except in ledge-rock, cobbles, stones, or water-saturated earth, mechanical excavation of trenches shall not extend below an elevation four inches (4") above the bottom of the pipe after placement in its final position. All additional excavation necessary for preparation of the trench bottom shall be made manually.

Sub-section B. Authorized Over-Excavation:

Where ledge-rock, cobble rock, stones or other material render the trench material unsuitable for pipe bedding, as determined by the Public Works Representative/Engineer, bedding material shall be imported and placed. The trench shall be excavated to a minimum of four-inches (4") below the bottom of the pipe after placement in its final position.

Where unstable material is encountered in the excavation, foundation material may be required, as determined by the Public Works Representative/Engineer. In such cases, a minimum of eight inches (8") below the bottom of the pipe after placement in its final position shall be removed. Over-excavation not ordered, specified, or shown shall be considered to be unauthorized excavation.

Sub-section C. Unauthorized Over-Excavation:

Any excavation carried below the elevation required to install the pipe as specified in these Specifications, or directed by the Public Works Representative/Engineer, shall be considered to be unauthorized. Such excavation shall be backfilled in accordance with these Specifications for "Imported Granular Material" and "Gravel Foundation for Pipelines and Pipeline Structures," all at the Developer/Contractor's expense.

Sub-section D. Trench Width:

The trench shall be excavated such that the pipe is always centered in the trench. The minimum clear trench width at the horizontal diameter of the pipe must not be less than the outside diameter of the pipe plus twelve inches (12"). The maximum clear width of trench at the top of the pipe must not be more than the outside diameter of the pipe plus eighteen inches (18"). If a trench is excavated to a greater width, the Developer/Contractor will be required to restore the trench to an acceptable condition by following the steps outlined in these Specifications for "Trenches in Embankments."

Trench width for pipeline structures, valves, or other accessories shall be sufficient to leave at least twelve inches (12") clear between their outer surfaces and the trench. Backfill with earth under structures or valves will not be permitted. Any unauthorized excess excavation below the elevation indicated for foundation of any structures shall be backfilled in accordance with these specifications for "Imported Granular Materials," and "Gravel Foundation for Pipe & Pipeline Structures," at the Developer/Contractor's expense.

Sub-section E. Trenches in Embankments:

Before laying pipes that are to be in fill or embankment areas, the embankment shall first be placed and compacted to the specified density to a depth of not less than two feet (2') above the top of the proposed pipe. After placing and compacting the embankment, the trench for the pipe or conduit shall be excavated through the fill and fine graded and the pipe installed as specified.

Sub-section F. Placement of Excavated Material:

All excess material shall be hauled away from the construction site and disposed of in an area obtained by the Developer/Contractor and approved by the Public Works Representative/Engineer. The Developer/Contractor shall be responsible for all rights-of-way, easements, and access associated with the disposal of excess excavated material. It shall further be responsible to obtain permission from the property owner or person controlling the property where the Developer/Contractor plans to dispose of excavated material. No compensation will be made to the Developer/Contractor for disposal of excess excavated material.

Non-excess excavated material shall be stockpiled in a manner as to cause a minimum of inconvenience to public travel and provide for emergency traffic as necessary, will not endanger the work, and will avoid obstructing sidewalks and driveways. Maintain free access to all existing fire hydrants, water and gas valves, and meters. Maintain clearance for free flow of storm water in all gutters, conduits, and natural water courses. Gutters and irrigation ditches shall be kept clear or other satisfactory provisions shall be made for street drainage and continuity of irrigation.

Grading of the area surrounding the trenches, including excavated materials, shall be performed as necessary to prevent surface water from flowing into trenches, or other excavations. Control of groundwater shall be as specified in section 2.05, Control of Groundwater.

Sub-section G. Fine Grading the Trench Bottom:

The bottom of the trench shall be accurately graded and prepared to provide uniform bearing and support on undisturbed soil or compacted granular bedding at every point along the entire length of the pipe. Bell holes shall be hand excavated after the trench bottom has been fine graded. Bell holes shall be only large enough to permit making the joints and to assure that any portion of the joint or bell does not support the pipe.

Section 2.07 TRENCH BACKFILL

Trench backfill for piping consists of four zones: foundation, bedding, initial backfill, and final backfill. "Pipe embedment" is a commonly used term that refers to the region including the bedding and initial backfill zones, or any region within one foot (1') of any pipe, pipeline structure, or accessory. The foundation is defined as the region between twelve inches (12") and six inches (6") below the bottom of the pipe. The bedding is defined as the region between six inches (6") below the bottom of the pipe and the bottom of the pipe. The initial backfill is defined as the region between the bottom of the pipe and twelve inches (12") above the top of the pipe. The final backfill is defined as the region above twelve inches (12") above the pipe.

All fill materials shall be compacted as specified in this section. The Developer/Contractor shall make arrangements for a source of water during construction and make arrangements for delivery of water to the site. They shall comply with all local laws and regulations when securing water from a water utility company or other source. The Developer/Contractor shall be responsible for the cost of obtaining and delivery of the water to the site.

All trench work within city right-of-way or future city right-of-way (future dedication) shall be backfilled with imported engineered trench fill classified as AASHTO A-1-a material unless native material is tested by a licensed geotechnical engineer and approved by the Public works Representative and City Engineer.

Sub-section A. Imported Granular Material:

Imported granular material for foundation, bedding, and backfill shall be cleaned crushed rock or gravel, free from sod, vegetation, and other organic or deleterious material. Slag will not be allowed in the pipe embedment. Pea gravel will not be allowed for pipe embedment or trench backfill except for sewer line pipe embedment.

Imported granular material shall conform to the following gradation specifications:

1) Pipe Embedment Material:

- i. Foundation Material: One hundred percent (100%) less than two-inch (2") and maximum of five percent (5%) less than one-half-inch (1/2").
- ii. Bedding and Initial Backfill Material: One Hundred percent passing the #4 sieve and less than 15 percent passing the #200 sieve.

2) Final Backfill Material: One hundred percent (100%) less than three-inch (3") and maximum of fifteen percent (15%) passing a No. 200 sieve.

Sub-section B. Foundation Placement:

When over-excavation is authorized by the Public Works Representative/Engineer, foundation material shall be placed in the foundation zone and below. The foundation material shall be placed so that the trench can be properly fine graded as specified. The foundation material shall be deposited over the entire trench width and compacted in layers. The layers shall have a maximum uncompacted thickness of six-inches (6").

The material shall then be fine graded in accordance with the specification for fine grading herein.

Sub-section C. Pipe Embedment:

Embedment material for other than PVC pipe may be excavated materials consisting of loose earth, sand, or gravel having no material larger than two-inches (2") in any dimension. For PVC pipe, the material must be no greater than- three quarter inch (3/4") in any dimension. If the excavated materials are not satisfactory, the specified imported granular material shall be used for pipe embedment.

- 1) Bedding: The bedding material shall be deposited over the entire trench width to a compacted thickness of no less than six inches (6"). The material shall have a maximum uncompacted thickness of eight inches (8").
- 2) Initial Backfill: After the pipe is in place, initial backfill material shall be placed at any point below the mid-point of the pipe simultaneously and uniformly on both sides of the pipe in un-compacted layers not to exceed ten-inches (10") or one-half the diameter of the pipe, whichever is less. Initial backfill material shall be placed with care to prevent displacement of or damage to the pipe during the embedment process. Initial backfill material shall be scattered alongside the pipe and not dropped into the trench in compact masses.

That section of the pipe zone from the mid-point of the pipe to twelve inches (12") above the top of the pipe shall then be filled with initial backfill materials and compacted.

Sub-section D. Final Backfill:

Final backfill shall be from twelve inches (12") above the top of the pipe to the level shown on the Standard Drawings.

All trench work within city right-of-way or future city right-of-way (future dedication) shall be backfilled with imported engineered trench fill classified as AASHTO A-1-a material unless native material is tested by a licensed geotechnical engineer and approved by the Public works Representative and City Engineer.

Sub-section E. Clay Dams:

In all areas where ground water is encountered, clay dams shall be constructed at a minimum of every manhole, or more often in steep slopes, to prevent ground water from following the trenches. Clay dams

shall be a minimum of 2 feet (2') thick and be keyed into the bottom and sides of the trench a minimum of 1 foot (1').

Sub-section F. Compaction:

Backfill shall be compacted by means of sheepsfoot rollers, pneumatic tire rollers, vibrating rollers, or mechanical tampers.

Under pavements or other surface improvements the in-place density shall be a minimum of ninety-five percent (95%) of laboratory standard the maximum dry density as determined by AASHTO T-180 (modified proctor). In shoulders and other areas the in-place density shall be a minimum of ninety percent (90%) of the maximum dry density as determined by AASHTO T-180 (modified proctor).

Fill material shall be placed at a moisture content and un-compacted lift thickness such that after compaction the required relative densities will be produced. In no event will the material be placed in lifts that, prior to compaction, exceed six inches (6") for foundation and embedment and twelve inches (12") for final backfill.

Prior to compaction each layer shall be evenly spread, moistened, and worked by disk harrowing or other equivalent means.

For trenches that exceed 8 feet in depth, compaction tests will need to be performed at every 3 feet of depth of backfill. The compaction tests shall be staggered 50 feet apart along the entire length of the trench.

If the required relative density is not attained, test sections will be required to determine any adjustments in compaction equipment, thickness of layers, moisture content and compactive effort necessary to attain the specified minimum relative density.

Approval of equipment, thickness of layers, moisture content, and compactive effort shall not be deemed to relieve the Developer/Contractor of the responsibility for attaining the specified minimum relative densities. The Developer/Contractor, in planning its work, shall allow sufficient time to perform the work connected with test sections and to permit the Public Works Representative/Engineer to make tests for relative densities.

Section 2.08 TRENCH CROSSINGS AND EASEMENTS

At road crossings or where existing driveways occur on a road, the Developer/Contractor shall make provisions for trench crossings either by means of backfill, tunnels, or temporary bridges.

Any disturbance to property caused by the Developer/Contractor's activity within easements shall be restored to the satisfaction of the owner of the property. If necessary, shrubs, fences, or other objects shall be removed carefully. If work must occur on a lawn, the lawn shall be cut to a width of two feet (2') wider than the intended work area (one foot (1') on each side). The lawn sod shall be stacked separately from and shall not be mixed with other excavated material.

After the sod is removed, if excavation is necessary, the topsoil shall be removed to a depth of twelve inches (12"), or the actual depth of the topsoil, whichever is less. The topsoil shall be stored separately from and shall not be mixed with other excavated material.

Following completion of the backfilling and the compaction of the trench, the Developer/Contractor shall replace topsoil, lawn sod, shrubs, fences, and other items that may have been removed from within the easement area and shall clean up and remove any rocks, dirt or any other debris that remain from the construction work. The Developer/Contractor shall obtain a release from the property owner stating that the repairs have been made to the satisfaction of the Owner. A copy of said release shall be delivered to the Public Works Representative/Engineer.

Section 2.09 RESTORATION OF CONSTRUCTION SITE

During the progress of the Work, the Developer/Contractor shall clean up all construction debris, excess excavation, and excess materials, and shall restore all fences, irrigation structures, ditches, culverts, private landscaping and similar items. The Developer/Contractor shall stockpile the excavated trench material so as to do the least damage to adjacent grassed areas, or fences, regardless of whether these are on private property or public rights-of-way. All excavated materials shall be removed from grassed and planted areas and these surfaces shall be left in a condition equivalent to their original surface and free from all rocks, gravel, boulders, or other foreign materials.

Section 2.10 OPEN TRENCH IN PUBLIC THOROUGHFARES

Trenches in public thoroughfares, regardless of trench depth, the Developer/Contractor shall safely barricade and limit open trenches to a maximum of 200 lineal feet in the daytime. In traveled roadways a maximum of 80 lineal feet of open trench will be allowed. All pipeline excavations need to be backfilled and compacted within 24 hours. Trenches shall be closed during nighttime conditions by backfilling as much of the trench as reasonable and placing metal plates over or placing a fence or barricade along the remaining trench.

Section 2.11 DEVELOPER/CONTRACTOR RESPONSIBILITY

The Developer/Contractor will be responsible to see that the backfilling and compaction are properly and adequately done. Settlement of trenches that is visible, measurable or affects drivability within a period of two- (2) years after final acceptance of the project shall be considered incontrovertible evidence of inadequate compaction, and the Developer/Contractor shall be responsible for correcting the condition in accordance with the provisions of these Specifications. This includes the replacement of sidewalk, curb and gutter, and other surface improvements.

DIVISION 3
PRESSURE PIPE -
PRESSURE IRRIGATION

Section 3.01 GENERAL

This division covers furnishing and installing pressure irrigation pipe as shown on the Improvement Drawings or established in the field, and all flushing, testing, repairing, as required to ensure adequate and safe operation of the irrigation system.

All new pressurized irrigation pressure pipe must be a minimum of 6 inches in diameter.

Section 3.02 DUCTILE IRON PIPE

Sub-section A. Materials:

Ductile iron pipe shall conform to all requirements of ANSI/AWWA C151/A21.51, "American National Standard for Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined molds, for Water or Other Liquids." The minimum Pressure Class will be 250. If thickness class pipe is used, the minimum shall be Thickness Class 51.

All pipe shall be made of good quality ductile cast iron and of such chemical composition and structure as is required to meet the physical and mechanical property requirements of the standard.

Install ductile iron pipe with a purple poly sleeve.

Sub-section B. Joints:

- 1) Mechanical Joints: All mechanical joints and gaskets shall meet the requirements of ANSI/AWWA C111/A21.11. All gaskets shall be smooth and free of porous areas, foreign materials, and visible defects. Gaskets shall be less than one (1) year old.
- 2) Push-on Joints: All push-on joints and gaskets shall meet the requirements of ANSI/AWWA C111/A21.11. All gaskets shall be smooth and free of porous areas, foreign materials, and visible defects. Gaskets shall be less than one (1) year old.

Lubricants shall have no deteriorating effects on gasket materials. Lubricants shall conform to ANSI 21.11.

- 3) Flanged Joints: Flanges, when required, shall conform to ANSI/AWWA C115/A21.15-83. Flanged joints shall meet the requirements of ANSI/AWWA C110/A21.10, "American National Standard for Ductile Iron and Gray Iron Fittings, 3-inch Through 48-inch for Water and Other Liquids." Flanged joints shall be bolted firmly with machine, stud, or cap bolts of proper size. Flanges may be cast integrally with the pipe or may be screwed on a threaded pipe. Flanges shall be faced and drilled and dimensioned properly for the size and pressure required. Bolts and nuts, unless otherwise specified, shall be made of the best quality refined iron or steel, and have clean, well-fitting threads. Bolts will be provided with standard hexagonal nuts and standard hexagonal heads. Bolts shall be of the diameter required for each flange, and when installed shall be of length so that no more than three-eighths inch (3/8") nor less than one-eighth inch (1/8") extends past the face of the nut. All buried metallic fittings and bolts shall be coated with a non-oxide wax and wrapped with polyethylene.

Gaskets shall be rubber, either ring or full face, and shall be one-eighth-inch (1/8") thick.

Sub-section C. Coatings and Linings for Ductile Iron Pipe:

All exterior surfaces of pipe and fittings shall be coated with hot coal tar at least one (1) mil thick. All interior surfaces shall be cement mortar lined with a standard thickness according to ANSI/AWWA C104/A21.4-80.

Sub-section D. Flanges:

Flanges when required shall conform to ANSI/AWWA C115/A21.15-83.

Sub-section E. Fittings:

Fittings for ductile iron pipe shall conform to the provisions of ANSI/AWWA C110/A21.10-82 or C153/A21.53-58. All fittings shall be Mechanical-Joint-(MJ)-type unless otherwise specified by the Public Works Representative/Engineer. FM grease shall be applied to the threads of the bolts on all fittings.

Section 3.03 PVC PIPE**Sub-section A. Materials:**

Pipe for the transmission and distribution of water shall be manufactured in accordance with AWWA C900 (latest revision), "AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4-inch through 12-inch, for Water" or in accordance with AWWA C909-02, "AWWA Standard for Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 In. through 24 In. (100 mm Through 600 mm), for Water Distribution". PVC pipe fourteen-inches (14") and larger shall be manufactured in accordance with AWWA C905 (latest revision), "AWWA Standard for Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14-inch through 36-inch." All PVC pipe four-inch (4") and larger shall be dimension ratio (DR) 18 with a working pressure of 150 psi. The PVC pipe shall have a cast-iron-pipe-equivalent outside diameter. The pipe shall be purple in color. If the pipe is not purple in color then install it with a purple poly sleeve. Pipe smaller than four-inches (4") shall be schedule 40 PVC.

Sub-section B. Joints:

Joints shall be the push-on rubber-gasket type. Lubrication shall be water soluble, non-supporting of bacteria growth, and have no deteriorating effect on the PVC pipe or rubber gaskets.

Sub-section C. Fittings:

All fittings to be used with the PVC pipe shall be the same as fittings for ductile iron pipe and shall conform to the provisions of ANSI/AWWA C110/A21.10-82 or C153/A21.53-58. All fittings shall be Mechanical-Joint-(MJ)-type unless otherwise specified by the Public Works Representative/Engineer. FM grease shall be applied to the threads of the bolts on all fittings.

Section 3.04 PIPE INSTALLATION

Installation of ductile iron pipe shall be in accordance with ANSI/AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances. Installation of PVC pipe shall be in accordance with AWWA C900, C905, ASTM D2774, and PVC Pipe, AWWA Manual M23 and with applicable manufacturer's instructions.

Sub-section A. Cutting:

Cutting of pipe for closure pieces or for other reasons shall be done in a neat and workmanlike manner by a method recommended by the manufacturer. After cutting, the pipe shall be beveled and filed to prevent gasket damage in joint assembly.

Sub-section B. Dewatering of Trench:

Where water is encountered in the trench, it shall be removed during pipe-laying operations and until the ends of the pipe are sealed. See "Control of Groundwater" in Division 2 Trench - Excavation and Backfill section 2.05.

Sub-section C. Laying of Pipe:

Inspect the pipe and pipe coating (where applicable) for defects before installation. Any defects shall be repaired or the pipe shall be replaced, whichever is deemed necessary by the Public Works Representative/Engineer.

All pipe shall be laid and maintained to the required lines with fittings and valves at the required locations, as shown on the Improvement Drawings.

All pipe, fittings, and valves shall be moved carefully, either when lowering from the truck, or when placing in the trench. Under no circumstances shall materials be dropped or dumped from the truck or into the trench.

The Developer/Contractor shall take the necessary precautions to ensure that foreign materials do not enter the pipe. No debris, tools, or other materials shall be placed in the pipe during laying operations. When laying of pipe is not in progress, the pipe shall be closed with a water tight plug.

Maximum deflections at pipe joints shall not exceed the joint specifications of AWWA C600 of latest revision, or the recommendations of the pipe manufacturer.

Deflections in PVC pipe shall be made by longitudinal bending of the barrel of the pipe rather than deflecting the pipe joints. Longitudinal bending shall be limited to eighty percent (80%) of the manufacturer's recommended minimum bending radius.

Sub-section D. Thrust Blocking and Megalug Joint Restraint:

Thrust blocking and megalug joint restraints shall be applied at all MJ tees, crosses, valves, plugs, caps, and at bends that deflect eleven and one-quarter (11-1/4°) degrees or more. The fitting shall be encased in a 12 mil protective plastic wrap before the thrust block is poured. Reaction blocking shall be concrete, having a compressive strength of not less than three-thousand (3000) psi at twenty-eight (28) days. No bag or hand mixed concrete (i.e. bagged concrete) is allowed. Blocking shall be placed between undisturbed soil and the fitting to be anchored. The area of bearing on the pipe and on the ground shall be as shown in the Standard Drawings. The blocking shall be placed so that the pipe and the fittings will be accessible for repair.

Sub-section E. Connections to Existing Water Lines:

Information on the Improvement Drawings regarding existing water lines is taken from "Record Drawings" from the City or utility company files and may or may not be accurate as to size, type of material, or location of those lines. The Developer/Contractor will be responsible to determine the proper fittings and materials required, obtain the Public Works Representative/Engineer's approval of the planned connection, and perform the construction in a suitable fashion.

Sub-section F. Corrosion Protection and Soil Tests:

When the Public Works/Engineer determines that a potential for corrosive conditions exists such as poor drainage or reactive soils, fittings shall be encased in polyethylene wrap. Polyethylene encasement shall meet the requirements of ANSI A21.5 or AWWA C105.

Standard pipe dimension ratio CTS (SDR) 9 – 200 or 250-psi pressure rating.

All tubing for service lines shall be cut and installed in a neat and workmanlike manner by a method recommended by the manufacturer.

Sub-section C. Compression Connection:

- 1) The interior surface of the coupling nut, including threads, shall have a baked on, fluorocarbon coating to reduce assembly friction and prevent the gasket from turning and twisting during tightening. The nut shall bottom on a cast or machined shoulder on the body when properly assembled. This design will provide a visual check to assure connection is properly assembled.
- 2) The sealing gasket shall be of molded synthetic rubber (ASTM D2000) with molded in place bronze spring (ASTM A134 Alloy #6) to eliminate the possible cold flow of the gasket between the pipe and fitting. A gripper band of hardened stainless steel (ANSI Type 401) shall be fitted into the gasket. When the gasket is compressed it will cause the gripper ring to distort the pipe giving the fitting a high resistance to pull out. The gripper band shall overlap itself to prevent cold flow of the gasket into the cavity under the band.
- 3) When Mueller 110 compression fittings are used with P.E. Pipe, Stainless Steel pipe stiffeners are required to eliminate cold flow of plastic pipe.
- 4) All fittings are to be for CTS Polyethylene pipe.
- 5) The Minimum pull out load for the fitting when used with PE plastic pipe shall be as follows for each given size:

<u>SIZE</u>	<u>MINIMUM PULL OUT (FT.LBS.)</u>
3/4"	400
1"	400
1 1/2"	500
2"	500

MUELLER 110 COMPRESSION COUPLINGS AND FITTINGS OR EQUIVALENT ARE TO BE USED ON ALL P.E. PLASTIC PIPE INSTALLATIONS.

Sub-section D. Service Fittings:

All service fittings such as brass tees, and brass ells shall be Mueller Insta-Tite connections or equivalent.

Sub-section E. Angle Ball Service Valve:

All components shall be manufactured of brass cast in conformance to AWWA C-800, General Section - 1, paragraph 1.2. The valve shall have a strong, reliable ball/stem connection that provides strong, reliable performance and resists breakage. The stem design must be totally blow-out-proof to prevent separation and assure dependable, safe operation. The stem shall have double O-ring seals supported in precision machined grooves and provide secure, leak-tight sealing. The end pieces shall be O-ring sealed to provide additional protection against leaking. The ball shall be manufactured of 85-5-5-5 waterworks brass; no other composition will be accepted. The ball shall be fluorocarbon coated for ease of operation. The valve shall be quarter turn valve and the fully open and closed positions shall be controlled by check lugs integrally cast on body to assure positive action. The valve shall have a lock wing to permit locking the valve in the closed position. The Inlet shall be a compression connection and the Outlet shall be female meter coupling thread.

All brass castings shall conform to ASTM B62, latest revision, Standards for composition brass or ounce metal castings of 85-5-5-5. The valve shall be manufactured and tested in accordance with ANSI/AWWA

C800, latest revision. A notarized certificate stating compliance with the Standards may be required. All component parts, body, key, washer, nut and tube nut, shall have the same metal analysis. The valve must maintain a working pressure of 300 PSIG.

All fittings are to be CTS (Copper Tube Size) size, used on CTS Polyethylene pipe. No IPS polyethylene pipe or fittings are to be used.

Angle ball service valve shall be Ford BA43-344W, CTS size compression connection by female meter coupling thread.

Sub-section F. Service Box and Meter:

Service box shall be an 13-inch by 24-inch traffic rated, irrigation box with cover. Service box shall be installed over the Ford BA43-344W Ball Meter Valve. A sign shall be attached or embossed to or on the cover indicating as follows: "IRRIGATION" Box shall be DFW Plastics 1324C4-12-4T 63D or approved equivalent. The meter box shall be provided with Waterworks Pentagon Head locking device. The meter will be supplied by the City. The City shall be responsible to locate and install the meter in the service box. A PVC pipe jumper, consisting of a PVC pipe and male adapter shall be installed from the service valve to the sleeve under the sidewalk to provide proper alignment of the meter from the service valve to the homeowner's property.

If a meter has to be relocated, the meter shall be installed parallel with the road.

If a PI meter box is located within a drive approach the standard green fiberglass irrigation box shall be replaced with a H20 load traffic rated box.

Sub-section G. PVC Pipe:

Pipe for the transmission of irrigation water from the PVC MIPT adapter to the homeowner's property line shall be Schedule 40 PVC pipe. Pipe shall be manufactured to meet the requirements of Materials - ASTM D1684, Product Design ASTM D1685, and Cell Class - ASTM D12454A. Joints shall be of solvent weld type recommended by the manufacturer of the pipe. A solvent weld cap will be installed on the end of the pipe near property line. No joints will be allowed under sidewalks or other paved surfaces.

Sub-section H. Hose Bib:

All hose bibs used in the service connection assembly shall be a 3/4-inch NIBCO, Figure No. 74, Boiler Drain or equal.

Sub-section I. Location of Stub Pipes:

In new street construction, a "PI" shall be stamped in the top of the curb before the concrete sets to indicate the location where the pressure irrigation water service pipe crosses the curb.

If the lot is located within a hillside development the following locations for service laterals will apply:

1. If the lot is 80 feet or less, place the lateral on the uphill side of the lot.
2. If the lot is 80 feet or more, place the lateral at middle of the lot.

Sub-section J. Service Pipe Installation:

The polyethylene service pipe shall be installed by use of a "Hole Hog" or other similar device under all existing paved surfaces. Where subsurface materials or conditions will not permit installation by this method, open trenching will be permitted with the approval of the Public Works Representative/Engineer. Open trenching will be used in new streets not yet paved.

Section 3.06 TESTING AND FLUSHING

All newly laid pipes or any valved section thereof shall be subjected to a hydrostatic pressure test. A leakage test shall be conducted concurrently with the pressure test. All new lines, and extensions therefrom, shall be flushed thoroughly before being placed into service.

Sub-section A. Pressure Test:

If the pipe section being tested includes concrete thrust blocking, the concrete shall be allowed at least twenty-four (24) hours to set before any testing is conducted.

- 1) Test Pressure Restrictions: Test pressures shall,
 - i. Be at least 1.5 times the working pressure at the highest point along the test section, but not less than 120 psi.
 - ii. Not exceed the pressure rating of the pipe.
 - iii. Be of at least 2 hour duration.
 - iv. Not vary by more than plus or minus five (± 5) psi for the duration of the test.
 - v. Not exceed twice the rated pressure of the valves or hydrants when the pressure boundary of the test section includes closed gate valves or hydrants.
 - vi. Not exceed the rated pressure of the valves when the test boundary of the test section includes closed, resilient-seated gate valves or butterfly valves.
- 2) Pressurization: Each valved section of pipe shall be filled slowly with water to the specified test pressure. Pressurization of the pipe shall be based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gage. Pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Public Works Representative/Engineer.
- 3) Air Removal: Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at all high points, the Developer/Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged.
- 4) Examination: All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, or hydrants that are discovered during the pressure test shall be repaired or replaced with sound materials and the test shall be repeated. Repairs or replacements to the pipeline and subsequent pressure testing shall be repeated as necessary for the pipeline to pass the pressure test.

Sub-section B. Leakage Test:

A leakage test shall be conducted concurrently with the pressure test.

- 1) Leakage defined: Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of the specified

test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.

- 2) **Allowable leakage:** No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{S * D\sqrt{P}}{148,000}$$

In which L is the allowable leakage, in gallons per hour; S is the length of pipeline tested in feet; D is the nominal diameter of the pipe, in inches; and P is the average test pressure (gage) during the leakage test, in pounds per square inch. See Table 3-1.

- i. Allowable leakage at various pressures is shown in Table 3-1.

TABLE 3-1
Allowable Leakage per 1000 ft of Pipeline - gph

Average Test Pressure	Nominal Pipe Diameter (in)															
	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48	54
450	0.430	0.57	0.86	1.15	1.43	1.72	2.01	2.29	2.58	2.87	3.44	4.30	5.16	6.02	6.88	7.74
400	0.405	0.54	0.81	1.08	1.35	1.62	1.89	2.16	2.43	2.70	3.24	4.05	4.86	5.68	6.49	7.30
350	0.379	0.51	0.76	1.01	1.26	1.52	1.77	2.02	2.28	2.53	3.03	3.79	4.55	5.31	6.07	6.83
300	0.351	0.47	0.70	0.94	1.17	1.40	1.64	1.87	2.11	2.34	2.81	3.51	4.21	4.92	5.62	6.32
275	0.336	0.45	0.67	0.90	1.12	1.34	1.57	1.79	2.02	2.24	2.69	3.36	4.03	4.71	5.38	6.05
250	0.321	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56	3.21	3.85	4.49	5.13	5.77
225	0.304	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.43	3.04	3.65	4.26	4.86	5.47
200	0.287	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29	2.87	3.44	4.01	4.59	5.16
175	0.268	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15	2.68	3.22	3.75	4.29	4.83
150	0.248	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99	2.48	2.98	3.48	3.97	4.47
125	0.227	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81	2.27	2.72	3.17	3.63	4.08
100	0.203	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62	2.03	2.43	2.84	3.24	3.65

*If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

**To obtain leakage in liters/hour, multiply the values in the table by 3.785.

- ii. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal/hr/in. of nominal valve size shall be allowed.
- iii. When hydrants are in the test section, the test shall be made against the closed hydrant.
- 3) **Examination:** All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, or hydrants that are discovered during the leakage test shall be repaired or replaced with sound materials and the test shall be repeated. Repairs or replacements to the pipeline and subsequent leakage testing shall be repeated as necessary for the pipeline to pass the leakage test.
- 4) **Acceptance of Installation:** Acceptance shall be determined on the basis of allowable leakage. If any test of pipe laid discloses leakage greater than specified, the Developer/Contractor shall, at its own expense, locate and repair the defective material until the leakage is within the specified allowance.

All visible leaks are to be repaired regardless of the amount of leakage.

Sub-section C. Flushing:

Flushing shall be accomplished through temporary flushing valves, or end of line blow-off assemblies at a minimum flushing velocity of two and one-half feet per second (2.5 fps). Flow volumes to produce this velocity are shown in Table 3-2:

TABLE 3-2
FLOW RATE AND OPENINGS TO FLUSH PIPELINES
(40 psi Residual Pressure)

Pipe Size (inches)	Flow Required to Produce 2.5 fps velocity (gpm)
2	26
4	100
6	220
8	390
10	610
12	880
14	1,200
16	1,565
18	1,980
20	2,450
24	3,525
30	5,507
42	10,800
48	14,100

DIVISION 3A
PRESSURE PIPE -
CULINARY WATER

Section 3A.01 GENERAL

This Division covers furnishing and installing pressure pipe to the lines and grades shown on the Improvement Drawings and/or established in the field, and all flushing, testing, repairing required to ensure adequate and safe operation of the water system. Ductile iron pipe shall be used in all areas of the city unless a soil corrosivity evaluation, as reviewed and approved by the City Public Works Representative/Engineer dictates otherwise. All culinary water lines shall be a minimum of 8-inch diameter. All materials that come into contact with drinking water including pipes, gaskets, lubricants, and O-rings shall be ANSI/NSF 61 certified. All pipes and fittings shall be lead free in accordance with the Safe Drinking Water Act.

There shall be no physical cross connections between the distribution system and pipe, pumps, hydrants, or tanks that may be contaminated from any source, including pressurized irrigation.

Neither steam condensate nor cooling water from engine jackets or other heat exchange devices shall be returned to the drinking water supply.

Section 3A.02 DUCTILE IRON PIPE

Sub-section A. Materials:

Ductile iron pipe shall conform to all requirements of ANSI/AWWA C151/A21.51, "American National Standard for Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined molds, for Water or Other Liquids." Minimum rated working pressure will be 250 psi for pipes larger than 12-inch diameter. Pipes of 12-inch diameter and smaller shall have a rated working pressure of 350 psi. The Thickness Class for pipes of diameters from 4-inches through 20-inches shall be minimum 51 and pipe 24-inch diameter and larger shall be minimum 50.

All pipe shall be made of good quality Ductile Cast Iron and of such chemical composition and structure as is required to meet the physical and mechanical property requirements of the standard.

Sub-section B. Joints:

- 1) Mechanical Joints: All mechanical joints shall meet requirements of ANSI/AWWA C111/A21.11. All gasket surfaces shall be smooth and free from imperfections. Gaskets shall conform to tests in accordance with specifications and shall be less than one year old.
- 2) Push-on Joints: All push-on joints shall meet the requirements of ANSI/AWWA C111/A21.11. Gaskets shall be free from defects and not over one year old.

Lubricants shall be non-toxic and have no deteriorating effects on gasket materials. It shall not impart taste to water in a pipe. It shall conform in every way to ANSI 21.1

- 3) Flanged Joints: Flanges shall meet the requirements of ANSI/AWWA C110/A21.10, "American National Standard for Ductile Iron and Gray Iron Fittings, 3-inch through 48-inch for Water and Other Liquids." Flanged joints shall be bolted firmly with machine, stud or cap bolts of proper size. Flange maybe cast integrally with the pipe or may be screwed on threaded pipe. Flanges shall be faced and drilled and of proper dimensions for size and pressure required. Bolts and nuts, unless otherwise specified, shall be made of the best quality refined iron or metal steel and have clean, well-fitting threads. Bolts will be provided with standard hexagonal nuts and standard hexagonal heads. Bolts shall be of the

diameter required for each flange and when installed shall be of length so that no more than 3/8-inch nor less than 1/8-inch extends past face of nut. All buried fittings having steel bolts shall be coated with a non-oxide wax and wrapped with polyethylene.

Gaskets shall be rubber, either ring or full face, and are 1/8th-inch thick. A gasket for each flanged joint of proper size as shown on the Improvement Drawings.

Sub-section C. Coatings and Linings for Ductile Iron Pipe:

All exterior surfaces of pipe and fittings shall be coated with hot coal tar approximately 1 mil thick. All interior surfaces shall be cement mortar lined with a standard thickness according to ANSI/AWWA C104/A21.4-80.

Sub-section D. Flanges:

Flanges when required shall conform to ANSI/AWWA C115/A21.15-83.

Sub-section E. Fittings:

Fittings for ductile iron pipe shall conform to the provisions of ANSI/AWWA C110/A21.10-82 or C153/A21.53-58. All fittings shall be Mechanical-Joint-(MJ)-type unless otherwise specified by the Public Works Representative/Engineer. FM grease shall be applied to the threads of the bolts on all fittings.

Section 3A.03 PVC PIPE

Sub-section A. Materials:

Pipe for the transmission and distribution of water shall be manufactured in accordance with AWWA C900 (latest revision), "AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4-inch through 12-inch, for Water" or in accordance with AWWA C909-02, "AWWA Standard for Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 In. through 24 In. (100 mm Through 600 mm), for Water Distribution". PVC pipe fourteen-inches (14") and larger shall be manufactured in accordance with AWWA C905 (latest revision), "AWWA Standard for Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14-inch through 36-inch." All PVC pipe four-inch (4") and larger shall be dimension ratio (DR) 18 with a working pressure of 150 psi. The PVC pipe shall have a cast-iron-pipe-equivalent outside diameter. The pipe shall be blue or white in color. Pipe smaller than four-inches (4") shall be schedule 40 PVC.

Sub-section B. Joints:

Joints shall be push on rubber gasket type. Lubrication shall be water soluble, non-toxic, non-objectionable in taste and odor imparted to the water, non-supporting of bacteria growth, and have no deteriorating effect on the PVC pipe or rubber gaskets.

Sub-section C. Fittings:

All fittings to be used with the PVC pipe shall be the same as fittings for Ductile Iron Pipe and shall conform to the provisions of ANSI/AWWA C110/A21.10-82 or C153/A21.53-58. All fittings shall be Mechanical-Joint-(MJ)-type unless otherwise specified by the Public Works Representative/Engineer. FM grease shall be applied to the threads of the bolts on all fittings.

Section 3A.04 PIPE INSTALLATION

Installation of ductile iron pipe shall be in accordance with ANSI/AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances. Installation of PVC pipe shall be in accordance with AWWA C900, C905, ASTM D2774, and PVC Pipe, AWWA Manual M23 and with applicable manufacturer's instructions.

Sub-section A. Cutting:

Cutting of pipe for closure pieces or for other reasons shall be done in a neat and workmanlike manner by a method recommended by the manufacturer. After cutting, the pipe shall be beveled and filed to prevent gasket damage in joint assembly.

Sub-section B. Dewatering of Trench:

Where water is encountered in the trench, it shall be removed during pipe laying operations and the trench so maintained until the ends of the pipe are sealed. See "Control of Groundwater" in Division 2 Trench - Excavation and Backfill.

Sub-section C. Laying of Pipe:

The pipe and pipe coating (where applicable) shall be inspected for defects before installation. Any defects shall be repaired or the pipe shall be replaced, whichever is deemed necessary by the Public Works Representative/Engineer.

All pipe shall be laid and maintained to the required lines and grades with fittings and valves at the required locations. The bottom of the trench shall be cut flat, true and even to provide uniform bearing for the full length of the pipe barrel. The pipes shall be installed with a 48-inch minimum cover from finished road surface for culinary water. The Developer/Contractor shall be responsible to install the pipe line to the alignment set by the Public Works Representative/Engineer or as shown on the Improvement Drawings.

All pipes, fittings and valves shall be carefully lowered from the truck when unloading or when installing into the trench. This should be done one piece at a time in order to prevent damage to pipe materials and protective coatings and linings. Under no circumstances shall materials be dropped or dumped from the truck or into the trench.

The Developer/Contractor shall take the necessary precautions such that foreign materials do not enter into the pipe. No debris, tools, or other materials shall be placed in the pipe during laying operations. When laying of pipe is not in progress, the pipe shall be closed by a watertight plug.

Maximum deflections at pipe joints shall not exceed the joint specifications of AWWA C600, latest revision, or the recommendations of the pipe manufacturer.

Deflections in PVC pipe shall be made by longitudinal bending of the barrel of the pipe rather than deflecting the pipe joints. Longitudinal bending shall be limited to eighty percent (80%) of the manufactures recommended minimum bending radius.

Sub-section D. Separation:

Maintain separation of water main from sewer piping in accordance with the current Plumbing Code and Utah Division of Drinking Water Standards. A minimum of eighteen-inch (18") vertical and ten-foot (10') horizontal separation shall be maintained unless the Division of Drinking Water R309-211-7 grants an exception.

Sub-section E. Pipe Bedding:

All pipes shall be protected from lateral displacement and possible damage resulting from impact or unbalanced loading during backfilling operations by being adequately bedded.

In the event trench materials are not, in the judgement of the Public Works Representative/Engineer,

satisfactory for pipe bedding, imported granular bedding will be required. See Division 2 of these specifications.

Sub-section F. Thrust Blocking and Megalug Joint Restraints:

Thrust blocking and megalug joint restraints shall be applied at all MJ tees, crosses, valves, plugs, caps and at bends deflecting 11 1/4° or more. The fitting shall be encased in a 12 mil protective plastic wrap before the thrust block is poured. Reaction blocking shall be concrete having a compressive strength of not less than 3000 pounds per square inch at 28 days. No bag or hand mixed concrete (i.e. bagged concrete) is allowed. Blocking shall be placed between undisturbed soil and the fitting to be anchored. The area of bearing on the pipe and on the ground shall be as shown in the Standard Drawings. The blocking shall be so placed that the pipe and the fittings will be accessible for repair.

Sub-section G. Connections to Existing Water Lines:

Information on the Improvement Drawings regarding existing water lines is taken from "Record Drawings" from the City or utility company files and may or may not be accurate as to size, type of material or location. The Developer/Contractor will be responsible to determine the proper fittings and materials required, obtain the Public Works Representative/Engineer's approval of the planned connection, and perform the construction in a suitable fashion. Where fitting sizes, such as tees and crosses, are shown on the plans, those sizes will be used. However, no attempt has been made to show all needed fittings or materials.

Sub-section H. Corrosion Protection and Soil Tests:

When the Public Works/Engineer determines that a potential for corrosive conditions exists such as poor drainage or reactive soils, pipe and fittings shall be encased in polyethylene wrap. Polyethylene encasement of ductile iron pipe shall meet the requirements of ANSI A21.5 or AWWA C105.

Sub-section I. Tracer wire:

All pipe shall include a 12 gauge solid THHN tracer wire installed according to NESC standards. The locator wire shall be installed in the pipeline trench approximately 6-inches above the top of pipe. The locator wire shall be brought up along and fastened to each fire hydrant to permit a continuity connection when doing line location.

Sub-section J. Damage and Repair of Water Mains and Appurtenances:

The Developer/Contractor shall be responsible for any damage to water mains and water facilities caused by his operations. The Developer/Contractor may be relieved of the responsibility under the following conditions:

- 1) He has not excavated below or beyond the required excavation lines, and
- 2) He has given proper and timely notice of his work plans, and
- 3) He has used reasonable care, and cooperated, minimizing the damage.

Any damage to water lines, valves, valve boxes, hydrants, and other surface appurtenances that result from the Developer/Contractor's operation shall be its sole responsibility.

Sub-section K. Dead end lines

To preserve the quality of water as well as maintain adequate pressure within the culinary water system, all dead end lines will follow the following requirements and will be the greater of the two

For slopes less than 10%

- 1) A maximum of 500 feet in length
- 2) Serve a maximum of 10 dwelling units.

water services shall not have any joints between the corporation stop and the ball valve.

Sub-section B. Excavation and Backfill:

Trench excavation and backfill shall conform to the applicable paragraphs of Division 2. Bedding shall meet the requirements of Division 2.

Sub-section C. Connection to Main:

Connections of services to main lines shall be direct tap on ductile iron mains and through a double strap cast iron service saddle on PVC mains, corporation type stop and 24-inch gooseneck formed with the tubing. All connections shall be made using pack joint (compression) type fittings. The service saddle shall be a epoxy or fusion plastic coated with a single stainless steel strap. The corporation stop shall be a one-inch (1") Mueller H-15008 "CC" thread for direct tap and a Ford Pack joint F-1100 for service saddle tap.

On existing services the existing connection to main will be used unless damaged or leaking.

Sub-section D. Meter, Meter Setter Assembly, Meter Box and Cover:

The City will furnish and install the meter. The double check valve, meter setter assembly, meter box and cover will be furnished by the Developer/Contractor and the entire installation, excluding the meter, shall be made by the Developer/Contractor. The cover shall have a recessed center for the MXU antenna. The service line shall be installed from the house to where the service line was stubbed from the water main, a thirty-inch (30") diameter hole excavated where the meter is to be installed prior to City crews installing the meter. No meters shall be located in sidewalks or driveways.

The Developer/Contractor shall furnish the meter box and cover for meters larger than one-inch (1"). The materials and type of box shall be approved by the Public Works.

If a meter box is located within a concrete surface the standard meter box shall be replaced with an H-20 or HS-20 load traffic rated box and a 2-foot diameter traffic rated lid and associated ring.

Sub-section E. Special Joints and Fittings:

- 1) Solder and Sweat Joints: Joints in copper tubing shall be made by the appropriate use of approved brass or copper fittings. The surface to be joined by soldering shall be thoroughly cleaned bright by manual or mechanical means. The joints shall be properly fluxed with an approved non-corrosive type flux and made up with approved solder. All solders and fluxes shall not have a lead content that exceeds current EPA guidelines.
- 2) Copper Tubing to Screw Pipe Joints: Joints from copper tubing to threaded pipe shall be made by the use of brass adapter fittings.

Sub-section F. Separation:

The water service line and sewer lateral shall be separated **horizontally** a minimum of ten-feet (10') and vertically a minimum of eighteen inches (18") should they cross, the culinary water service line must be located above the sewer lateral. At all locations there shall be at least eighteen (18") inches of separation **horizontally and vertically** above the sewer lateral.

Sub-section G. Location of Stub Pipes:

In new street construction, a "W" shall be stamped in the top of the curb before the concrete sets to indicate the location where the culinary water service pipe crosses the curb.

If the lot is located within a hillside development the following locations for service laterals will apply:

1. If the lot is 80 feet or less, place the lateral on the uphill side of the lot.
2. If the lot is 80 feet or more, place the lateral at middle of the lot.

Sub-section H. Flushing, Testing and Disinfecting:

Flushing, testing and disinfecting shall be done at the time the water main is flushed, tested and disinfected. The ball valve shall be left exposed to allow for discharging water out of the service line for proper flushing and to insure that the line has been adequately disinfected. The line shall be flushed thoroughly following installation. Flushing, testing and disinfecting shall conform to the applicable paragraphs of this division.

On existing services the Developer/Contractor shall take precautions to prevent contamination of the pipe and connections during installation. The line shall be flushed thoroughly following installation.

Section 3A.06 FLUSHING, DISINFECTING, AND TESTING

Sub-section A. Flushing:

All new water systems or extensions to existing systems shall be thoroughly flushed before being placed in service. Flushing shall be accomplished through hydrants, or end of line blow-off assemblies at a minimum flushing velocity of 2.5-feet per second. See Table 3A-1 below:

TABLE 3A-1

FLOW RATE AND OPENINGS TO FLUSH PIPELINES
(40- psi Residual Pressure)

Pipe Size (inches)	Flow Required to Produce 2.5 fps velocity (gpm)
2	26
4	100
6	220
8	390
10	610
12	880
14	1,200
16	1,565
18	1,980
20	2,450
24	3,525
30	5,507

Sub-section B. Disinfection:

After flushing, all culinary water lines shall be disinfected by chlorination. Chlorination shall provide a minimum of 25 ppm residual after 24 hours contact in the pipeline. This may be expected with an application of 50 ppm, although some conditions may require more. Chlorine in the form of a 1% slurry of high-test calcium hypochlorite (HTH, Perchloron, Pittchlor, etc. which are 70% available chlorine by weight) shall be fed into the pipeline in such a manner as to mix with the water flowing in the pipeline. (A 1% slurry - 10,000 ppm - results from mixing one pound of calcium hypochlorite with 8.40 gallons of water.)

Table 3A-2 below provides information as to the required quantity of slurry to be used per 100 feet of pipe to provide a chlorine concentration of 50 ppm:

TABLE 3A-2

Pipe Size (in.)	Vol. of 100 ft. Length (gal)	Required Amount of 1 % Chlorine Slurry (gal)
1 ½	9.18	0.07
2	16.32	0.12
2 ½	25.50	0.18
3	36.73	0.26
4	65.28	0.47
6	146.90	1.05
8	261.10	1.87
10	408.10	2.92
12	587.60	4.20

During the process of chlorinating the pipeline, operate all valves and other pipeline appurtenances several times to provide sufficient contact with the chlorinating agent. Following chlorination, drain and thoroughly flush the water line according to Section A above.

Disinfection shall conform to the requirements of AWWA C651 (latest edition): AWWA Standard for Disinfecting Water Mains and Rule R309-550. Facility Design and Operation: Transmission and Distribution Pipelines of the Utah Division of Drinking Water.

The Developer/Contractor shall provide 3 copies of the Disinfection Report that includes:

1. Date issued.
2. Project Name and Location
3. Treatment Contractor's name, address, and phone number
4. Type and form of disinfectant used.
5. Time and date of disinfectant injection started.
6. Time and date of disinfectant injection completed.
7. Test locations.
8. Initial and 24 hour disinfection residuals in ppm for each outlet tested.
9. Time and date flushing started.
10. Time and date flushing completed.
11. Disinfectant residual after flushing in ppm for each outlet tested.

Sub-section C. Bacteriological Test:

The Developer/Contractor is responsible to submit and pay for the bacteriological test. Re-chlorinate the water line and retest the water, if necessary, until the results of the bacteriological test are satisfactory. Bacteriological tests shall be as follows:

1. No samples for testing shall be taken sooner than 24 hours after system flushing.
2. Sample water at each of the following locations, as applicable: where water enters system, ends of pipe runs, and remote outlets
3. Analyze water samples in accordance with State of Utah Requirements.
4. After final flushing and before the new water line is connected to the distribution system, two (2) consecutive sets of acceptable samples, taken at least 24 hour apart, shall be collected for the new line. At least one set of samples shall be collected from every 1200 feet of new water line, plus one set from the end of the line and at least one set from each branch. All samples shall be tested for bacteriological quality in accordance with Standard Methods for the Examination of Water and Wastewater, and shall show the absence of coliform organisms. Provide three (3) copies of the report to the Public Works Director.

The Bacteriological Report shall include:

1. Date issued.
2. Project name and location.
3. Laboratory's name, certification number, address, and phone number.
4. Time and date of water sample collection.
5. Name of person collecting samples.
6. Test location.
7. Time and date of laboratory test start.
8. Coliform bacteria test results for each outlet tested.
9. Certification that water conforms or fails to conform to bacterial standards of State of Utah Public Drinking Water Regulations.
10. Bacteriologist's signature.

Sub-section D. Pressure Test:

All newly laid pipes or any valved section thereof shall be subjected to a hydrostatic pressure. A leakage test shall be conducted concurrently with the pressure test.

- 1) Test Pressure Restrictions: Test pressures shall,
 - i. Not be less than 1.5 times the static pressure at the highest point along the test section.
 - ii. Not exceed pipe or thrust restraint design pressures.
 - iii. Be of at least 2-hour duration.
 - iv. Not vary by more than plus or minus five (± 5) psi for the duration of the test.
 - v. Not exceed twice the rated pressure of the valves or hydrants when the pressure boundary of the test section includes closed gate valves or hydrants.
 - vi. Not exceed the rated pressure of the valves when the test boundary of the test section includes closed, resilient-seated gate valves or butterfly valves.
- 2) Pressurization: Each valved section of pipe shall be slowly filled with water and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gage, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Public Works Representative/Engineer.
- 3) Air Removal: Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at all high points, the Developer/Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged.
- 4) Examination: All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, or hydrants that are discovered following the pressure test shall be repaired or replaced with sound materials and the test shall be repeated until it is satisfactory to the Owner.

Sub-section E. Leakage Test:

A leakage test shall be conducted concurrently with the pressure test.

- 1) Leakage Defined: Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.
- 2) Allowable Leakage: No pipe installation will be accepted if the leakage is greater than that determined

by the following formula:

$$L = \frac{S * D\sqrt{P}}{148,000}$$

In which L is the allowable leakage, in gallons per hour; S is the length of pipeline tested in feet; D is the nominal diameter of the pipe, in inches; and P is the average test pressure during the leakage test, in pounds per square inch gage.

- i. Allowable leakage at various pressures is shown in Table 3A-3.
- ii. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal/hr/in. of nominal valve size shall be allowed.
- iii. When hydrants are in the test section, the test shall be made against the closed hydrant.

TABLE 3A-3
Allowable Leakage per 1000 ft of Pipeline - gph

Average Test Pressure PSI	Nominal Pipe Diameter (in)															
	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48	54
450	0.430	0.57	0.86	1.15	1.43	1.72	2.01	2.29	2.58	2.87	3.44	4.30	5.16	6.02	6.88	7.74
400	0.405	0.54	0.81	1.08	1.35	1.62	1.89	2.16	2.43	2.70	3.24	4.05	4.86	5.68	6.49	7.30
350	0.379	0.51	0.76	1.01	1.26	1.52	1.77	2.02	2.28	2.53	3.03	3.79	4.55	5.31	6.07	6.83
300	0.351	0.47	0.70	0.94	1.17	1.40	1.64	1.87	2.11	2.34	2.81	3.51	4.21	4.92	5.62	6.32
275	0.336	0.45	0.67	0.90	1.12	1.34	1.57	1.79	2.02	2.24	2.69	3.36	4.03	4.71	5.38	6.05
250	0.321	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56	3.21	3.85	4.49	5.13	5.77
225	0.304	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.43	3.04	3.65	4.26	4.86	5.47
200	0.287	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29	2.87	3.44	4.01	4.59	5.16
175	0.268	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15	2.68	3.22	3.75	4.29	4.83
150	0.248	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99	2.48	2.98	3.48	3.97	4.47
125	0.227	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81	2.27	2.72	3.17	3.63	4.08
100	0.203	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62	2.03	2.43	2.84	3.24	3.65

*If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

**To obtain leakage in liters/hour, multiply the values in the table by 3.785.

- 3) **Acceptance of Installation:** Acceptance shall be determined on the basis of allowable leakage. If any test of pipe laid discloses leakage greater than specified, the Developer/Contractor shall, at its own expense, locate and repair the defective material until the leakage is within the specified allowance.

All visible leaks are to be repaired regardless of the amount of leakage.

3A.07 SURFACE WATER CROSSINGS**Subsection A – Crossing type**

- 1) Above Water Crossings – the pipe shall be adequately supported and anchored, protected from damage and freezing, and accessible for repair.
- 2) Underwater Crossings – A minimum of two feet (2') of cover or greater, as local conditions dictate, shall be provided.

Subsection B – Water Crossings greater than 15 feet (15')

- 1) Pipe with joints shall be of special construction, having restrained joints for joints within the surface water course and flexible restrained at both edges of the water course.
- 2) Isolating valves shall be provided on both sides of the water crossing at locations not subject to high ground water or flooding, so that the section can be isolated for testing and repair.
- 3) A means shall be provided, such as sampling tap, not subject to flooding, to allow for representative water quality testing on the upstream and downstream side of the crossing.
- 4) A means shall be provided to pressure test the underground water crossing pipe.

DIVISION 4

CONCRETE PIPE

Section 4.01 GENERAL

This section covers the requirements for concrete pipe materials and installation in sanitary sewer, storm drain, and other gravity line construction.

Section 4.02 PIPE

Concrete pipe used in sewer line, storm drain line and other gravity line construction shall be reinforced concrete pipe or non-reinforced concrete pipe, as required by design loading and fill heights and as follows:

Sub-section A. Reinforced Concrete Pipe:

All reinforced concrete pipe used in the construction shall be of the rubber gasket type, bell and spigot joint design, conforming to the requirements of the latest revision of ASTM Designation C76 (Class III.) Pipe class shall be as shown on the Improvement Drawings. The minimum joint length of all pipes provided shall be 7 1/2 feet. All pipe 12-inch diameter and larger shall be reinforced concrete.

Sub-section B. Non-Reinforced Concrete Pipe:

All non-reinforced concrete pipe used in the construction shall be of the rubber gasket type, bell and spigot joint design, conforming to the requirements of the latest revision of ASTM Designation C14. Pipe class shall be as shown on the Improvement Drawings. The minimum joint length for pipe shall be four feet for pipe up to ten inches and seven and a half feet for all other pipe.

Sub-section C. Bell and Spigot Joints:

Bell and spigot joints, including rubber gaskets, shall conform to the requirements of the latest revision of ASTM Designation C443. The pipe joint shall be so designed as to provide for self-centering, and when assembled, to compress the gasket to form a water tight seal. The gasket shall be confined in a groove on the spigot, so that pipe movement or hydrostatic pressure cannot displace the gasket.

Sub-section D. Minimum Size and Slope Requirements:

In no case shall sanitary sewer mains be less than eight inches in diameter. Sewers shall be laid with uniform slope between manholes. All sewers shall be designed and constructed to give mean velocities of not less than 2 feet per second when flowing full, based on Manning's formula using an n value of .013. Absolute minimum slope allowed shall be those published by the Utah Department of Environmental Quality, Division of Water Quality as Administrative Rules for Design Requirements for Wastewater Collection, Treatment and Disposal System, R317-3, **Table R317-3-2.3 (D)(4) Minimum Slopes**.

Whenever possible the slope should exceed 0.006 ft/ft. The pipe should be sized to meet anticipated hydraulic loads, increasing the pipe size to reduce the minimum slope requirements shall not be allowed. Sewer slopes shall not exceed 0.12 ft/ft, drop manholes shall be used when steeper slopes are needed, drop manholes shall be used to keep line grade below maximum grade allowed.

Section 4.03 PIPE LAYING

All concrete pipe installation shall proceed upgrade on a stable foundation, with joints closely and accurately fitted. Rubber gaskets shall be fitted properly in place, and care shall be taken in joining the pipe sections to avoid twisting of gaskets. Joints shall be clean and dry, and a joint lubricant as recommended by the pipe supplier shall be applied uniformly to the mating joint surfaces to facilitate easy positive joint closure.

Pipe shall be installed with uniform bearing under the full length of the barrel, with suitable excavations being made to receive pipe bells.

Select material shall be compacted around the pipe to firmly bed the pipe in position. If adjustment of position of a pipe length is required after being laid, it shall be removed and re-jointed as for a new pipe. When laying is not in progress, the ends of the pipe shall be closed with a tight-fitting stopper to prevent the entrance of foreign material.

In addition to the above requirements, all pipe installation shall comply with the specific requirements of the pipe manufacturer.

Section 4.04 GRAVEL FOUNDATION FOR PIPE

Wherever the subgrade material does not afford a sufficiently solid foundation to support the pipe and superimposed load, or where groundwater must be drained, the subgrade shall be excavated to such depth as may be necessary and replaced with crushed rock or gravel compacted into place.

Gravel for concrete pipe foundation shall be clean crushed rock or gravel with one hundred percent (100%) less than two-inch (2") and a maximum of five percent (5%) less than one-half-inch (1/2").

Section 4.05 INSTALLATION REQUIREMENTS FOR LINE AND GRADE

All concrete pipes shall be installed accurately to the defined line and grade with the following limits:

Variance from established line and grade shall not be greater than one-sixteenth (1/16) inch per inch of pipe diameter in ten feet, and not to exceed one-half inch in ten feet, provided that such variation does not result in a level or reverse sloping invert; provided also that variation in the invert elevation between adjoining ends of pipe, due to non-concentricity of joining surface and pipe interior surfaces, does not exceed one-sixty-fourth (1/64) inch per inch of pipe diameter, or one-half (1/2) inch maximum.

Section 4.06 PIPE BEDDING

All pipes shall be protected from lateral displacement and possible damage resulting from impact or unbalanced loading during backfilling operations by being adequately bedded.

A groove shall be excavated in the bottom of the trench to receive the bottom quadrant of the pipe. Before preparing the groove, the trench bottom shall be excavated or filled and compacted to an elevation sufficiently above the grade of the pipe so that, when completed, the pipe will be true to line and grade. Bell holes shall be excavated so that only the barrel of the pipe receives bearing from the trench bottom.

Pipe bedding materials placed at any point below the mid-point of the pipe shall be deposited and compacted in layers not to exceed ten inches (10") in uncompacted depth. Deposition and compaction of bedding materials shall be done simultaneously and uniformly on both sides of the pipe. Compaction shall be accomplished with hand or mechanical compactors. All bedding materials shall be placed in the trench in such a manner that they will be scattered alongside the pipe and not dropped into the trench in compact masses. Bedding materials shall be loose earth, free from lumps; sand or gravel, free from rocks larger than two-inch (2") diameter. All materials shall be free from roots, sod, or other vegetable matter.

If in the opinion of the Public Works Representative/ Engineer the trench materials are not satisfactory for pipe bedding, modified bedding will be required. Modified bedding shall consist of placing compacted granular material on each side of and to the level of twelve inches (12") above the top of the pipe.

Modified bedding material shall be graded as follows: One-hundred percent (100%) passing a one and one-half inch (1-1/2") screen and a maximum of five percent (5%) passing a No. 4 sieve.

Section 4.07 TESTS

On all sanitary sewer main lines and storm drain lines the Developer/Contractor will be required to conduct an air test and displacement test and televise all sewer and storm drain main lines in the presence of the Public Works Representative/Engineer or his representative. If these tests prove to be inconclusive, any or all of the other required tests shall be conducted in the presence of the Public Works Representative/Engineer or his representative.

For storm drain and other gravity lines, the Developer/Contractor will be required to conduct a displacement test in the presence of the Public Works Representative/Engineer or his representative. If this test proves to be inconclusive, other required tests shall be conducted in the presence of the Public Works Representative/Engineer or his representative. If a storm drain or other gravity line visibly contains excessive sediment and/or debris, the Public Works Representative/Engineer may request the line to be televised.

Tests shall be performed as follows:

Sub-section A. Displacement Test:

In conducting the displacement test a light will be flashed between manholes or, if the manholes have not as yet been constructed, between the locations of the manholes, by means of a flashlight or by reflecting sunlight with a mirror. If the illuminated interior of the pipe shows broken, misaligned or displaced pipe or other defects, the defects designated by the Public Works Representative/Engineer shall be remedied at the Developer/Contractor's expense.

Sub-section B. Infiltration Test:

The Developer/Contractor shall furnish labor, equipment, and materials, including pumps, and shall assist the Public Works Representative/Engineer in making infiltration tests of the completed line before it can be placed into service. The Developer/Contractor shall furnish and install the measuring weirs or other measuring devices. The length of line to be tested at any time shall be subject to the approval of the Public Works Representative/Engineer. The maximum allowable infiltration shall not exceed one-hundred-fifty (150) gallons per inch diameter per mile per twenty-four hours (24 hrs) for all installed pipe. If the quantity of infiltration is in excess of the maximum allowable, the leaking joints shall be repaired to the satisfaction of the Public Works Representative/Engineer at the expense of the Developer/Contractor.

Sub-section C. Exfiltration Test:

The Developer/Contractor shall furnish labor, equipment, and materials, including pumps, and shall assist the Public Works Representative/Engineer in making ex-filtration tests of the completed line before it can be placed into service. The length of line to be tested at one time shall be limited to the length between adjacent manholes. The maximum allowable ex-filtration shall not exceed one-hundred-fifty (150) gallons per inch diameter per mile per 24 hours for all installed pipe. The end of the line, which projects into the manhole, shall be plugged. The pipe shall then be filled with water from the upper manhole, and the line maintained under a light pressure of four feet (4') of head. The inflow of water necessary to maintain this head shall be recorded as the leakage of the system. If the quantity of ex-filtration is in excess of the maximum allowable, the leaking joints shall be repaired to the satisfaction of the Public Works Representative/Engineer at the expense of the Developer/Contractor.

Sub-section D. Air Testing:

The Developer/Contractor or his representative (a qualified firm or individual agreed upon by the Public Works Representative/Engineer and the Developer/Contractor) shall furnish labor, equipment, and materials, including pumps and compressors, and shall perform, in the presence of the Public Works Representative/Engineer, air tests of the completed pipe before it can be placed in service. Each section of sanitary sewer pipeline between manholes shall be tested after all the four-inch service laterals (and plugs) have been installed. Each test section shall be pressurized to 4.0 psi. For the purpose of stabilizing the air pressure in each test section, the 4.0 psi pressure shall be maintained for a two-minute period. Each test section shall then be re-pressurized to 4.0 psi for a period of four minutes. The test section shall be accepted if, after four minutes, the pressure gauge indicates 3.5 psi or greater. Failure of the Developer/Contractor's testing equipment to properly function shall render the test unacceptable. All faulty sections of pipeline shall be repaired and re-tested until the minimum air testing requirements have been met.

Sub-section E. Televising

The Developer/Contractor or his representative shall furnish labor, equipment, and materials, and shall televise the completed line, in the presence of the Public Works Representative/Engineer, before it can be placed into service. The line shall be taped continuously through the entire length of each section of pipe. A pipe will be deemed unsatisfactory if there is excessive cracking, deflection or damage, if the pipe contains excessive sediment and/or debris, or if the Public Works Representative/Engineer finds any other unsatisfactory conditions as a result of the test. All faulty, damaged, debris-laden, or otherwise unacceptable sections of pipe shall be repaired and/or cleaned to the satisfaction of the Public Works Representative/Engineer and re-tested as deemed necessary by the Public Works Representative/Engineer.

If upon inspection of a sewer manhole it is found that the plywood floor has not been installed, or if it appears that material has been introduced into the sewer pipe line, the Public Works Representative/Engineer may require additional televising of the sewer line prior to final acceptance of the line.

The Contractor/Developer must provide the City with a DVD of the televising of the line. The Contractor/Developer shall pay the cost of televising the lines. The televising equipment used must record on the DVD a continuous distance from the point of entry.

Section 4.08 MANHOLE CONNECTIONS

Concrete pipe connections to manholes shall be achieved by use of manhole coupling adapters, rubber gaskets, positive seal gasket system with 300 series nonmagnetic corrosion-resistant steel bands, or grouting a bell or spigot pipe at the appropriate locations. Connections shall meet the requirements of Division 5 MANHOLES.

Section 4.09 SEWER SERVICE LATERALS

New service laterals shall be constructed with materials and procedures as specified herein.

Existing service laterals shall be constructed with materials compatible with the existing laterals with appropriate connections for joining the ends of existing laterals. All laterals shall be four-inch (4") in diameter unless shown otherwise.

Sub-section A. Extent and Location of Laterals:

New sewer laterals installed to lots shall be located five feet (5') downhill from the center of the lot. Service laterals shall extend from the sewer main to a point ten feet (10') beyond the street right-of-way line unless shown or staked otherwise. A two-inch (2") by four-inch (4"), with the top twenty-four inches (24") painted green, shall be installed to clearly mark the end of each lateral line. The marker shall extend vertically from the end of the pipe to a minimum of thirty-six inches (36") above the ground surface. The depth to the sewer lateral shall be written on the marker with a permanent marking pen. In addition to the marker, the

Developer/Contractor shall station (give a distance) the location of the lateral connection to the main from the nearest downstream manhole and show station on Record Drawings. Laterals shall be capped with a cap suitable to withstand test pressure and prevent any leakage into or out of the lateral.

When an existing sewer lateral is encountered along the line and grade of a new pipeline it shall be relocated using appropriate pipe and fittings and graded to insure adequate slope to drain properly. Minimum slope shall be one-quarter-inch (1/4") per foot, unless otherwise approved by Public Works.

Sub-section B. Excavation and Backfill:

Trench excavation and backfill shall conform to the applicable paragraphs of Division 2 and the bedding requirements of this Division.

Sub-section C. Pipe:

Pipe used for new service laterals shall be PVC Plastic Pipe conforming to ASTM D3034 SDR 35.

Sub-section D. Connection to Main:

Connection to a new main shall be made using a precast wye or tee installed in the main line at time of installation with a 4-inch PVC adapter or rubber gasket into which the 4-inch PVC lateral is inserted to form a water tight connection. In pipes 12 inches and larger the connection may be made using a cored hole in the pipe and a rubber boot. Recommendations of the manufacturer of the materials used shall be carefully followed.

Connections onto existing sewer mains shall be made with field installed service saddles (gasketed and clamped). All connections by field installed service saddles on existing sewer mains shall be done with a sewer tapping machine and all required fittings and materials. Connections shall be made as shown on the Standard Drawing and at the location specified herein, shown on the improvement drawings or as staked in the field.

Sub-section E. Cover Over Sewer Lateral Lines:

There shall be a minimum of 3 feet of cover over all sewer lateral lines (3'6" minimum at property line.)

Sub-section F. Sewer Clean Outs:

There shall be a maximum distance of 5 feet from the foundation wall to the first exterior clean out with a maximum distance between clean-outs of one hundred (100) feet. There shall be a clean out when a combination of bends is ninety degrees (90°) or greater.

Sub-section G. Location of Stub Pipes:

In new street construction, an "S" shall be stamped in the top of the curb before the concrete sets to indicate the location where the sewer service pipe crosses the curb.

Sub-section H. Testing:

The service laterals shall be tested as a part of the sewer main to which they are connected.

Sub-section I. Damage and Repair of Sewers and Appurtenances:

The Developer/Contractor shall be responsible for the protection of existing improvements, and any damage resulting from its operations shall be its sole responsibility.

Damage to the sewers, laterals, or appurtenances shall be repaired by acceptable and approved methods.

DIVISION 4A**PVC PLASTIC PIPE****Section 4A.01 GENERAL**

This section covers the requirements for PVC plastic sewer pipe materials and installation in sanitary sewer, storm drain, and other gravity line construction.

Section 4A.02 PIPE

PVC gravity sewer pipe and fittings shall conform to ASTM D3034, for diameters from four-inch (4") to fifteen-inch (15") and ASTM F679 for eighteen-inch (18") to twenty-seven-inch (27"), with integral bell gasket joints. Rubber gaskets shall be factory installed and conform to ASTM F477. Pipe shall be made of PVC plastic having a cell classification of 12454A or 13364B (with minimum tensile modulus of 500,000 PSI) as defined in ASTM D1784 and shall have a SDR of 35 and minimum pipe stiffness of 46 PSI according to ASTM test D2412.

Pipe shall be installed in compliance with ASTM D2321 and the manufacturer's requirements.

Sub-section A. Minimum Size and Slope Requirements:

In no case shall sanitary sewer mains be less than eight inches in diameter. Sewers shall be laid with uniform slope between manholes. All sewers shall be designed and constructed to give mean velocities of not less than 2 feet per second when flowing full, based on Manning's formula using an n value of .013. Absolute minimum slope allowed shall be those published by the Utah Department of Environmental Quality, Division of Water Quality as Administrative Rules for Design Requirements for Wastewater Collection, Treatment and Disposal System, R317-3, **Table R317-3-2.3 (D)(4) Minimum Slopes**.

Whenever possible the slope should exceed 0.006 ft/ft. The pipe should be sized to meet anticipated hydraulic loads, increasing the pipe size to reduce the minimum slope requirements shall not be allowed. Sewer slopes shall not exceed 0.12 ft/ft, drop manholes shall be used when steeper slopes are needed, drop manholes shall be used to keep line grade below maximum grade allowed.

Section 4A.03 FITTINGS

Fittings shall be made of PVC plastic conforming to ASTM D1784 and a cell classification as outlined in ASTM D3034.

Section 4A.04 PIPE LAYING

All pipe installation shall proceed upgrade on a stable foundation, with joints closely and accurately fitted. Joints shall be clean and dry, and a joint lubricant as recommended by the pipe supplier shall be applied uniformly to the mating joint surfaces to facilitate easy positive joint closure.

Pipe shall be installed with uniform bearing under the full length of the barrel, with suitable excavations being made to receive pipe bells.

Select material shall be compacted around the pipe to firmly bed the pipe in position. Haunching material (bed to springline) should be carefully worked under the haunches of the pipe and compacted from the pipe to the trench wall or two and one half (2-1/2) pipe diameters on each side of the pipe to ensure support. If adjustment of position of a pipe length is required after being laid, it shall be removed and re-jointed as for a new pipe. When pipe laying is not in progress, the ends of the pipe shall be closed with a tight-fitting stopper to prevent the entrance of foreign material. In addition to the above requirements, all pipe installation shall rigidly adhere to the specific requirements of the pipe manufacturer.

Section 4A.05 GRAVEL FOUNDATION FOR PIPE

Wherever the subgrade material does not afford a sufficiently solid foundation to support the pipe and superimposed load, and where groundwater must be drained, the subgrade shall be excavated to such depth as may be necessary and replaced with crushed rock or gravel compacted into place.

Gravel for PVC pipe foundation shall be clean crushed rock or gravel with one hundred percent (100%) less than two-inch (2") and a maximum of five percent (5%) less than one-half-inch (1/2").

Section 4A.06 INSTALLATION REQUIREMENTS FOR LINE AND GRADE

All PVC pipe shall be installed accurately to the defined line and grade with the following limits:

- a) Variance from established line and grade shall not be greater than one-sixteenth (1/16) inch per inch of pipe diameter in ten feet, and not to exceed one-half inch in ten feet, provided that such variation does not result in a level or reverse sloping invert; provided also that variation in the invert elevation between adjoining ends of pipe, due to non-concentricity of joining surface and pipe interior surfaces, does not exceed one-sixty-fourth (1/64) inch per inch of pipe diameter, or one-half (1/2) inch maximum.

Section 4A.07 PIPE BEDDING

All pipe sewers and drains shall be protected from lateral displacement and possible damage resulting from impact or unbalanced loading during backfilling operations by being adequately bedded.

A groove shall be excavated in the bottom of the trench to receive the bottom quadrant of the pipe. Before preparing the groove, the trench bottom shall be excavated or filled and compacted to an elevation sufficiently above the grade of the pipe so that, when completed, the pipe will be true to line and grade. Bell holes shall be excavated so that only the barrel of the pipe receives bearing from the trench bottom.

Pipe bedding materials placed at any point below the mid-point of the pipe shall be deposited and compacted in layers not to exceed ten inches (10") in uncompacted depth. Deposition and compaction of bedding materials shall be done simultaneously and uniformly on both sides of the pipe. Compaction shall be accomplished with hand or mechanical compactors. All bedding materials shall be placed in the trench with hand tools or other approved method in such a manner that they will be scattered alongside the pipe and not dropped into the trench in compact masses. Bedding materials shall be loose earth, free from lumps; sand or gravel, free from rocks larger than ~~one~~ three quarter inch ($\pm 3/4$ ") diameter; with all materials free from roots, sod, or other vegetable matter.

In the event trench materials are not satisfactory for pipe bedding, modified bedding will be required. Modified bedding shall consist of placing compacted granular material on each side of and to the level of twelve inches (12") above the top of the pipe.

Modified bedding material shall be graded as follows: One-hundred percent (100%) passing a three quarter inch ($3/4$ ") screen and maximum of five percent (5%) passing a No. 200 sieve.

Section 4A.08 TESTS

On all sewer main lines the Developer/Contractor will be required to conduct an air test and displacement test and televise the sewer main in the presence of the Public Works Representative/Engineer or his representative. If these tests prove to be inconclusive, any or all of the other required tests shall be conducted in the presence of the Public Works Representative/Engineer or his representative. For storm drain and other gravity lines, the Developer/Contractor will be required to conduct a displacement test in the presence of the Public Works Representative/Engineer or his representative. If this test proves to be inconclusive, other required tests shall be conducted in the presence of the Public Works Representative/Engineer or his representative. If a storm drain or other gravity line visibly contains excessive sediment and/or debris, the Public Works Representative/Engineer may request the line to be televised. Tests shall be performed as follows:

Sub-section A. Displacement Test:

In conducting the displacement test a light will be flashed between manholes or, if the manholes have not as yet been constructed, between the locations of the manholes, by means of a flashlight or by reflecting sunlight with a mirror. If the illuminated interior of the pipe shows broken, misaligned or displaced pipe or other defects, the defects designated by the Public Works Representative/Engineer shall be remedied at the Developer/Contractor's expense.

Sub-section B. Infiltration Test:

The Developer/Contractor shall furnish labor, equipment, and materials, including pumps, and shall assist the Public Works Representative/Engineer in making infiltration tests of the completed line before it can be placed into service. The Developer/Contractor shall furnish and install the measuring weirs or other measuring devices. The length of line to be tested at any time shall be subject to the approval of the Public Works Representative/Engineer. The maximum allowable infiltration shall not exceed one-hundred-fifty (150) gallons per inch diameter per mile per twenty-four hours (24 hrs) for all installed pipe. If the quantity of infiltration is in excess of the maximum allowable, the leaking joints shall be repaired to the satisfaction of the Public Works Representative/Engineer at the expense of the Developer/Contractor.

Sub-section C. Ex-filtration Test:

The Developer/Contractor shall furnish labor, equipment, and materials, including pumps, and shall assist the Public Works Representative/Engineer in making ex-filtration tests of the completed line before it can be placed into service. The length of line to be tested at one time shall be limited to the length between adjacent manholes. The maximum allowable ex-filtration shall not exceed one-hundred-fifty (150) gallons per inch diameter per mile per 24 hours for all installed pipe. The end of the line, which projects into the manhole, shall be plugged. The pipe shall then be filled with water from the upper manhole, and the line maintained under a light pressure of four feet (4') of head. The inflow of water necessary to maintain this head shall be recorded as the leakage of the system. If the quantity of ex-filtration is in excess of the maximum allowable, the leaking joints shall be repaired to the satisfaction of the Public Works Representative/Engineer at the expense of the Developer/Contractor.

Sub-section D. Air Testing:

The Developer/Contractor or his representative (a qualified firm or individual agreed upon by the Public Works Representative/Engineer and the Developer/Contractor) shall furnish labor, equipment, and materials, including pumps and compressors, and shall perform, in the presence of the Public Works Representative/Engineer, air tests of the completed pipe before it can be placed in service. Each section of sanitary sewer pipeline between manholes shall be tested after all the four-inch service laterals (and plugs) have been installed. Each test section shall be pressurized to 4.0 psi. For the purpose of stabilizing the air pressure in each test section, the 4.0 psi pressure shall be maintained for a two-minute period. Each test section shall then be re-pressurized to 4.0 psi for a period of four minutes. The test section shall be accepted if, after four minutes, the pressure gauge indicates 3.5 psi or greater. Failure of the Developer/Contractor's testing equipment to properly function shall render the test unacceptable. All faulty sections of pipeline shall be repaired and re-tested until the minimum air testing requirements have been met.

Sub-section E. Televising

The Developer/Contractor or his representative shall furnish labor, equipment, and materials, and shall televise the completed line, in the presence of the Public Works Representative/Engineer, before it can be placed into service. The line shall be taped continuously through the entire length of each section of pipe. A pipe will be deemed unsatisfactory if there is excessive cracking, deflection or damage, if the pipe contains excessive sediment and/or debris, or if the Public Works Representative/Engineer finds any other unsatisfactory conditions as a result of the test. All faulty, damaged, debris-laden, or otherwise unacceptable Sections of pipe shall be repaired and/or cleaned

to the satisfaction of the Public Works Representative/Engineer and re-tested as deemed necessary by the Public Works Representative/Engineer.

If upon inspection of a sewer manhole it is found that the plywood floor has not been installed, or if it appears that material has been introduced into the sewer pipe line, the Public Works Representative/Engineer may require additional televising of the sewer line prior to final acceptance of the line.

The Contractor/Developer must provide the City with a DVD of the televising of the line. The Contractor/Developer shall pay the cost of televising the lines. The televising equipment used must record on the DVD a continuous distance from the point of entry.

Section 4A.09 MANHOLE CONNECTIONS

PVC pipe connections to manholes shall be achieved by use of manhole coupling adapters, rubber gaskets, or positive seal gasket system with 300 series nonmagnetic corrosion-resistant steel bands. PVC may not be grouted directly to concrete. Connections shall meet the requirements of Division 5 MANHOLES.

Section 4A.10 SEWER LATERAL CONNECTIONS

All sewer lateral connections onto new sewer mains shall be made through preformed tee fittings installed in the main line at the time of main line installation.

Connections onto existing sewer mains shall be made with field installed service saddles (gasketed and clamped). All connections by field installed service saddles on existing sewer mains shall be done with a sewer tapping machine and all required fittings and materials. Connections shall be made as shown on the Standard Drawing and at the location specified herein, shown on the improvement drawings or as staked in the field.

Section 4A.11 SEWER SERVICE LATERALS

New service laterals shall be constructed with materials and procedures as specified herein.

Existing service laterals shall be constructed with materials compatible with the existing laterals with appropriate connections for joining the ends of existing laterals. All laterals shall be four inch (4") in diameter unless shown otherwise.

Sub-section A. Extent of Laterals and Location of Laterals:

New sewer laterals installed to lots shall be located five feet (5') downhill from the center of the lot. Service laterals shall extend from the sewer main to a point ten feet (10') beyond the street right-of-way line unless shown or staked otherwise. A two-inch (2") by four-inch (4"), with the top twenty-four inches (24") painted green, shall be installed to clearly mark the end of each lateral line. The marker shall extend vertically from the end of the pipe to a minimum of thirty-six inches (36") above the ground surface. The depth to the sewer lateral shall be written on the marker with a permanent marking pen. In addition to the marker, the Developer/Contractor shall station (give a distance) the location of the lateral connection to the main from the nearest downstream manhole and show station on Record Drawings. Laterals shall be capped with a cap suitable to withstand test pressure and prevent any leakage into or out of the lateral.

When an existing sewer lateral is encountered along the line and grade of a new pipeline it shall be relocated using appropriate pipe and fittings and graded to insure adequate slope to drain properly. Minimum slope shall be one-quarter-inch (1/4") per foot.

Sub-section B. Excavation and Backfill:

Trench excavation and backfill shall conform to the applicable paragraphs of Division 2 and the bedding requirements of this Division.

Sub-section C. Pipe:

Pipe used for new service laterals shall be PVC Plastic Pipe conforming to ASTM D3034 SDR 35.

Sub-section D. Connection to Main:

Connections to the main shall be made as specified in Section 4A.10 SEWER LATERAL CONNECTIONS. Recommendations of manufacturer of the materials used shall be carefully followed.

Sub-section E. Cover Over Sewer Lateral Lines:

There shall be a minimum of 3 feet of cover over all sewer lateral lines (3'6" minimum at property line.)

Sub-section F. Sewer Clean Outs:

There shall be a maximum distance of 5 feet from the foundation wall to the first exterior clean out with a maximum distance between clean-outs of one hundred (100) feet. There shall be a clean out when a combination of bends is ninety degrees (90°) or greater.

Sub-section G. Location of Stub Pipes:

In new street construction, an "S" shall be stamped in the top of the curb before the concrete sets to indicate the location where the sewer service pipe crosses the curb.

Sub-section H. Testing:

The service laterals shall be tested as a part of the sewer main to which they are connected.

Sub-section I. Damage and Repairs of Sewers and Appurtenances:

The Developer/Contractor shall be responsible for the protection of existing improvements, and any damage resulting from its operations shall be its sole responsibility.

Damage to the sewers, laterals, or appurtenances shall be repaired by acceptable and approved methods.

Section 4A.12 "GO/NO-GO" MANDREL PROOF TESTING

Not less than thirty (30) days after installation of the flexible sewer or drain pipe, the Developer/Contractor shall test the buried pipe to insure that ring-deflection of the pipe does not exceed five percent (5%) of the pipe's specified minimum inside diameter (ID). This proof test shall establish that the Developer/Contractor has installed the flexible pipe in full compliance with the Project Specifications thereby providing required pipe/soil structural strength.

The Developer/Contractor, with Inspector present, shall pull a "Go/No-Go" Mandrel, inspected and approved by the Public Works Representative/Engineer, through the full length of installed flexible pipe. The Mandrel shall be fabricated from suitable metal with a minimum of nine (9) properly sized radial fins mounted upon a center pulling shaft. In any case, the Mandrel shall be provided with an odd number of rigidly mounted radial fins. The Mandrel shall be provided with a proof-sizing ring that can demonstrate that the Mandrel's minimum outside diameter (OD) is not less than ninety-five percent (95%) of the specified minimum inside diameter of the installed flexible pipe. The Mandrel shall be pulled by the Developer/Contractor through one hundred percent (100%) of the installed flexible pipe without using mechanical equipment. Failure of the Mandrel to pass through a pipeline shall be deemed evidence of inadequate installation by the Developer/Contractor not in compliance with the Project Specifications.

The Public Works Representative/Engineer may require, if deemed appropriate or necessary, additional proof testing of designated lengths of the buried flexible pipe approximately one year (1 yr.) after installation but prior to the

expiration of the Developer/Contractor's Maintenance Bond. The flexible pipeline shall be cleaned adequately prior to performing the "Go/No-Go" Mandrel ring deflection proof test. The Developer/Contractor, with Inspector present, shall pull a Mandrel, approved by the Public Works Representative/Engineer, through the designated length of pipeline without using mechanical equipment. Failure of the Mandrel to pass through the pipeline shall be deemed evidence of inadequate installation by the Developer/Contractor not in compliance with the Project Specifications.

DIVISION 4B**POLYETHYLENE CORRUGATED PIPE****Section 4B.01 GENERAL**

This section covers the requirements for high-density polyethylene corrugated pipe with integrally formed smooth interior for use in storm drains.

Section 4B.02 PIPE

This specification is applicable to nominal sizes 12 - 36 inch diameter and larger if or when available. Requirements for test methods, dimensions, and markings are those found in AASHTO Designation M-294 Type S.

Pipe and fittings shall be made of polyethylene compounds that meet or exceed the requirements of ASTM F 405 or ASTM F 667, Type III, Category 4 or 5, Grade P33 or P34, Class C as defined by ASTM D 1248.

Minimum parallel plate pipe stiffness values at 5% deflection shall be as follows:

<u>Diameter</u>	<u>Pipe Stiffness*</u>
12"	50 psi
15"	42 psi
18"	40 psi
24"	34 psi
30"	28 psi
36"	22 psi

*As Described in ASTM Test Method D 2412 with exceptions stated in M 294

The pipe and fittings shall be free of foreign inclusions and visible defects. The ends of the pipe shall be cut squarely and cleanly so as not to adversely effect joining.

The nominal size for the pipe and fittings is based on the nominal inside diameter of the pipe. Corrugated fittings maybe either molded or fabricated by the manufacturer. Fittings produced by manufacturers other than the supplier of the pipe shall not be permitted without the approval of the Public Works Representative/Engineer.

A manufacturers' certification that the product was manufactured, tested, and supplied in accordance with this specification shall be furnished to the Public Works Representative/Engineer upon request.

Pipe installation shall be in accordance with ASTM Recommended Practice D 2321 and the manufacturer's requirements.

Section 4B.03 JOINTS

Joints shall be made with split couplings, corrugated to match the pipe corrugations, and shall engage a minimum of 6 corrugations for 12" - 24" diameter and 4 corrugations for 30" and 36" diameter pipe.

Section 4B.04 PERFORATIONS

All perforated pipe used in the construction shall have either circular or slotted perforations. Circular perforations shall not be more that 5/16 in. nor less than 3/16 in. in diameter, and arranged in rows parallel to the axis of the pipe. Perforations shall be 3 in. center-to-center, along rows. The spigot or tongue end shall not be perforated for a length equal to the depth of the socket, or depth of the groove plus 3/4 in. and perforations shall continue at uniform spacing along the entire length of the barrel. There shall be a total of 8 rows for an 18-inch pipe. The rows shall be spaced over not more than 165 deg of circumference. Rows shall be symmetrically arranged with respect to the intended top of bottom of the pipe.

Slots shall be circumferential in direction, not more than 3/16 in. or less than 1/8 in. in width, and 3 in. long. The slots shall be spaced 6 in. apart. There shall be two rows of slots, spaced 120° apart. The distance from the spigot end or from the shoulder of the tongue end, to the first pair of slots shall be not more than 1 in. greater than the specified slot spacing, nor less than 1 in. less than the specified slot spacing. Slots shall continue at uniform spacing along the entire length of the barrel.

Section 4B.05 PIPE LAYING

All pipe installation shall proceed upgrade on a stable foundation, with joints closely and accurately fitted.

Pipe shall be installed with uniform bearing under the full length of the barrel, with suitable excavations being made to receive pipe joints.

Select material shall be compacted around the pipe to firmly bed the pipe in position. Haunching material (bed to springline) should be carefully worked under the haunches of the pipe and compacted from the pipe to the trench wall, or two and one-half (2-1/2) pipe diameters on each side of the pipe, to ensure support. If adjustment of position of a pipe length is required after being laid, it shall be removed and re-jointed as for a new pipe. When pipe laying is not in progress, the ends of the pipe shall be closed with a tight-fitting stopper to prevent the entrance of foreign material.

In addition to the above requirements, all pipe installation shall rigidly adhere to the specific requirements of the pipe manufacturer.

Section 4B.06 GRAVEL FOUNDATION FOR PIPE

Wherever the subgrade material does not afford a sufficiently solid foundation to support the pipe and superimposed load, and where groundwater must be drained, the subgrade shall be excavated to such depth as may be necessary and replaced with crushed rock or gravel compacted into place.

Gravel for pipe foundation shall be clean crushed rock or gravel with one hundred percent (100%) less than two-inch (2") and a maximum of five percent (5%) less than one-half-inch (1/2").

Section 4B.07 INSTALLATION REQUIREMENTS FOR LINE AND GRADE

All pipe shall be installed accurately to the defined line and grade with the following limits:

- a) Variance from established line and grade shall not be greater than one-sixteenth (1/16) inch per inch of pipe diameter in ten feet, and not to exceed one-half inch in ten feet, provided that such variation does not result in a level or reverse sloping invert; provided also that variation in the invert elevation between adjoining ends of pipe, due to non-concentricity of joining surface and pipe interior surfaces, does not exceed one-sixty-fourth (1/64) inch per inch of pipe diameter, or one-half (1/2) inch maximum.

Section 4B.08 PIPE BEDDING

All pipe sewers and drains shall be protected from lateral displacement and possible damage resulting from impact or unbalanced loading during backfilling operations by being adequately bedded.

A groove shall be excavated in the bottom of the trench to receive the bottom quadrant of the pipe. Before preparing the groove, the trench bottom shall be excavated or filled and compacted to an elevation sufficiently above the grade of the pipe so that, when completed, the pipe will be true to line and grade. Joint holes shall be excavated so that only the barrel of the pipe receives bearing from the trench bottom.

Pipe bedding materials placed at any point below the mid-point of the pipe shall be deposited and compacted in layers not to exceed ten inches (10") in uncompacted depth. Deposition and compaction of bedding materials shall be done simultaneously and uniformly on both sides of the pipe. Compaction shall be accomplished with hand or

mechanical compactors. All bedding materials shall be placed in the trench with hand tools or other approved method in such a manner that they will be scattered alongside the pipe and not dropped into the trench in compact masses. Bedding materials shall be loose earth, free from lumps; sand or gravel, free from rocks larger than one and one-half inch (1-1/2") diameter; with all materials free from roots, sod, or other vegetable matter.

In the event trench materials are not satisfactory for pipe bedding, modified bedding will be required. Modified bedding shall consist of placing compacted granular material on each side of and to the level of twelve inches (12") above the top of the pipe.

Modified bedding material shall be graded as follows: One-hundred percent (100%) passing a one inch (1") screen and maximum of five percent (5%) passing a No. 200 sieve.

Section 4B.09 TESTS

The Developer/Contractor will be required to conduct a displacement test in the presence of the Public Works Representative/Engineer or his representative. If this test proves to be inconclusive, other required tests shall be conducted in the presence of the Public Works Representative/Engineer or his representative. If a storm drain visibly contains excessive sediment and/or debris, the Public Works Representative/Engineer may request the line to be televised. The tests shall be performed as follows:

Sub-section A. Displacement Test:

In conducting the displacement test a light will be flashed between manholes or, if the manholes have not as yet been constructed, between the locations of the manholes, by means of a flashlight or by reflecting sunlight with a mirror. If the illuminated interior of the pipe shows broken, misaligned, or displaced pipe or other defects, the defects designated by the Public Works Representative/Engineer shall be remedied at the Developer/Contractor's expense.

Sub-section B. Televising

The Developer/Contractor or his representative shall furnish labor, equipment, and materials, and shall televise the completed line, in the presence of the Public Works Representative/Engineer, before it can be placed into service. The line shall be taped continuously through the entire length of each section of pipe. A pipe will be deemed unsatisfactory if there is excessive cracking, deflection or damage, if the pipe contains excessive sediment and/or debris, or if the Public Works Representative/Engineer finds any other unsatisfactory conditions as a result of the test. All faulty, damaged, debris-laden, or otherwise unacceptable sections of pipe shall be repaired and/or cleaned to the satisfaction of the Public Works Representative/Engineer and re-tested as deemed necessary by the Public Works Representative/Engineer.

The Contractor/Developer must provide the City with a DVD of the televising of the line. The Contractor/Developer shall pay the cost of televising the lines. The televising equipment used must record on the DVD a continuous distance from the point of entry.

Section 4B.10 MANHOLE CONNECTIONS

Corrugated polyethylene pipe connections to manholes shall be achieved by use of manhole coupling adapters, rubber boots with 300 series nonmagnetic corrosion-resistant steel bands, or grouted directly to concrete.

Section 4B.11 LATERAL CONNECTIONS

All lateral connections into new storm drain mains shall be through preformed tee fittings installed in the main line or with field installed service saddles. All connections by field installed service saddles on new or existing storm drain mains shall be done in accordance with manufacturer recommendations and with all required fittings and materials. Connections shall be at the locations shown in the Improvement Drawings.

DIVISION 4C**POLYETHYLENE CORRUGATED PIPE
WITH WATER TIGHT JOINTS****Section 4C.01 GENERAL**

This section covers the requirements for high density polyethylene corrugated pipe with integrally formed smooth interior for use in storm drains with water tight joints.

Section 4C.02 PIPE

This specification is applicable to nominal sizes 12 to 24 inch and 30 to 36 inch diameter. Requirements for test methods, dimensions, and markings are those found in AASHTO Designation M-252 and M-294 and ASTM F405 and F-667.

Pipe shall be made of polyethylene compounds that meet or exceed the requirements of Type III, Category 4 or 5, Grade P33 or P34, Class C per ASTM Designation D 1248 with the applicable requirements defined in ASTM D 1248. Clean reworked material may be used.

Minimum parallel plate pipe stiffness values shall be as follows:

<u>Diameter</u>	<u>Pipe Stiffness*</u>
4"	50 psi
6"	50 psi
8"	50 psi
10"	50 psi
12"	50 psi
15"	42 psi
18"	40 psi
24"	34 psi
30"	28 psi
36"	22 psi

*As Described in ASTM Test Method D 2412 with exceptions stated in M 294

The pipe shall be free of foreign inclusions and visible defects. For pipe sizes 12" diameter and greater, holes of any kind in the corrugation crests or sidewalls shall be considered unacceptable. The ends of the pipe shall be cut squarely and cleanly so as not to adversely effect joining. The nominal size for the pipe is based on the nominal inside diameter of the pipe.

A manufacturer's certification that the product was manufactured, tested, and supplied in accordance with this specification shall be furnished to the Public Works Representative/Engineer upon request.

Section 4C.03 FITTINGS

Fittings shall be molded from SDR-35 PVC pipe manufactured in accordance with the applicable requirements defined in ASTM D3034. Fittings shall be free of foreign inclusions and visible defects. The nominal size for the fittings is based on the nominal inside diameter of the pipe. Fittings shall be molded by the manufacturer. Fittings produced by manufacturers other than the supplier of the pipe shall not be permitted.

Section 4C.04 PIPE LAYING

Pipe installation shall be in accordance with ASTM D 2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and other Gravity Flow Applications and the manufacturer's requirements.

All pipe installation shall proceed upgrade on a stable foundation, with joints closely and accurately fitted. Pipe shall be installed with uniform bearing under the full length of the barrel, with suitable excavations being made to receive pipe joints.

Select material shall be compacted around the pipe to firmly bed the pipe in position. Haunching material (bed to springline) should be carefully worked under the haunches of the pipe and compacted from the pipe to the trench wall or two and one half (2-1/2) pipe diameters on each side of the pipe to ensure support. If adjustment of position of a pipe length is required after being laid, it shall be removed and re-jointed as for a new pipe. When laying is not in progress, the ends of the pipe shall be closed with a tight-fitting stopper to prevent the entrance of foreign material.

In addition to the above requirements, all pipe installation shall rigidly adhere to the specific requirements of the pipe manufacturer.

Section 4C.05 GRAVEL FOUNDATION FOR PIPE

Wherever the subgrade material does not afford a sufficiently solid foundation to support the pipe and superimposed load, or where groundwater must be drained, the subgrade shall be excavated to such depth as may be necessary and replaced with crushed rock or gravel compacted into place.

Gravel for pipe foundation shall be clean crushed rock or gravel with one hundred percent (100%) less than two-inch (2") and a maximum of five percent (5%) less than one-half-inch (1/2").

Section 4C.06 INSTALLATION REQUIREMENTS FOR LINE AND GRADE

All pipe shall be installed accurately to the defined line and grade with the following limits:

- a) Variance from established line and grade shall not be greater than one-sixteenth (1/16) inch per inch of pipe diameter in ten feet, and not to exceed one-half inch in ten feet, provided that such variation does not result in a level or reverse sloping invert; provided also that variation in the invert elevation between adjoining ends of pipe, due to non-concentricity of joining surface and pipe interior surfaces, does not exceed one-sixty-fourth (1/64) inch per inch of pipe diameter, or one-half (1/2) inch maximum.

Section 4C.07 PIPE BEDDING

All pipe sewers and drains shall be protected from lateral displacement and possible damage resulting from impact or unbalanced loading during backfilling operations by being adequately bedded.

A groove shall be excavated in the bottom of the trench to receive the bottom quadrant of the pipe. Before preparing the groove, the trench bottom shall be excavated or filled and compacted to an elevation sufficiently above the grade of the pipe so that, when completed, the pipe will be true to line and grade. Joint holes shall be excavated so that only the barrel of the pipe receives bearing from the trench bottom.

Pipe bedding materials placed at any point below the mid-point of the pipe shall be deposited and compacted in layers not to exceed ten inches (10") in uncompacted depth. Deposition and compaction of bedding materials shall be done simultaneously and uniformly on both sides of the pipe. Compaction shall be accomplished with hand or mechanical compactors. All bedding materials shall be placed in the trench with hand tools or other approved method in such a manner that they will be scattered alongside the pipe and not dropped into the trench in compact masses. Bedding materials shall be loose earth, free from lumps; sand or gravel, free from rocks larger than one and one-half inch (1-1/2") diameter; with all materials free from roots, sod, or other vegetable matter.

In the event trench materials are not satisfactory for pipe bedding, modified bedding will be required. Modified bedding shall consist of placing compacted granular material on each side of and to the level of twelve inches (12") above the top of the pipe.

Modified bedding material shall be graded as follows: One-hundred percent (100%) passing a one inch (1") screen and maximum of five percent (5%) passing a No. 200 sieve.

Section 4C.08 TESTS

The Developer/Contractor will be required to conduct an air test and a displacement test in the presence of the Public Works Representative/Engineer or his representative. If this test proves to be inconclusive, other required tests shall be conducted in the presence of the Public Works Representative/Engineer or his representative. If a storm drain visibly contains excessive sediment and/or debris, the Public Works Representative/Engineer may request the line to be televised. Tests shall be performed as follows:

Sub-section A. Displacement Test:

In conducting the displacement test a light will be flashed between manholes or, if the manholes have not as yet been constructed, between the locations of the manholes, by means of a flashlight or by reflecting sunlight with a mirror. If the illuminated interior of the pipe shows broken, misaligned or displaced pipe or other defects, the defects designated by the Public Works Representative/Engineer shall be remedied at the Developer/Contractor's expense.

Sub-section B. Infiltration Test:

The Developer/Contractor shall furnish labor, equipment, and materials, including pumps, and shall assist the Public Works Representative/Engineer in making infiltration tests of the completed line before it can be placed into service. The Developer/Contractor shall furnish and install the measuring weirs or other measuring devices. The length of line to be tested at any time shall be subject to the approval of the Public Works Representative/Engineer. The maximum allowable infiltration shall not exceed one-hundred-fifty (150) gallons per inch diameter per mile per twenty-four hours (24 hrs) for all installed pipe. If the quantity of infiltration is in excess of the maximum allowable, the leaking joints shall be repaired to the satisfaction of the Public Works Representative/Engineer at the expense of the Developer/Contractor.

Sub-section C. Ex-filtration Test:

The Developer/Contractor shall furnish labor, equipment, and materials, including pumps, and shall assist the Public Works Representative/Engineer in making ex-filtration tests of the completed line before it can be placed into service. The length of line to be tested at one time shall be limited to the length between adjacent manholes. The maximum allowable ex-filtration shall not exceed one-hundred-fifty (150) gallons per inch diameter per mile per 24 hours for all installed pipe. The end of the line, which projects into the manhole, shall be plugged. The pipe shall then be filled with water from the upper manhole, and the line maintained under a light pressure of four feet (4') of head. The inflow of water necessary to maintain this head shall be recorded as the leakage of the system. If the quantity of ex-filtration is in excess of the maximum allowable, the leaking joints shall be repaired to the satisfaction of the Public Works Representative/Engineer at the expense of the Developer/Contractor.

Sub-section D. Air Testing:

The Developer/Contractor or his representative (a qualified firm or individual agreed upon by the Public Works Representative/Engineer and the Developer/Contractor) shall furnish labor, equipment, and materials, including pumps and compressors, and shall perform, in the presence of the Public Works Representative/Engineer, air tests of the completed pipe before it can be placed in service. Each section of sanitary sewer pipeline between manholes shall be tested after all the four-inch service laterals (and plugs) have been installed. Each test section shall be pressurized to 4.0 psi. For the purpose of stabilizing the air pressure in each test section, the 4.0 psi pressure shall be maintained for a two-minute period. Each test section shall then be re-pressurized to 4.0 psi for a period of four minutes. The test section shall be accepted if, after four minutes, the pressure gauge indicates 3.5 psi or greater. Failure of the Developer/Contractor's

testing equipment to properly function shall render the test unacceptable. All faulty sections of pipeline shall be repaired and re-tested until the minimum air testing requirements have been met.

Sub-section E. Televising

The Developer/Contractor or his representative shall furnish labor, equipment, and materials, and shall televise the completed line, in the presence of the Public Works Representative/Engineer, before it can be placed into service. The line shall be taped continuously through the entire length of each section of pipe. A pipe will be deemed unsatisfactory if there is excessive cracking, deflection or damage, if the pipe contains excessive sediment and/or debris, or if the Public Works Representative/Engineer finds any other unsatisfactory conditions as a result of the test. All faulty, damaged, debris-laden, or otherwise unacceptable sections of pipe shall be repaired and/or cleaned to the satisfaction of the Public Works Representative/Engineer and re-tested as deemed necessary by the Public Works Representative/Engineer.

The Contractor/Developer must provide the City with a DVD of the televising of the line. The Contractor/Developer shall pay the cost of televising the lines. The televising equipment used must record on the DVD a continuous distance from the point of entry.

Section 4C.09 MANHOLE CONNECTIONS

Corrugated polyethylene pipe connections to manholes shall be achieved by use of manhole coupling adapters, rubber boots with 300 series nonmagnetic corrosion-resistant steel bands, or grouted directly to concrete.

Section 4C.10 LATERAL CONNECTIONS

All lateral connections into new storm drain mains shall be through preformed tee fittings installed in the main line or with field installed service saddles. All connections by field installed service saddles on new or existing storm drain mains shall be done in accordance with manufacturer's recommendations and with all required fittings and materials. Connections shall be at the locations shown in the Improvement Drawings.

Section 4C.11 "GO/NO-GO" MANDREL PROOF TESTING

Not less than thirty (30) days after installation of the flexible sewer or drain pipe, the Developer/Contractor shall test the buried pipe to insure that ring-deflection of the pipe does not exceed five percent (5%) of the pipe's specified minimum inside diameter (ID). This proof test shall establish that the Developer/Contractor has installed the flexible pipe in full compliance with the Project Specifications thereby providing required pipe/soil structural strength.

The Developer/Contractor, with Inspector present, shall pull a "Go/No-Go" Mandrel, inspected and approved by the Public Works Representative/Engineer, through the full length of installed flexible pipe. The Mandrel shall be fabricated from suitable metal with a minimum of nine (9) properly sized radial fins mounted upon a center pulling shaft. In any case, the Mandrel shall be provided with an odd number of rigidly mounted radial fins. The Mandrel shall be provided with a proof-sizing ring that can demonstrate that the Mandrel's minimum outside diameter (OD) is not less than ninety-five percent (95%) of the specified minimum inside diameter of the installed flexible pipe. The Mandrel shall be pulled by the Developer/Contractor through one-hundred percent (100%) of the installed flexible pipe without using mechanical equipment. Failure of the Mandrel to pass through a pipeline shall be deemed evidence of inadequate installation by the Developer/Contractor not in compliance with the Project Specifications.

The Public Works Representative/Engineer may require, if deemed appropriate or necessary, additional proof testing of designated lengths of the buried flexible pipe approximately one year (1 yr) after installation but prior to the expiration of the Developer/Contractor's Maintenance Bond. The flexible pipeline shall be cleaned adequately prior to performing the "Go/No-Go" Mandrel ring deflection proof test. The Developer/Contractor, with Inspector present, shall pull a Mandrel, approved by the Public Works Representative/Engineer, through the designated length of pipeline without using mechanical equipment. Failure of the Mandrel to pass through the pipeline shall be deemed evidence of inadequate installation by the Developer/Contractor not in compliance with the Project Specifications.

DIVISION 5

MANHOLES

Section 5.01 GENERAL

This division covers the requirements for manhole materials and installation. Manholes shall be installed at the locations and at the depth shown on the Improvement Drawings. Manholes shall be furnished complete with cast-iron frames and covers.

Spacing between Sanitary sewer manholes shall not exceed 400 feet.

Section 5.02 CONCRETE BASE

Unless otherwise noted manhole bases shall be precast and shall have pipe inverts and a resilient connection between pipe and manhole for each pipe connecting to the manhole.

Where sewer lines pass through or enter manholes, the invert channels shall be smooth and semi-circular in cross section, conforming to the details shown on the Standard Drawings. Changes of direction of flow within the manholes shall be made with a smooth curve with as long a radius as possible. The slope of the inlet pipe(s) and outlet pipe shall be carried through the manhole with the intersection of the slope being in the center of the manhole. The floor of the manhole outside the flow channels shall be smooth and slope toward the channel at not less than one inch (1") per foot.

Concrete pipe connections to manholes shall be achieved by use of manhole coupling adapters, rubber gaskets, positive seal gasket system, or grouting a bell or spigot pipe at the appropriate locations. Rubber gaskets or boots shall be made of rubber compound meeting ASTM C923 Specifications for resilient connections between pipe and manhole. They shall meet all other applicable ASTM specifications, including ASTM F477.

Positive seal gasket systems boot shall have a wall thickness of three-eighths inch (3/8"). The boot shall either be "cast-in-place" in the precast base or attached to the precast base by means of an internal expanding band. When the boot is attached to the precast base, a water tight seal between the boot and the precast base must be accomplished. An external band (take-up clamp) shall be supplied and used to clamp and seal the boot to the pipe. The band shall be made of 300 series nonmagnetic corrosion-resistant steel. After the band has been placed, it shall be completely coated with a bituminous material approved by the Public Works Representative/Engineer.

PVC pipe connections to manholes shall be achieved by use of manhole coupling adapters, rubber gaskets, or positive seal gasket system. PVC may not be grouted directly to concrete.

The maximum size pipe that can be used in a 48-inch manhole is twenty-four (24") inch PVC or twenty-one (21") inch concrete. Pipes larger than these require a 60-inch manhole or concrete box.

Concrete for manhole bases shall comply with the requirements of Division 8, Concrete, of these Specifications.

Section 5.03

All manholes shall be back filled with imported material that will prevent settling. These materials include AASHTO classified A-1-a material or flowable fill and shall be at a minimum of a two (2) foot radius around the manhole. The imported materials shall be compacted to a 95% compaction, in 3 foot lifts and 5 to 8 compaction tests done with each lift.

Section 5.04 WALL AND CONE SECTIONS

All manholes shall be precast, sectional, reinforced concrete pipe of forty-eight-inch (48") or sixty-inch (60") diameter as specified. Both cylindrical and taper sections shall conform to all requirements of ASTM Designation C478-88 (or

latest revision) for Precast Reinforced Concrete Manhole Sections with the following exceptions:

- a) The throat section of the manhole shall be adjustable, by use of manhole sections, up to forty-eight inches (48") in height.
- b) The taper section shall be a maximum of thirty-six inches (36") in height for 48-inch manholes and thirty-nine inches (39") for 60-inch manholes, shall be of eccentric conical design, and shall taper uniformly to thirty inches (30") inside diameter.
- c) The pipe used in the base section shall be furnished in section lengths of one, two, three, and four-feet (1, 2, 3, and 4 feet) as required.

All joint surfaces of precast sections and the face of the manhole base shall be thoroughly cleaned and wet prior to setting precast sections. All joints, including grade rings, shall be set in mortar or butyl rubber gasket. The mortar shall consist of one (1) part cement and one and one-half (1-1/2) parts sand with sufficient water added to bring the mixture to workable consistency or the joints shall be sealed with a butyl rubber gasket that is permanently flexible and non-shrinking. All joints shall be water tight and free from appreciable irregularities in the interior wall surface.

Sub-section A. Manholes Shall Be Furnished With Steps:

All manholes are to be furnished with steps made of co-polymer polypropylene. The co-polymer polypropylene used shall conform to ASTM D4101-82 PP200B33450Z02. The steel used in manufacturing of this product shall be a deformed ½" reinforcing rod. This material shall be grade 60 and conform to the requirements of ASTM A615.

Section 5.05 DROP MANHOLES

When the difference in elevation of an incoming sewer is 12 inches or greater a drop manhole shall be used. The drop shall be constructed inside the manhole as shown in Standard Drawing S4. The piping for the drop shall be ductile iron or PVC pipe with appropriate fittings. If the sewer main that the drop manhole is a part of is concrete, then a transition coupling (Fernco) shall be used to connect the main with the drop pipe assembly.

Section 5.06 MANHOLE FRAMES AND COVERS

Adjustable manhole frames are required for any manhole being installed under a pavement or concrete section. Industry standard frames can only be used in planters or open field installations if no future pavement or concrete section is planned to go over the manhole.

All iron casting shall conform to the requirements of ASTM Designation A48 (Class 35) for grey iron castings, and ASTM Designation A-536 for ductile iron castings. Castings shall be free from blowholes and shrinkage defects, free from fins and burrs and shall be shot-blasted to remove sand and other foreign matter. The castings shall also meet the applicable requirements of AASHTO M106 and M306 and shall be designed for H-20 and HS-20 loading.

Industry Standard frames and covers shall be equal to the twenty-four inch (24") Standard circular, with machined bearing surfaces, gravity, solid, non-rocking type. The minimum weight of the cover shall be one hundred sixty (160) pounds. The minimum weight of the ring shall be two hundred eighty (280 lbs.). No flat frames and covers shall be allowed. Each cover shall contain air vent holes unless otherwise determined by the Public Works Director. The tops of the cover and ring shall be flush and there shall be 1/8-inch clearance between the cover and the ring. In addition to the foundry name and year of manufacture, the cover shall be marked "SEWER," "STORM DRAIN," "DRAIN," or "IRRIGATION" as appropriate.

Adjustable Manhole Frames are a fully adjustable manhole system that can be rotated to match the exact grade and cross slope of the road. All manholes installed where a combination of surface grade and cross-slope exceed 2% shall use an adjustable angle manhole frame, unless a concrete collar is used with the Industry Standard frame.

1. Adjustable Angle Manhole Frames, the adjustable system shall fit neatly onto the concrete manhole cone or box providing full support for the entire assembly, shall provide a solid, non-rocking seat on the cone or box, and shall be continuously adjustable from 2% to 16% grade across the lid in increments of 1% or less. Any adjustable parts shall provide a positive lock to prevent movement after installation. The frame shall have a starting height at the center point of the lid of 6-inches.
2. Adjustable Height and Angle Manhole Frames, the adjustable system shall fit neatly onto the concrete manhole cone or box providing full support for the entire assembly, shall provide a solid, non-rocking seat on the cone or box, and shall be adjustable in one fourth-inch or smaller increments through a range of two and three fourths-inches or more. The frame shall be continuously adjustable from 2% to 16% grade across the lid in increments of 1% or less. The frame shall have a starting height 6-inches or 9 ¼ -inches at center point of the lid. Any adjustable parts shall provide a positive lock to prevent movement after installation.

The CONTRACTOR shall take steps necessary to protect and preserve the system for future adjustment of the manhole frame. In addition to the foundry name and year of manufacture, the cover shall be marked "SEWER," "STORM DRAIN," "DRAIN," or "IRRIGATION" as appropriate.

Sub-section A. Setting of Manhole Frames and Covers:

Industry Standard and Adjustable manhole frames shall be set in place with the shaft in a bed of cement sand mortar, which mix shall be one part cement to two parts sand or Kent Seal.

Prior to paving the Adjustable manhole frame shall be raised to within 1-inch of the finished asphalt surface. The paving crew shall then pave directly over the manhole cover assembly and compact the asphalt to the proper grade. The excess asphalt should then be raked off the cover and raise it to final grade. Asphalt disturbed during the raising process shall be re-compacted and the annular space between the manhole and asphalt sealed. After the street is paved concrete collars shall be constructed around all manholes within Santaquin City R-O-W. Concrete collars shall be have fiber mesh reinforcement and no bag mix or hand mixed concrete is permitted. The asphalt shall be cut with a round hole-saw. Manhole collars shall use a whirly-gig system and shall be cut to an additional twelve (12) inch radius around the manhole cover. The use of a jackhammer to remove the asphalt around the manhole cover is not permitted. The cut asphalt must be inspected prior to pouring any concrete collar.

Frames and covers shall be protected during backfilling and compaction of the soil and during the placing or replacing of road surfaces. Any frames or covers loosened from the manhole sections shall be reset in cement mortar and any frames or covers damaged or broken shall be replaced by the Developer/Contractor at its expense. Manholes placed in asphalt surfacing shall be constructed such that the cast iron ring is one-quarter inch (1/4") lower than the pavement grade. No cast iron ring shall be less than one-sixteenth (1/16") nor greater than one-half inch (1/2") lower than the pavement. Brick shall not be used to raise the manhole. Cones shall not be broken out to lower the ring to meet the road grade. Sections shall be removed and grade rings or adapter rings (risers) used.

Section 5.07 CONNECTIONS TO EXISTING SEWER

Manholes used to connect the sewer to the existing sewer shall be plumb and centered on the existing pipe at the elevation designated and the base placed as specified. Care shall be taken not to disturb the alignment of the existing sewer.

The cutting of the existing sewer pipe shall be done in the presence of the Public Works Representative/Engineer. The cut shall be full area of the new pipe and shall be finished so as to leave no projections that will restrict the flow or catch solids.

Every precaution shall be taken to prevent any material from entering the sewer main. Any such materials entering the sewer shall be removed.

Section 5.08 INCOMING SEWER LINES

In no case shall an incoming sanitary sewer be allowed to drop more than 12 inches to the base. In Sewer lines where the grade is higher than 12 inches above the existing base, a drop manhole connection shall be used. In all cases the base shall have a channel for the incoming wastewater.

Section 5.09 PREVENTING MATERIALS FROM ENTERING THE SEWER MAIN

After installation of the sewer manhole and connection of sewer lines, a plywood floor (hinged) shall be placed inside the sewer manhole to prevent materials from entering the pipeline and shall not be removed until the street is paved or the project is complete.

Section 5.10 TESTING OF MANHOLES, GREASE INTERCEPTORS & SAND/OIL INTERCEPTORS

Testing shall be in accordance with one of the following:

- a) Water test by plugging all inlet and outlet pipes and filling the test section with water to the top of the frame rim. The water should be introduced into the test section at least 4 hours in advance of the official test period to allow the concrete and joint material to become saturated. The test section shall then be refilled to the original water level.

At the beginning of the test, the elevation of the water in the test section shall be carefully measured from a point on the frame rim. After a period of 4 hours, the water elevation shall be measured from the same point on the frame rim and the loss of water during the test period calculated. If this calculation is difficult, enough water shall be measured into the test section to restore the water to the level existing at the beginning of the test, and the amount added taken as the total leakage.

The allowable leakage shall not exceed 0.13 gallons per hour. Manholes, Grease Interceptors, and Sand Oil Interceptors showing leakage in excess of that allowed shall be repaired or reconstructed as necessary to reduce the leakage to that specified. All failures shall be retested after the necessary repairs have been completed.

OR

- b) Vacuum test by using acceptable equipment approved by the City. Vacuum test equipment shall be used per the manufacturers' specifications. A vacuum of 10-inches mercury should be drawn on the manhole. The time, in seconds, for the vacuum to drop to 9-inches mercury shall be measured and shall not be less than the times listed below for various manholes and interceptors.

Time (sec.)	Manhole Diameter (in.)	Interceptor Size (gal.)
60	48	
75	60	
90	72	
80		500 to 999
120		1,000 to 1,499
150		1,500 to 1,999
180		2,000 to 2,499

Note: Grease interceptors and sand/oil interceptors shall be completely drained and cleaned before initiation of the water or vacuum test.

Section 5.11 Pipe Connections to manholes

All connections to a manhole shall be grouted in place.

For new pipe connections to existing manholes the hole shall be cut with a core drill.

DIVISION 6**VALVES, COUPLINGS, AND FIRE HYDRANTS****Section 6.01 GENERAL**

This section covers distribution valves to be used in the water system, couplings, and fire hydrants. Blowoffs, drains and air control devices are also covered.

A sufficient number of valves shall be provided on water mains so that inconvenience and sanitary hazards will be minimized during repairs. Valves shall be located at not more than 500 foot intervals in commercial districts and at not more than one block or 800 foot intervals in other districts. Where systems serve widely scattered customers and where future development is not expected, the valve spacing shall not exceed one mile.

Section 6.02 RESILIENT SEATED GATE VALVE

Valves in sizes 4" through 12" shall be of the iron body, non-rising bronze stem, resilient seated type, manufactured to equal or exceed all applicable AWWA standards of C-515 latest revision and all specific requirements outlined in these specifications.

- a) Valves shall open left and be provided with 2" square operating wrench nuts unless otherwise specified.
- b) When valves have Mechanical Joints, they shall be furnished with all necessary glands, followers, and bolts and nuts to complete installation.
- c) The disc shall have integrally cast ASTM B62 bronze stem nut to prevent twisting, binding or angling of the stem. Designs with loose stem nuts are not acceptable.
- d) Bronze valve stems shall be interchangeable with stems of the double disc valves of the same size, direction of opening and manufacture.
- e) All internal ferrous surfaces shall be coated, holiday free, to a minimum thickness of 4 mills with a two part thermo setting epoxy coating. Said coating shall be non-toxic, impart no taste to the water, formulated from materials deemed acceptable in the Food and Drug Administration Document Title 21 of the Federal Regulations on food additives, Section 121.2514 entitled Resins and Polymeric Coatings. It shall protect all seating and adjacent surfaces from corrosion and prevent build-up of scale or tuberculation.
- f) The sealing element shall be secured to the disc with self-locking stainless steel screws, and it shall be field replaceable, and shall be such that it cannot be installed improperly.
- g) Stem failure from over torquing in either the open or closing position shall occur externally at such a point as to enable the stem to be safely turned by use of a readily available tool after exposure of the valve through excavation.
- h) Valve design shall incorporate a positive metal-to-metal stop to prevent over-compression of the sealing element.
- i) A full-faced composition gasket placed between machined body and bonnet flanges is required to eliminate cold flow or creep action present with "O" ring gasketed bodies.
- j) Valves shall have a test plug in the bonnet area to vent air and allow line pressure testing.
- k) The exterior of the valves shall be Asphalt Varnish, JAN-P-450. If exterior epoxy is used, all bolts and nuts

shall be made of Stainless Steel to prevent galvanic corrosion of said nuts and bolts due to insulation from the ferrous valve and line.

- l) Within commercial zones the maximum distance between valves shall not exceed 500 feet.

Section 6.03 BUTTERFLY VALVE

Valves in sizes greater than 10" shall be butterfly valves and Av-Tech Double Eccentric Butterfly valve 2504 or an "equal" as approved by the Public Works Director and City Engineer and shall conform to the latest revision of AWWA Standard C504, Class 150-B, and comply with the following:

- a) Valve bodies shall be cast iron, ASTM A126 Class B. Body ends shall be flanged with facing and drilling in accordance with ANSI B16.1, Class 125; or mechanical joint in accordance with AWWA C111. All mechanical joint end valves shall be furnished complete with joint accessories (bolts, nuts, gaskets, and glands). All valves shall conform to AWWA Standard C504, Table 3, Laying Lengths for Flanged Valves and Minimum Body Shell Thickness for all Body Types.
- b) Valve disc shall be ductile iron ASTM A536, grade 65-45-12. Valve disc shall be of the offset design providing 360-degree uninterrupted seating.
- c) The resilient seat shall be natural rubber bonded to an 18-8, Type 304 stainless steel retaining ring secured to the disc by 18-8, Type 304 stainless steel screws. The seat shall be capable of mechanical adjustment in the field and field replaceable without the need for special tools. Valve body seat shall be 18-8, Type 304 Stainless Steel.
- d) Valve shafts shall be 18-8, Type 304 stainless steel. Shafts shall be of the two piece stub design and attached to the disc by means of "O" ring sealed taper pins with lock nuts.
- e) The valve assembly shall be furnished with a non-adjustable factory set thrust bearing designed to center the valve disc at all times.
- f) Shaft bearings shall be contained in the integral hubs of the valve body and shall be self-lubricated sleeve type.
- g) Valve shaft seal shall consist of "O" Rings. Where the valve shaft projects through the valve body for actuator connection, the "O" Ring packing seal shall be field replaceable as a part of a removable bronze cartridge.
- h) When manual actuators are required they shall be of the traveling nut design capable of withstanding 450 foot pounds of input torque against the open and closed stops. All actuators shall have adjustable mechanical stop limits. The closed position stop shall be externally adjustable. Valves shall be installed with the shaft horizontal unless otherwise directed by the Public Works Representative/Engineer and shall be provided with a 2-inch square operating nut for manually operating the valve with a "T" handle wrench.
- i) All valves shall be coated with epoxy in conformance to AWWA Standard C550, latest revision. Interior wetted ferrous surfaces shall be coated nominal 10 mils thick for long life; and body exterior shall have a minimum of 3 to 4 mils coating thickness in order to provide superior base for field-applied finish coats.

Section 6.04 VALVE BOXES

All buried valves shall be installed complete with two-piece, cast iron, sleeve type, 5-1/4-inch shaft valve box with locking lid. The lid shall have the words "WATER" or "IRR." cast in the metal depending on the application.

Valves and valve boxes shall be installed where shown on the Improvement Drawings. Valves and valve boxes shall

be set plumb. Valve boxes shall be centered directly over the valve. Culinary water valves shall be installed at the tee or cross and shall be FLG x MJ. Pressure Irrigation valves shall be aligned with property lines where possible. Earth fill shall be carefully tamped around the valve box to a distance of four (4) feet on all sides of the box, or to the undisturbed trench face if less than four (4) feet. Valves shall have the interiors cleaned of all foreign matter before installation. All valve boxes located in streets shall be installed to grade. Valves placed in asphalt surfacing shall be constructed such that the cast iron ring is one-sixteenth inch (1/16") lower than the pavement. After the street is paved concrete collars shall be constructed around valve boxes within Santaquin City R-O-W. Concrete collars shall have fiber mesh reinforcement and no bag mix or hand mixed concrete is permitted. The asphalt shall be saw cut with a round hole-saw to an additional twelve (12) inch radius around the valve box. The use of a jackhammer to remove the asphalt around the valve box is not permitted. The cut asphalt must be inspected prior to pouring the concrete collar.

Pipe direction shall be indicated by marking a line within the concrete collar by marking a line or arrow parallel with the direction of the pipe prior to the concrete hardening.

Valve boxes in off-road areas shall extend six (6) inches above grade.

Section 6.05 COUPLINGS

Couplings shall be equal to the product of Smith-Blair or Dresser with ductile iron couplings being used on all ductile iron and PVC pipe. Couplings shall be of the straight, transition, or reducing style as required by the specific installation. Where the coupling is used to join a ductile iron line to a steel line appropriate transition gaskets will be used. All steel fittings and bolts shall be coated with a non-oxide coating and wrapped with 12 mil polyethylene.

Section 6.06 FIRE HYDRANTS

Fire hydrants shall be "traffic model" type designed to conform to AWWA Specification C502 and shall be of either the compression or toggle joint type. Hydrants shall be Waterous "Pacer" or an equal as approved by the City Engineer and Public Works Director.

Hydrant valves shall be a minimum of 6-inch size. Hydrants shall be supplied complete with two 2 1/2-inch hose nozzles and one 4 1/2-inch pumper nozzle. All nozzles shall be provided with National Standard threading. A one cubic yard gravel sump shall be provided at each hydrant. All hydrants shall be mechanical joint end and shall be connected to the main by means of a mechanical joint by flanged tee and flanged by mechanical joint auxiliary gate valve and box as shown on the Standard Drawings. Each hydrant shall also be supplied with O-ring seals, a National Standard pentagon operating nut which is designed for clockwise rotation closing, and a 6-inch mechanical joint inlet. The color of the hydrant shall be red.

Set hydrants plumb with the pumper nozzle perpendicular to and facing roadway. The hydrant shall be set so the flange is one-tenth of a foot (0.10') above the elevation of the top back of curb. Hydrants shall be located in planter strips and at property lines where possible.

Final fire hydrant placement, design, demand, operating pressure and fire flow will be approved by the City engineer/fire chief for compliance with applicable local, state and national codes.

Section 6.07 BLOWOFF VALVE

A blow-off valve is required on the culinary system at high points in the water main where air can accumulate, in cul-de-sac's and in temporary dead-end streets. The installation in cul-de-sacs shall be permanent and shall come off the end of the culinary water line. On temporary dead-ended streets the connection shall be made using a main size by three-inch MJ tee.

The open end of the air relief vent pipe from automatic valves shall be provided with a #14 mesh, non-corrodible screen and a downward elbow, and where possible, be extended to at least one foot above grade. Alternatively, the open end of the pipe may be extended to as little as one foot above the top of the pipe if the valves chamber is not

subject to flooding, or if it is not connected to a storm drain or sanitary sewer and the chamber can drain to daylight.

The blow-off valve shall be an Eclipse Model 85 blow-off hydrant.

Section 6.08 PRESSURE IRRIGATION 2-INCH AIR INLET AND REMOVAL FACILITY

The connection to the main for the air inlet and removal facility shall be by a line size by 2-inch tapped tee for line sizes 4-inch through 12-inch and by a bronze service clamp, Mueller Model H-13490 for line sizes 14-inches and larger. Air inlet and removal facilities shall be placed at high points or uphill end points in the system. Tapping the main through the service clamp will be accomplished with standard tapping equipment before the system is put into service.

Connection to the tapped tee or service clamp shall be by a 2-inch PVC MIPT adapter. Piping and bends shall be 2-inch Schedule 40 PVC pipe with solvent weld joints. This piping shall extend from the main to the utility box. The utility box shall house a 2-inch brass ball valve with screwed ends, 2-inch brass nipples, 2-inch brass 90° elbow, 2-inch by 2 1/2-inch brass reducer, 2 1/2-inch brass nipple and 2 1/2-inch fire hose connection. All threads except the fire hose connection shall be standard pipe threads. The fire hose connection shall have standard fire hose connection threads for a 2 1/2-inch fire hose. A fire hose cap with chain secured to the standpipe shall be installed at the end of the vertical standpipe. For units installed near curb and gutter a 11 3/4-inch by 17-inch standard green fiberglass irrigation box with cover shall be installed over the 2-inch gate valve and 2-inch stand pipe. A sign shall be attached to or embossed on the cover indicating as follows: "IRRIGATION AIR RELEASE". Box shall be Brooks 1419 series utility box and lid with recessed standard waterworks pentagon head locking device. For Units installed where there is no curb and gutter, the irrigation box shall be a 30-inch by 2-foot (30" X 2') concrete pipe section with a 24-inch CI manhole ring and grate equal to D&L Supply C2670 as shown on Standard Drawing Number 21.

The Developer/Contractor shall provide smooth bore, circular woven suction hose reinforced with spring steel wire. The rubber friction cover shall be durable and resistant to wear and abrasion. The fire hose shall be two and one-half inch (2 1/2") National Fire hose 55-HD-77 or equivalent. Each hose shall be fitted with a two and one-half inch (2 1/2") male end adapter and a two and one-half inch (2 1/2") female end adapter firmly attached to withstand working pressures of 200 PSI. Each hose furnished for a unit with a fiberglass box shall also be provided with an Akron swivel elbow #632 or equivalent for connection of the fire hose to the air inlet and removal valve.

Section 6.09 PRESSURE IRRIGATION DRAINS

When system drains are necessary to be installed on extensions of the pressure irrigation system they shall be constructed as a system drain to a curb inlet box or system drain to a storm drainpipe. The drain shall be constructed as shown on the Standard Drawings. The materials used shall meet the requirements of Division 3, Pressure Pipe Pressure Irrigation. The connection to the box or pipe shall be by coring a hole and grouting the drainpipe in. A non-shrink grout shall be used.

When a section of pressure irrigation pipeline has to be laid such that there is a belly in it then a local drain sump will need to be constructed. The drain shall be constructed as shown on the Standard Drawings. The materials used shall meet the requirements of Division 3, Pressure Pipe Pressure Irrigation, Division 4, Concrete Pipe, and Division 5, Manholes.

Section 6.10 PRESSURE IRRIGATION 4-INCH FLUSHING, AIR INLET AND REMOVAL FACILITY

A 4-inch flushing, air inlet and removal facility is intended to allow high enough velocities to flush an irrigation main, to allow air into the system during draining and to allow air out of the system when filling.

Each 4-inch flushing, air inlet and removal facility shall be constructed as detailed and placed at the locations shown on the drawings. The work is to include excavation, gravel foundation, backfill, piping, fittings, concrete thrust blocks and collars, valves, utility boxes, sod replacement, and appurtenances.

- a) Configuration: Use reducers as needed to transition from the size of the main line to the 4" flushing, air inlet and removal facility. Install a vertical MJ bend or tee (with thrust block) on the main line, followed by a vertical MJxPE 4-inch diameter ductile iron pipe. The pipe shall be of a length necessary to bring it to a point in relation to the finished ground surface as described below.
- b) Gate Valve: The 4-inch flushing, air inlet and removal facility requires a 4-inch gate valve between the flushing, air inlet and removal facility and the last service on the main line. Place the gate valve just beyond the service, or 60 feet from the vertical 4-inch ductile iron pipe, whichever is closest to the ductile iron pipe, but not within 10 feet of the ductile iron pipe.
- c) Installation in Streets: In paved street areas, the 4-inch diameter ductile iron pipe shall extend to a point 6 inches below the finished ground surface. A cast iron valve box top shall be placed over the 4-inch diameter ductile iron pipe. It shall be a 5 1/4" shaft, slip-type (flange on bottom of unit), 16 inch tall valve box top, with a drop-type lid having "IRR" cast in the top. The valve box top shall be set flush with the road surface, and installed as described in Division 6, Valves, Couplings and Fire Hydrants, including the square concrete collar.
- d) Installation outside of Streets: In areas outside of street pavement, the 4-inch diameter ductile iron pipe shall extend to the ground surface. Place an irrigation box consisting of a 30-inch diameter by 2-foot long concrete pipe section with a 24-inch cast iron manhole ring and grate equal to D&L Supply C-2670 over the pipe, as shown on the Drawings. For additional details see Division 5, Manholes

DIVISION 7

EARTHWORK

Section 7.01 GENERAL

This section defines the requirements for excavation and backfill for structures, construction requirements of earth embankments and earth fills, and subgrade preparation required by the Standard Drawings and Specifications.

Section 7.02 EXCAVATION FOR STRUCTURES

Where suitable subgrade soils exist, structures shall be founded on undisturbed original subsoil. All unauthorized excavation below the specified subgrade shall be replaced with concrete, monolithic with that of the slab above or with coarse gravel thoroughly compacted into place.

Subgrade soils for structures not suitable for proper support shall be replaced with firm, dense, thoroughly compacted and consolidated material free from mud and muck. Coarse gravel or crushed stone may be used for subsoil reinforcement if satisfactory results can be obtained thereby. Such material shall be applied in thin layers, each layer being embedded in the subsoil by thorough tamping. All excess soil shall be removed to compensate for the displacement of the gravel or crushed stone and the finished elevation of any subsoil reinforced in this manner shall not be above the specified subgrade elevation.

Ground excavation shall follow the recommendation of the geotechnical investigation and shall be in accordance with any applicable ordinances.

Section 7.03 GRANULAR FOUNDATION BORROW

Granular foundation borrow shall be compacted to not less than 95% of maximum dry density as determined by ASTM D1557.

Section 7.04 BACKFILL AROUND STRUCTURES

No backfilling around or behind structures shall be initiated until the concrete is fully cured for **seven days**. Backfill around structures shall be placed to the lines shown on the Improvement Drawings, or as directed. After completion of foundation footings and walls and other construction below the elevation of the final grades, and prior to backfilling, all forms shall be removed and the excavation shall be cleaned of all trash and debris. Hand compacted fill, including fill compacted by manually directed power tampers, shall be placed in layers whose thickness before compaction is not greater than four (4) inches. Material for backfilling shall consist of suitable excavated material or imported sand, gravel, or other suitable material with no rocks whose greatest dimension is larger than two (2) inches.

Fill shall be placed in a manner that will prevent damage to the structures and will allow the structures to assume the loads from the fill gradually and uniformly. The height of the fill adjacent to a structure shall be increased at approximately the same rate on all sides of the structure. Each layer shall be compacted by hand or machine tampers or by other suitable equipment to a density equal to 95% of maximum dry density as measured by ASTM D1557.

Section 7.05 CONSTRUCTION OF EMBANKMENTS AND FILLS

Sub-section A. Foundation Preparation:

Foundations for earth fill shall have unsuitable materials, such as weeds, sod, roots larger than 1/4-inch in diameter, vegetation, or other organic material shall be removed by clearing, stripping, and/or grubbing. Except as otherwise specified, earth foundation surfaces shall be graded to remove surface irregularities and shall be scarified parallel to the axis of the fill or otherwise acceptably scored and loosened to a minimum depth of six inches. The moisture content of the loosened material shall be controlled as specified for the earth fill, and the surface materials of the foundation shall be compacted and bonded with the first layer of

earth fill as specified for subsequent layers of earth fill.

Earth abutment surfaces shall be free of loose, uncompacted earth in excess of 2 inches in depth normal to the slope and shall be at such a moisture content that the earth fill can be compacted against them to affect a good bond between the fill and the abutments.

Rock foundation and abutment surfaces shall be cleared of all loose material by hand or other effective means and shall be free of standing water when fill is placed upon them. Occasional rock outcrops in earth foundations for earth fill, except in dams and other structures designed to restrain the movement of water, shall not require special treatment if they do not interfere with compaction of the foundation and initial layers of the fill or the bond between the foundation and the fill.

Sub-section B. Placement:

Fill shall not be placed until the required excavation and foundation preparation have been completed and the foundation has been inspected and approved by the Public Works Representative/Engineer and any Regulatory Agency having authority over the project. Fill shall not be placed upon a frozen surface, nor shall snow, ice, or frozen material be incorporated in the fill.

Fill shall be placed in approximately horizontal layers. The thickness of each layer before compaction shall not exceed the maximum thickness specified. Materials placed by dumping in piles or windrows shall be spread uniformly to not more than the specified thickness before being compacted. Hand compacted fill, including fill compacted by manually-directed power tampers, shall be placed in layers whose thickness before compaction is not greater than four (4) inches. All rock whose greatest dimension is larger than two-inch (2") shall be removed from the material receiving compaction by manually directed power tampers.

Earth fill designed to restrain the movement of water shall be placed so as to meet the following additional requirements:

- 1) The distribution of materials throughout each zone shall be essentially uniform, and the fill shall be free from lenses, pockets, streaks, or layers of material differing substantially in texture or gradation from the surrounding material.
- 2) If the surface of any layer becomes too hard and smooth for proper bond with the succeeding layer, it shall be scarified parallel to the axis of the fill, to a depth of not less than 2 inches before the next layer is placed.
- 3) The top surfaces of embankments shall be maintained approximately level during construction, except that a crown or cross-slope of not less than 2 percent shall be maintained to ensure effective drainage, and except as otherwise specified for drain fill zones. If the Improvement Drawings or specifications require or the Public Works Representative/Engineer directs that fill be placed at a higher level in one part of the embankment than another is, the top surface of each part shall be maintained as specified above.
- 4) Dam embankments shall be constructed in continuous layers from abutment to abutment except where openings to facilitate construction of inlet and outlet pipes are specifically authorized in the contract.
- 5) Embankments built at different levels as described in 3 and 4 shall be constructed so that the slope of the bonding surfaces between the embankment in place and embankment to be placed is not steeper than 2 feet horizontal to 1-foot vertical. The bonding surface of the embankment in place shall be stripped of all loose material, scarified, moistened and recompacted when the new fill is placed against it. This is needed to ensure a good bond with the new fill, to obtain the specified moisture content and specified density at the junction of the in-place and new fill.

Sub-section C. Borrow:

When the embankment or fill exceeds the amount of excavation, sufficient additional material shall be obtained from borrow pits provided by the Developer/Contractor. All material proposed to be imported shall be subject to the review and approval of the Public Works Representative/Engineer prior to starting of hauling operations.

The materials used for embankment and fill construction shall be free from sod, grass, roots larger than 1/4-inch diameter, trash, clods, rocks larger than six inches in diameter, and all other material unsuitable for construction of compacted fills. Rotomilled asphalt meeting the large rock requirement may be used as borrow.

Grading of completed embankments and fills shall bring the surfaces to a smooth, uniform condition with final grades being within 0.1 foot of the design grade.

Section 7.06 COMPACTION OF MATERIALS

The material shall be deposited in horizontal layers having a thickness of not more than eight inches (8") prior to being compacted as hereinafter specified. The distribution of materials shall be such that the compacted material will be homogeneous and free from lenses, pockets, or other imperfections.

During placement and compaction of fill, the moisture content of the materials being placed shall be maintained within the specified range, and the moisture content shall be uniform throughout the layers. Discing, blading or other approved methods prior to compaction of the layer shall obtain uniform moisture distribution. The moisture shall be controlled at a level to permit compaction of the fill as specified; at the time of compaction the moisture content shall be plus or minus 2 percent (i.e. optimum 15.2%, range 13.2% to 17.2%) of the optimum moisture as determined by AASHTO T-180 (Modified Proctor).

The application of water to the fill materials shall be accomplished at the borrow areas insofar as practicable. Water may be applied by sprinkling the materials after placement on the fill, if necessary.

Material that is too wet when deposited on the fill shall either be removed or dried to specified moisture content prior to compaction.

If the top surface of the preceding layer, a foundation or abutment surface in the zone of contact with the fill becomes too dry to permit suitable bond it shall be scarified and moistened by sprinkling to the required moisture content prior to placement of the next layer of fill.

When the material has been conditioned as here in before specified the backfill or embankment shall be compacted to a minimum of 95% of maximum dry density as determined by AASHTO T-180 (Modified Proctor). Densification of earth fill shall be performed by equipment designated solely for that purpose. Each layer of fill shall be compacted as necessary to make the density of the fill matrix not less than the minimum density specified. The fill matrix is defined as the portion of the fill material finer than the maximum particle size used in the compaction test method specified.

Sub-section A. Under Roadways:

Under roadways and extending one foot beyond the proposed curb-line the fill or embankment material shall be compacted to a minimum of 95% of maximum density specified above.

Sub-section B. Under Sidewalks and Driveways:

Under sidewalks and driveways extending one foot each side of the edge of slab the fill or embankment material shall be compacted to a minimum of 95% of maximum density specified above.

7.7 REMOVAL OF DEFECTIVE FILL AND PLACEMENT OF ACCEPTABLE FILL

Fill placement at densities lower than the specified minimum density or at moisture contents outside the specified acceptable range of moisture content or otherwise not conforming to the requirements of the specifications shall be reworked to meet the requirements or removed and replaced with acceptable fill. The replaced fill and the foundation, abutment and fill surfaces upon which it is placed shall conform to all requirements of this specification for foundation preparation, approval, placement, moisture control and compaction.

DIVISION 8**PORTLAND CEMENT CONCRETE****Section 8.01 GENERAL**

The work shall consist of furnishing, forming, placing, finishing, and curing Portland cement concrete, as required.

Section 8.02 MATERIALS**Sub-section A. Portland Cement:**

Portland cement shall be Type II and shall comply with the Standard Specification for Portland Cement, ASTM C150.

If air-entraining cement is to be used, the Developer/Contractor shall furnish the manufacturers written statement giving the source, amount and brand name of the air-entraining addition.

Cement shall be stored in such a manner as to be protected from weather, dampness or other destructive agents. Cement that is partially hydrated or otherwise damaged will be rejected.

Sub-section B. Aggregate:

Aggregates shall conform to Tentative Specifications for Concrete Aggregates, ASTM C33 for the specified sizes. Aggregates that fail to meet any requirement may be accepted only when: (1) the specified alternate conditions of acceptance can be proved prior to the use of the aggregates on the job and within a period of time such that no work under the contract will be delayed by the requirements of such proof; or, (2) the specification for concrete expressly contains a provision of special mix requirements to compensate for the effects of the deficiencies.

The potential reactivity of aggregates with the alkalis in cement shall be evaluated by petrographic examination and, where applicable, the chemical method of test, ASTM Designation C289, or by the results of previous tests or service records of concrete made from similar aggregates from the same source. The standards for evaluating potential reactivity shall be as described in ASTM Specification C33, Appendix A1.

Aggregates indicated by any of the above to be potentially reactive shall not be used, except under one of the following conditions:

- 1) Applicable test results of mortar bar tests, made according to ASTM Method C227, are available which indicate an expansion of less than 0.10 per cent at six months in mortar bars made with cement containing not less than 0.8 per cent alkalis expressed as sodium oxide; or
- 2) Concrete made from similar aggregates from the same source has been demonstrated to be sound after 3 years or more of service under conditions of exposure to moisture and weather similar to those anticipated for the concrete under these specifications.

Aggregates indicated to be potentially reactive, but within acceptable limits as determined by mortar bar test results or service records, shall be used only with "low alkali" cement, containing less than 0.60 per cent alkalis expressed as sodium oxide.

Aggregate of each class and size shall be stored and handled by methods that prevent segregation of particle sizes or contamination by intermixing with other materials.

Sub-section C. Water:

Water shall be cleaned and free from injurious amounts of oil, salt, acid, alkali, organic matter or other deleterious substances and shall meet the requirements of ACI Standard Code (ACI 318 latest edition), paragraph 3.4.

Sub-section D. Air-Entraining Agent:

Air-entraining agent shall be used in all concrete exposed to the weather. The agent shall conform to ASTM Designation C150 and C260, except that the relative durability factor in the freezing and thawing test shall be not less than 95.

Sub-section E. Steel Reinforcement:

Refer to Division 9 (Reinforcing Steel) for specifications.

Sub-section F. Water-Reducing and Set-Retarding Admixtures:

Water-reducing and set-retarding admixtures shall conform to the requirements of ASTM Specification C494, except that resistance to freezing and thawing shall be determined in all cases, and the minimum relative durability factor shall be 95.

Admixtures shall be Type A, Water-Reducing or Type D, Water-Reducing and Retarding, as defined in ASTM Specification C494.

When added, in the manner and amount recommended by the manufacturer, to the concrete used on the job, with no change in the cement content or proportions of the aggregates, admixtures shall have the following effects:

Type A or Type D: The water content at the required slump shall be at least 5 percent less with the admixture than without. The air content shall remain within the range specified, but shall not exceed 8 per-cent in any case.

Type D: The time of initial setting, determined as prescribed in ASTM C494, shall be from 1 to 3 hours longer with the admixture than without.

Sub-section G. Curing compound:

Concrete shall be cured using a membrane forming compound that meets the criteria of ASTM C 1315, Type ID Class A (clear with fugitive dye), or Type II Class A or B (white pigmented.) The following requirements apply:

- 1) Meet applicable Volatile Organic Compounds (VOC) air-pollution control requirements.
- 2) Submit a manufacturer certificate that shows product meets performance criteria.
- 3) Follow product manufacturer's recommendations for preparing surfaces.
- 4) Deliver the curing compound in ready-mixed form with the pigment uniformly disbursed without diluting or altering the compound.
- 5) Apply membrane-curing compound at the manufacturer's recommended rate.

Section 8.03 CLASS OF CONCRETE

For the purpose of practical identification, concrete has been divided into four classes: Class AA(AE), A(AE), B(AE) and C(AE). The specific use for each Class is identified in the Division in which the concrete is used. The symbol (AE) designates air-entrainment. Basic requirements for each class are as follows:

Class of Concrete	Maximum Net Water Content (gallons/bag)	Minimum Cement Content (bags/cubic yard)	Minimum 28-day Compressive Strength (psi)
AA(AE)	5	6 1/2	4000
A(AE)	6	6	3500
B(AE)	7	5	2500
C(AE)	8	4	2000

Section 8.04 COMPOSITION OF CONCRETE**Sub-section A. Aggregate:**

Aggregates maximum size shall be not larger than one-fifth (1/5) of the narrowest dimension between forms within which the concrete is to be cast, nor larger than three-fourths (3/4) of the minimum clear spacing between reinforcing bars or between reinforcing bars and forms. For un-reinforced concrete slabs, the maximum size of aggregates shall not be larger than one-fourth (1/4) the slab thickness.

Sub-section B. Water:

Water shall be added to the mix to produce concrete with the minimum practicable slump. The slump of mechanically vibrated concrete shall not exceed four-inches (4").

Sub-section C. Air-Content:

Air-Content for air-entrained concrete shall comply with the following:

Course Aggregate Size (in.)	Air Content (percent)
1 1/2 to 2 1/2	5 ± 1
3/4 or 1	6 ± 1
3/8 or 1/2	7 ± 1

The air-entraining agent shall be added as liquid to the mixing water by means of mechanical equipment capable of accurate measurement and control.

Sub-section D. Admixtures:

Water Reducing and/or Set Retarding admixtures shall not be used except with previous approval from the Public Works Representative/Engineer and shall in such a case, conform to the standards of materials set forth in the specification.

Calcium chloride or calcium chlorate may be used upon approval from the Public Works Representative/Engineer. No more than 2% by weight of calcium chloride can be used. No calcium chloride shall be used in concrete when metal is to be embedded into or in constant contact with the concrete.

Section 8.05 DESIGN OF THE CONCRETE MIX

The proportions of the aggregates shall be such as to produce a concrete mixture that will work readily into the corners and angles of the forms and around reinforcement when consolidated, but will not segregate or exclude free water during consolidation.

Prior to placement of concrete, the Developer/Contractor shall furnish the Public Works Representative/Engineer, for approval, a statement of the materials and mix proportions (including admixtures, if any) it intends to use. The statement shall include evidence satisfactory to the Public Works Representative/Engineer that the materials and proportions will produce concrete conforming to this specification. The materials and proportions so stated shall constitute the "job mix." After the job mix has been reviewed for conformance to specification by the Public Works Representative/Engineer, neither the source, character, grading of the aggregates, the type and brand of cement, nor admixture shall be changed without prior notice to the Public Works Representative/Engineer. If such changes are necessary, no concrete containing such new or altered materials shall be placed until the Public Works Representative/Engineer has approved a revised job mix.

Section 8.06 OBSERVATION AND TESTING

The Public Works Representative/Engineer shall have free entry to the plant and equipment furnishing concrete under the contract. Proper facilities shall be provided for the Public Works Representative/Engineer to observe the materials, equipment and processes and to obtain samples of the concrete. All tests and observations will be conducted so as not to interfere unnecessarily with manufacture and delivery of the concrete.

Section 8.07 HANDLING AND MEASUREMENT OF MATERIALS

Materials shall be stockpiled and batched by methods that will prevent segregation or contamination of aggregates and insure accurate proportioning of the ingredients of the mix.

Except as otherwise provided in Division 8, cement and aggregates shall be measured as follows:

- a) Cement shall be measured by weight or in bags of 94 pounds each. When cement is measured in bags, no fraction of a bag shall be used unless weighed.
- b) Aggregates shall be measured by weight. Mix proportions shall be based on saturated, surface-dry weights. The batch weight of each aggregate shall be the required saturated, surface-dry weight plus the weight of surface moisture it contains.
- c) Water shall be measured by weight, to accuracy within one per cent of the total quantity of water required for the batch.
- d) Admixtures shall be measured within a limit of accuracy of 3 per cent of the total quantity of each admixture required for the batch.

Section 8.08 MIXERS AND MIXING

Concrete shall be uniform and thoroughly mixed when delivered to the work site. Variations in slump of more than 1 inch within a batch will be considered evidence of inadequate mixing and shall be corrected by increasing mixing time or other means. For stationary mixers, the mixing time after all cement and aggregates are in the mixer drum shall be not less than 1 1/2 minutes. When concrete is mixed in a truck mixer, the number of revolutions of the drum or blades at mixing speed shall be not less than 70 or more than 100. No bag mix or hand mixed concrete shall be used for any improvement within city right-of-way.

Unless otherwise specified, volumetric batching and continuous mixing at the construction site will be permitted if approved by Public Works Representative/Engineer. The batching and mixing equipment shall conform to the requirements of ASTM Specification C685 and shall be demonstrated prior to placement of concrete, by tests with

the job mix, to produce concrete meeting the specified proportioning and uniformity requirements. Concrete made by this method shall be produced, inspected, and certified in conformance with Sections 6, 7, 8, 13, and 14 of ASTM Specification C685.

No mixing water in excess of the amount called for by the job mix shall be added to the concrete during mixing or hauling or after arrival at the delivery point.

Section 8.09 FORMS

Forms shall be of wood, plywood, steel or other approved material and shall be mortar tight. The forms and associated falsework shall be substantial and unyielding and shall be constructed so that the finished concrete will conform to the specified dimensions and contours. Form surfaces shall be smooth and free from holes, dents, sags or other irregularities. Forms shall be coated with a non-staining form oil before being set in place.

Metal ties or anchors within the forms shall be equipped with cones, she-bolts or other devices that permit their removal to a depth of at least one inch without injury to the concrete.

All edges that will be exposed to view when the structure is completed shall be chamfered by placing molding in the forms, unless finished with molding tools.

Section 8.10 PREPARATION OF FORMS AND SUBGRADE

Prior to placement of concrete the forms and subgrade shall be free of chips, sawdust, debris, water, ice, snow, extraneous oil, mortar, or other harmful substances or coatings. Any oil on the reinforcing steel or other surfaces required to be bonded to the concrete shall be removed. Rock surfaces shall be cleaned by air-water cutting, wet sandblasting or wire brush scrubbing, as necessary, and shall be wetted immediately prior to placement of concrete. Earth surfaces shall be firm and damp. Placement of concrete on mud, dried earth or uncompacted fill or frozen subgrade will not be permitted.

Unless otherwise specified, when concrete is to be placed over drain fill, the contact surface of the drain fill shall be covered with a layer of asphalt-impregnated building paper or polyvinyl sheeting prior to placement of the concrete. Forms for weepholes shall extend through this layer into the drain fill.

Items to be embedded in the concrete shall be positioned accurately and anchored firmly.

Weepholes in walls or slabs shall be formed with nonferrous materials.

Section 8.11 CONVEYING

Concrete shall be delivered to the site and discharged into the forms within 1 1/2 hours after the introduction of the cement to the aggregates. In hot weather (90° F and above) or under conditions contributing to quick stiffening of the concrete, the time between the introduction of the cement to the aggregates and discharge shall not exceed 45 minutes. The Public Works Representative/Engineer may allow a longer time, provided the setting time of the concrete is increased a corresponding amount by the addition of an approved set-retarding admixture. In any case, concrete shall be conveyed from the mixer to the forms as rapidly as practicable by methods that will prevent segregation of the aggregates or loss of mortar.

Concrete shall not be dropped more than five feet vertically unless suitable equipment is used to prevent segregation.

Section 8.12 PLACING

Concrete shall not be placed until the sub-grade, forms and steel reinforcement have been inspected and approved. No concrete shall be placed except in the presence of the Public Works Representative/Engineer. The Developer/Contractor shall give 48-hour notice to the Public Works Representative/Engineer each time it intends to place concrete. Such notice will give the Public Works Representative/Engineer adequate time to inspect the subgrade, forms, steel reinforcement and other preparations for compliance with the specifications before concrete is

delivered for placing.

The concrete shall be deposited as closely as possible to its final position in the forms and shall be worked into the corners and angles of the forms and around all reinforcements and embedded items in a manner to prevent segregation of aggregates or excessive laitance. Unless otherwise specified, slab concrete shall be placed to design thickness in one continuous layer. Formed concrete shall be placed in horizontal layers not more than 20 inches thick. Hoppers and chutes, pipes or "elephant trunks" shall be used as necessary to prevent splashing of mortar on the forms and reinforcing steel above the layers being placed.

Immediately after the concrete is placed in the forms, it shall be consolidated by spading, hand tramping or vibration as necessary to insure smooth surfaces and dense concrete. Each layer shall be consolidated to insure monolithic bond with the preceding layer. If the surface of a layer of concrete in place sets to the degree that it will not flow and merge with the succeeding layer when spaded or vibrated, the Developer/Contractor shall discontinue placing concrete and shall make a construction joint according to the procedure specified.

If placing is discontinued when an incomplete horizontal layer is in place, the unfinished end of the layer shall be formed by a vertical bulkhead.

Section 8.13 CONSTRUCTION JOINTS

Construction joints shall be made at the locations shown on the Improvement Drawings. If construction joints are needed which are not shown on the Improvement Drawings, they shall be placed in locations approved by the Public Works Representative/Engineer.

Where a featheredge would be produced at a construction joint, as in the top surface of a sloping wall, an inset form shall be used so that the resulting edge thickness on either side of the joint is not less than six inches (6").

In walls and columns, as each lift is completed, the top surfaces shall be immediately and carefully protected from any condition that might adversely affect the hardening of the concrete.

Steel tying and form construction adjacent to concrete in place shall not be started until the concrete has cured at least 12 hours. Before new concrete is deposited on or against concrete that has hardened, the forms shall be retightened. New concrete shall not be placed until the hardening concrete has cured at least 12 hours.

Surfaces of construction joints shall be cleaned of all unsatisfactory concrete, laitance, coatings or debris by washing and scrubbing with a wire brush or wire broom or by other means approved by the Public Works Representative/Engineer. The surfaces shall be kept moist for at least one hour prior to placement of the new concrete.

Section 8.14 EXPANSION AND CONTRACTION JOINTS

Expansion and contraction joints shall be made at locations specified in Division 12 and shown on the Standard Drawings. Contraction joints shall be a minimum of $t/4$ where t is the thickness of the concrete.

Exposed concrete edges at expansion and contraction joints shall be carefully tooled or chamfered, and the joints shall be free of mortar and concrete. Joint filler shall be left exposed for its full length with clean and true edges.

Preformed expansion joint filler shall be held firmly in the correct position as the concrete is placed.

Open joints, when specified, shall be constructed by the insertion and subsequent removal of a wooden strip, metal plate or other suitable template in such a manner that the corners of the concrete will not be chipped or broken. The edges of open joints shall be finished with an edging tool prior to removal of the joint strips.

Section 8.15 WATERSTOP

Waterstops shall be held firmly in the correct position as the concrete is placed. Joints in metal waterstops shall be soldered, brazed or welded. Joints in rubber or plastic waterstops shall be cemented, welded or vulcanized as recommended by the manufacturer.

Section 8.16 REMOVAL OF FORMS

Forms shall not be removed without the approval of the Public Works Representative/Engineer. Forms shall be removed in such a way as to prevent damage to the concrete. Supports shall be removed in a manner that will permit the concrete to take the stresses due to its own weight uniformly and gradually.

Section 8.17 FINISHING FORMED SURFACES

Immediately after the removal of the forms:

- a) All fins and irregular projections shall be removed from exposed surfaces.
- b) On all surfaces, the holes produced by the removal of form ties, cone-bolts, and she-bolts shall be cleaned, wetted and filled with a dry-pack mortar consisting of one part Portland cement, three parts sand that will pass a No. 16 sieve, and water just sufficient to produce a consistency such that the filling is at the point of becoming rubbery when the material is solidly packed.

Section 8.18 FINISHING UNFORMED SURFACES

All exposed surfaces on the concrete shall be accurately screeded to grade and then float finished, unless specified otherwise.

Excessive floating or troweling of surfaces while the concrete is soft will not be permitted.

The addition of dry cement or water to the surface of the screeded concrete to expedite finishing will not be allowed.

Joints and edges on unformed surfaces that will be exposed to view shall be chamfered or finished with molding tools.

Section 8.19 CURING AND PROTECTION

Concrete shall be prevented from drying for a curing period of at least 7 days after it is placed. Exposed surfaces shall be kept continuously moist for the entire period, or until curing compound is applied as specified below. Sprinkling, flooding or fog spraying shall maintain moisture or by covering with continuously moistened canvas, cloth mats, straw, sand or other approved material. Wood forms (except plywood) left in place during the curing period shall be kept wet. Formed surfaces shall be thoroughly wetted immediately after forms are removed and shall be kept wet until patching and repairs are completed. Water or covering shall be applied in such a way that the concrete surface is not eroded or otherwise damaged.

As soon as the concrete has hardened sufficiently to prevent damage, the finished surface shall be protected for curing one of the following ways:

- a) Ponding of water on the surface or continuous sprinkling.
- b) Application of absorptive mats such as three-inches (3") of cured hay, clean straw or fabric kept continuously wet.
- c) Application of two-inches (2") of moist earth or sand uniformly distributed on the surface and kept saturated by spraying with water.

- d) Application of light colored waterproof plastic materials, conforming to "Specifications for Waterproof Sheet Materials for Curing Concrete" ASTM C171, placed and maintained in contact with the surface of the concrete.
- e) Application of a curing compound, conforming to "Specification for Liquid Membrane - Forming Compounds Having Special Properties for Curing and Sealing Concrete" ASTM C 1315. The compound shall be light in color and shall be applied in accordance with the manufacturer's recommendations immediately after any water sheen, which may develop after finishing, has disappeared from the concrete surface.

Curing compound shall not be applied to surfaces requiring bond to subsequently placed concrete, such as construction joints, shear plates, reinforcing steel and other embedded items. If the membrane is damaged during the curing period, the damaged area shall be re-sprayed at the rate of application specified above.

Section 8.20 REMOVAL OR REPAIR

When concrete is honey combed, damaged or otherwise defective, the Developer/Contractor shall remove and replace the structure or structural member containing the defective concrete or, where feasible, correct or repair the defective concrete. Prior to starting repair work the Developer/Contractor shall obtain the Public Works Representative/Engineer's approval of its plan for affecting the repair. The Developer/Contractor shall perform all repair work in the presence of the Public Works Representative/Engineer.

Section 8.21 CONCRETING IN COLD WEATHER

Concrete shall not be mixed nor placed when the daily minimum atmospheric temperature is less than 40° F unless facilities are provided to prevent the concrete from freezing. If concrete is to be placed in cold weather, APWA cold weather specifications (03 30 10-3.4 (c)) shall be followed.

Section 8.22 CONCRETING IN HOT WEATHER

The Developer/Contractor shall apply effective means to maintain the temperature of the concrete below 90° F during mixing, conveying and placing. The contractor shall be responsible to insure the protection of the concrete regarding these requirements.

DIVISION 9

REINFORCING STEEL

Section 9.01 GENERAL

Furnish and place reinforcing steel and epoxy-coated reinforcing steel. Steel reinforcement shall be free from rust, oil, grease, paint or other deleterious matter. Use deformed billet-steel bars as specified. All reinforcing bars shall be Grade 40 or Grade 60 as required. Wire Fabric shall conform to ASTM A185-70.

Before supply of steel, the Developer/Contractor shall provide all order lists and bending diagrams for approval of the Public Works Representative/Engineer. The approval of such lists and diagrams shall in no way relieve the Developer/Contractor of responsibility for the correctness of reinforcing supplied and all expenses incidental to revision of furnished reinforcing steel shall be carried by the Developer/Contractor.

All steel to conform to ACI Standard Code (ACI 318 latest edition), Section 3.5. Gages, spacing and arrangement of wires in welded steel wire fabric shall be as defined in ACI Standard Code (ACI 315 latest edition) for the specified style designations.

Steel reinforcement stored at the site of the work shall be stored above the ground surface on platforms, skids or other supports and shall be protected from mechanical injury and corrosion.

Section 9.02 FABRICATION AND PLACING REINFORCEMENT

Sub-section A. Fabrication:

Reinforcement shall be cold bent to the shapes shown in accordance with ACI Standard Code (ACI 318 latest edition), Section 7.1.

Sub-section B. Clearances:

All bars shall be of the size specified and shall be placed in the positions shown on the Improvement Drawings in such a manner as to be firmly held during the placing of the concrete. Where not otherwise indicated, minimum clearance and cover as required by the ACI Standard Code (ACI 318 latest edition), Section 7.7 shall be maintained.

Reinforced Clearances	Minimum Cover Inches
Cast In Place Concrete (Non Prestressed)	
Concrete cast against and permanently exposed to earth	3
Concrete exposed to earth or weather:	
No. 6 through No. 18 Bar	2
No. 5 Bar, W31 or D31 wire, and smaller	1 1/2
Concrete not exposed to weather or in contact with ground:	
- Slabs, Walls, and Joists:	
No. 14 and no. 18 Bar	1 1/2
No. 11 Bar and smaller	3/4
- Beams, Columns:	
Primary reinforcements, ties, stirrups, spirals	1 1/2
- Shells, Folded Plate Members:	
No. 6 Bar and larger	3/4
No. 5 Bar, W31 or D31 wire, and smaller	1/2

Reinforcement Clearances	Minimum Cover Inches
Precast Concrete (Manufactured Under Plant Controlled Conditions) Concrete exposed to earth or weather: <ul style="list-style-type: none"> - Wall Panels: <ul style="list-style-type: none"> No. 14 and No. 18 Bars No. 11 Bar and smaller -Other Members: <ul style="list-style-type: none"> No. 14 and No. 18 Bars No. 6 through No. 11 Bars No. 5 Bar, W31 or D31 wire, and smaller Concrete not exposed to weather or in contact with ground: <ul style="list-style-type: none"> - Slabs, Walls, Joists: <ul style="list-style-type: none"> No. 14 and No. 18 Bars No. 11 Bar and smaller - Beams, Columns: <ul style="list-style-type: none"> Primary reinforcement Ties, stirrups, spirals - Shells, folded plate members: <ul style="list-style-type: none"> No. 6 Bar and larger No. 5 Bar, W31 or D31, and smaller 	1 1/2 3/4 2 1 1/2 1 1/4 1 1/4 5/8 1 1/2 3/8 5/8 3/8

Sub-section C. Support:

Bars shall be tied at all intersections except where the spacing is less than twelve inches (12") where alternate intersections shall be tied. Distance from supports shall be by means of ties, hangers, or other approved supports. Metal chairs of approved design shall be used to hold reinforcement from contact with the forms. Metal chairs that are in contact with the exterior surface of the concrete shall be galvanized. Layers of bars or when placing concrete directly on a prepared subgrade reinforcing shall be separated by precast mortar blocks or by other equally suitable devices. The use of stones, pieces of broken brick, metal pipe, or wooden blocks shall not be permitted. Reinforcement in any member shall be placed and then inspected and approved by the Public Works Representative/Engineer before the placement of concrete begins. Concrete placed in violation of this provision may be rejected in which case removal will be required.

If the fabric reinforcement is shipped in rolls, it shall be straightened into flat sheets before being placed.

Sub-section D. Splicing:

All splices shall be staggered so that splices in adjacent bars shall be not less than four feet (4') apart, and shall conform to ACI Standard Code (ACI 318 latest edition), Section 12.15.

Section 9.03 EPOXY COATING

Sub-section A. Prequalify all Coatings:

Ensure that epoxy coating applicator has Concrete Reinforcing Steel Institute (CRSI) fusion bonded epoxy coating applicator plant certification. Furnish a copy of the Prequalification Test Report to the Public Works Representative/Engineer. Provide an 8-ounce sample of the coating material from each batch.

Sub-section B. Coat Bars as Specified:

The following requirements shall be followed:

- 1) Maintain the coating thickness between 8 and 12 mils.
- 2) Coat bars after bending, unless the fabricator can show that satisfactory results can be obtained by coating before bending
- 3) Reject any bent bars with visible cracks or damage in the coating.

Sub-section C: Handling:

Do not damage the bars or the coating during handling and storage.

- 1) Use systems with padded contact areas when handling coated bars.
- 2) Pad all bundling bands.
- 3) Lift all bundles with strong back, multiple supports, or a platform bridge.
- 4) Do not drop or drag bars.
- 5) Repair damaged bars or coating at no additional cost to the Owner.
- 6) Use patching material per manufacturer's recommendation to repair damaged coating.
- 7) Have the coated bars inspected for damage to the coating after the bars are in place and immediately before concrete placement.
- 8) Repair all visible defects using the specified patching or repair material.

Section 9.04 FIELD CUTTING EPOXY-COATED BARS**Sub-section A. Cutting:**

Saw or shear epoxy-coated bars that are specified to be cut in the field. Do not flame cut.

Sub-section B. Repairing:

Repair the sawed or sheared end using the specified patching or repair material.

DIVISION 10**RESTORATION OF SURFACE IMPROVEMENTS****Section 10.01 GENERAL**

The Developer/Contractor shall be responsible for the protection and the restoration or replacement of any improvements existing on public or private property at the start of work or placed there during the progress of the work.

Existing improvements shall include but not be limited to permanent surfacing, curbs, gutters, sidewalks, planted areas, ditches, driveways, culverts, fences, and walls. All improvements shall be reconstructed to equal or better, in all respects, than the existing improvements removed.

Section 10.02 FIELD VERIFICATION OF IMPROVEMENTS

The Developer/Contractor will be deemed to have carefully examined the site of the work and to have acquainted itself with all conditions relating to the protection and restoration of existing improvements. The Public Works Representative/Engineer does not guarantee that all improvements are shown on the Improvement Drawings, and it shall be the Developer/Contractor's responsibility to provide for the protection and restoration of all existing improvements whether or not each is provided for specifically on the Improvement Drawings.

Section 10.03 REMOVAL OF PAVEMENT, SIDEWALKS, CURBS, ETC.

The pavement, sidewalk, curb and gutter, driveway, etc. shall be cut vertically along the lines forming the trench, or nearest full joint, in such a manner as to not cause damage to adjoining pavement, sidewalk, curb and gutter, driveway, etc. An undercut level at the rate of one inch (1") per foot of thickness or an underlap joint will be provided at the proposed junction between old and new surfaces. The portion to be removed shall be broken up in a manner that will not cause damage to the pavement or concrete outside the limits of the trench; however, any pavement damaged by operations outside the limits of the trench shall be replaced at the Developer/Contractor's expense. Broken paving materials shall be removed immediately from the site of the work.

Section 10.04 MATERIALS

Materials used for repair or replacement of surface improvements shall be equal to or better than the material removed

Sub-section A. Untreated Base Course:

Untreated base course shall comply with the requirements of Division 11, Section 11.08, Base Course. The Public Works Representative/Engineer shall take samples of the untreated base course on a random basis. All materials not meeting the tolerance requirements shall be removed from the project and replaced with specification material.

Sub-section B. Bituminous Surface Course:

The bituminous surface shall be hot-rolled plant mix in accordance with Division 11, Section 11.09, Bituminous Asphalt Cement Pavement or Division 11, Section 11.11, Plant Mix Seal Coat, as applicable.

Sub-section C. Concrete:

Concrete shall comply with Division 8 of these Standard Specifications. Concrete shall be Class AA(AE).

Section 10.05 RESTORING BITUMINOUS, CONCRETE, OR ASPHALT STREET SURFACES

Where trenches are in or cross bituminous or concrete surfaced roads, traffic lanes, driveways, parking areas, etc., the bituminous or concrete surface shall be cut, restored as quickly as there is sufficient quantity to make it practical, weather permitting, and maintained as follows:

Sub-section A. Before Excavation:

All existing asphalt or concrete surfaces shall be saw cut or roto-milled to a square edge before excavation.

Sub-section B. Temporary Graded Surface:

Until resurfacing can be done in paved areas a temporary gravel surface shall be placed deep enough to provide a minimum of eight inches (8") below the bottom of the bituminous surface and shall be brought flush with the paved surface.

The untreated base shall be placed in the trench at the time it is backfilled. Excess material shall be removed from the premises immediately. The Developer/Contractor will maintain the temporary gravel surface until the asphalt is placed.

Sub-section C. Preparation for Paving:

The area over trenches to be resurfaced shall be graded and rolled with a roller weighing not less than 12 tons, or with the rear wheels of a five-yard truck loaded to capacity, until the subgrade is firm and unyielding. Mud or other soft or spongy material shall be removed and the void filled with gravel and rolled and tamped thoroughly in layers not exceeding six inches in thickness. The edges of trenches, which are broken down during the making of subgrade, shall be removed and trimmed neatly before resurfacing.

Before any permanent resurfacing is placed, the Developer/Contractor shall trim the existing paving to clean straight lines as nearly parallel to the centerline of the trench as practicable. Said straight lines shall be thirty feet minimum lengths and no deviations from such lines shall be made except as specifically permitted by the Public Works Representative/Engineer.

Existing bituminous paving shall be saw cut or roto-milled back a minimum of twelve-inches (12") beyond the limits of any excavation or cave-in along the trench so that the edges of the new paving will rest on at least twelve-inches (12") of undisturbed soil.

Sub-section D. Bituminous Surface:

The bituminous surface over trenches shall be restored by standard paving practices to a minimum thickness of three inches (3"). Bituminous Asphalt shall meet the requirements of Division 11 ROADWAY CONSTRUCTION Section 11.10.

Pavement restoration shall include priming of pavement edges with SS-1 or SS-1h or equivalent bituminous material and placing rolled plant hot mix bituminous material to the level of the adjacent pavement surfaces with allowance for shrinkage or settling. No priming of pavement edges (tacking) shall be done more than 24-hours prior to paving.

Section 10.06 GRAVEL SURFACE

Where trenches are excavated through gravel-surfaced areas such as roads and shoulders, parking areas, unpaved driveways, etc., the gravel surface shall be restored and maintained as follows:

Sub-section A. Layer Thickness:

The gravel shall be placed deep enough to provide a minimum of six inches of material.

Sub-section B. Placement:

The gravel shall be placed in the trench at the time it is backfilled. The surface shall be maintained by blading, sprinkling, rolling, adding gravel, etc., to maintain a safe, uniform surface. Excess material shall be removed from the premises immediately.

Sub-section C. Gradation:

Material for use on gravel surfaces shall be obtained from sound, tough, durable gravel or rock meeting the following requirements for gradation:

Sieve Size	Percent Passing
1-inch sieve	100%
1/2-inch sieve	79-91%
No. 4 sieve	49-61%
No. 16 sieve	27-35%
No. 200 sieve	7-11%

Section 10.07 MISCELLANEOUS IMPROVEMENTS

It shall be the Developer/Contractor's responsibility to restore to their original condition all irrigation canals, levees, culverts, gates, fences, drainage ditches, and all such improvements, which are cut or disturbed during construction. Topsoil in farming areas or along road edges shall be stored separate from subsoil during pipe trench excavation.

Topsoil shall be replaced during backfill operations as nearly as possible to its original condition, thereby assuring suitable soil for reseeding.

Section 10.08 RESTORATION OF SURFACES

Unless otherwise directed, all street surfacing, curbs, gutters, sidewalks, driveways, or other hard surface that must be removed in the performance of the work shall be restored in kind by the Developer/Contractor in accordance with the Specifications contained herein. Deviation of more than one-fourth inch (1/4") between old and new work or within new construction shall be corrected. Such measurement shall be made from a ten-foot (10') minimum length straight edge. Adjoining surfaces between old and new must be flush.

Section 10.09 CLEANUP

At the completion of each area of work all equipment, barricades, and similar items shall be removed from the area. All excess material will be removed. All rocks larger than two inches (2") shall be removed from the surface. Adjacent borrow pits and road shoulders used for storage of excavating materials will be smoothed and returned to its original contour.

Section 10.10 PAVEMENT MARKINGS

The Developer/Contractor shall be responsible for restoration of pavement markings on all City and/or County roadways. Restoration of pavement markings shall conform to the applicable local and state specifications.

On roadways under UDOT jurisdiction temporary pavement markings shall be provided for any removed or obliterated markings. The temporary markings shall conform to UDOT standards and specifications. Permanent pavement markings will be replaced by UDOT.

DIVISION 11**ROADWAY CONSTRUCTION****Section 11.01 GENERAL**

This Division covers roadway construction, including work consisting of pulverizing existing asphalt, earthwork, and roadway excavation. It also includes imported subgrade preparation, drain rock, granular borrow, granular backfill borrow, flowable backfill, base course, tack coat, asphalt surface, adjusting manholes and valve boxes to final grade, pavement crack seal and chip seal, and pavement marking materials.

All compaction testing must be completed no less than 24 hours prior to the placement of any asphalt or concrete within the roadway and sidewalk.

No surface improvements (i.e. Roadbase, asphalt, curb, gutter, sidewalk...) shall be installed until all conduits and public utility crossings (i.e. Power conduits, gas line conduits...) are fully and completely installed.

Section 11.02 MINIMUM ROADWAY CROSS SECTION

The minimum cross section thickness shall be 12 inches of structural fill, 8 inches of road base and 3 inches of asphalt. This section may be increased per a geotechnical report from a licensed geotechnical engineer, roadway designation, or city engineer/public works representative.

Streets shall have an approved preservation coat installed with appropriate crack sealing prior to the completion of the warrantee period. This preservation coat shall be determined by the Public Works Representative and the City Engineer.

If the road has been cut during the 2 year warrantee period an asphalt overlay with a fabric reinforcing underlayment over the cut portions shall be placed. The fabric reinforcing shall follow APWA standards. (Section 31 05 19)

Section 11.03 PULVERIZING

The Developer/Contractor may pulverize the existing asphalt and road base to a depth of 6 to 8 inches. The limits of the area to be pulverized will be as shown on the Improvement Drawings. This material will be used for granular borrow or untreated road base. The Developer/Contractor has the option of methods he feels will result in the least work and best product in breaking up the existing asphalt, provided that the maximum size for a single piece of asphalt does not exceed 3 inches. Placing, grading and compacting of this material shall comply with the requirements of borrow or road base. The existing asphalt edges where the pulverizing terminates shall be saw cut following or prior to being pulverized.

Section 11.04 EARTHWORK

The earthwork needed for roadway construction shall meet the requirements of Division 7, Earthwork.

Section 11.05 ROADWAY EXCAVATION

The roadway shall be excavated to the lines and grades shown on the Improvement Drawings. Materials not suitable for use as granular borrow or roadbase shall be removed from the road section. Excavation may be done on one-half of the road at a time.

Section 11.06 SUBGRADE PREPARATION

This work shall consist of the shaping and compacting of the subgrade in accordance with these specifications and in conformity with the lines, grades, and typical cross sections shown on the Improvement Drawings and Standard Drawings or as established by the Public Works Representative/Engineer.

Following roadway excavation the subgrade shall be proof rolled by running moderate-weight rubber tire-mounted construction equipment uniformly over the surface at least twice. During the rolling operation moisture content of the subgrade layer shall be maintained at a level to permit compaction of the subgrade, but in no case greater or less than plus or minus two percent (i.e. optimum 15.2%, range 13.2% to 17.2%) of the optimum moisture as determined by AASHTO T-180. Rolling shall be continued until the entire roadbed is compacted to the specified density to a minimum depth of 8-inches.

Section 11.07 DRAIN ROCK

Drain rock shall be free draining natural aggregate or crushed slag material meeting the following gradation:

Sieve Size	Percent Passing
1 - ½ inch	100
1 inch	95-100
½ inch	25-60
No. 4	0-10

Section 11.08 GRANULAR BORROW

Granular borrow (foundation or roadway) material shall consist of well graded granular bank run natural aggregate material with a maximum size of 3 inches and less than 15% passing a No. 200 sieve. The material shall meet the following gradation:

Sieve Size	Percent Passing
No. 10	50 max.
No. 40	30 max.
No. 200	15 max.

The granular borrow material shall be compacted to not less than 95% maximum dry density as determined by AASHTO T-180 (Modified Proctor). Granular foundation borrow shall be compacted to not less than 95% of maximum dry density as determined by ASTM D1557. Surfaces shall be true to the established grade with thickness being not less than 1/4-inch from the required layer thickness and with the surface elevation varying not more than 3/8-inch in ten feet from the true profile and cross section.

Section 11.09 GRANULAR BACKFILL BORROW

Granular backfill borrow shall be backfill material that is not mechanically graded. It shall be a bank run material free of shale, clay, slag, friable material and debris. It shall be reasonably uniformly graded with one hundred percent (100%) less than three-inch (3") and maximum of fifteen percent (15%) passing a No. 200 sieve. It shall reasonably meet the requirements of AASHTO M 145 classification A-1-a.

Section 11.10 FLOWABLE BACKFILL

When required by UDOT, required as part of the Contract, or directed by the Public Works Representative/Engineer, flowable backfill shall be used in place of native backfill or granular backfill borrow. The flowable backfill shall meet the following requirements:

Sub-section A. Cement:

Use Portland Cement, Type II per Division 8, Portland Cement Concrete.

Sub-section B. Fly Ash:

Supply fly ash that complies with ASTM C-618 Class F except that the loss on ignition must be 3 percent or

less.

Sub-section C. Fine Aggregate:

Use natural sand. The sand shall meet the following gradation when tested in accordance with AASHTO T-27.

Fine Aggregate

Sieve Size	Percent Passing
No. 3/4	100
No. 100	0-10

Sub-section D. Mix Design:

The mix design shall meet the following requirements:

- Mix design compressive strength (28 day) – between 50 to 150 psi.
- Portland Cement – at least 50 pounds per cubic yard.
- Fly Ash – at least 300 pounds per cubic yard.
- Slump – 6 to 10 inches maximum.

Section 11.11 BASE COURSE

Base for all streets shall consist of clean, hard, tough, durable, and sound mineral aggregates that consist of crushed stone, gravel, or crushed recycled concrete and shall be graded as follows:

Sieve Size	Percent Passing
3/4 inch	100
3/8 inch	78-92
No. 4 sieve	55-67
No. 16 sieve	28-38
No. 200 sieve	7-11

The crushed recycled concrete shall have 75% to 100% passing the 3/4 inch sieve. Slag is not permitted to be used.

The material shall be deposited and spread in a uniform layer, without segregation of size, with such depth that when compacted, the layer will have the required thickness as stated below.

Developer/Contractor shall be required to set red heads to ensure that the road is crowned to give 2% cross slope. Red heads shall be set every 25 feet. Any other spacing shall require approval by the Public Works Representative/Engineer.

Each layer shall be compacted for the full width and depth. Alternate blading and rolling will be required to provide a smooth, even and uniformly compacted course true to cross section and grade. Places inaccessible to rolling shall be compacted with mechanically operated hand tampers.

The gravel base shall be compacted to not less than 95% maximum dry density as determined by AASHTO T-180 (Modified Proctor). Surfaces shall be true to the established grade with thickness being not less than 1/4-inch from the required layer thickness and with the surface elevation varying not more than 3/8-inch in ten-feet from the true profile and cross section.

Section 11.12 TACK COAT

The Developer/Contractor shall apply asphaltic material to existing asphalt concrete or Portland cement concrete edges and surfaces that will be in contact with the bituminous surface course. Apply tack coat only to area covered with bituminous surface course in the same day. APWA standard (Section 32 12 13.13) or the following criteria shall be followed, whichever is more stringent:

- 1) Certificate showing asphaltic material complies with these Specifications.
- 2) Identify water/asphalt dilution ratio.
- 3) Identify tack coat application rate (typically 0.05 to 0.15 gallons per square yard).
- 4) All existing asphalt shall be saw cut to remove fractures, cracked, or damaged asphalt. Developer/Contractor shall trim the existing pavement to clean straight lines as nearly perpendicular or parallel to the centerline of the street as practicable. Said straight lines shall be thirty feet minimum lengths and no deviations from such lines shall be made except as specifically permitted by the Public Works Representative/Engineer.
- 5) Apply tack coat only when air and roadbed temperatures in the shade are greater than 40 degrees F. The temperature restrictions may be waived only on written authorization from Public Works Representative/Engineer.
- 6) Do not apply tack coat during rain, fog, dust, or other unsuitable weather. Do not apply coat to wet surfaces.
- 7) Follow notification requirements stated in these Specifications.
- 8) Tack coat shall be SS-1 or SS-1h or equivalent.
- 9) Clean the surface to be treated free of dust and other foreign material. If flushed, allow surface to dry. If leaves from trees, blow clean.
- 10) Prevent pedestrian, vehicles, pets, etc. access to tack surfaces.
- 11) The tack shall be applied under pressure using a spray bar or hose and nozzle. The tack shall be evenly spread with 100% coverage. Other methods of application may be used only upon approval of the Public Works Representative/Engineer.
- 12) Protect all surfaces exposed to public view from being spattered or marred. Remove spattering, over-coating, or marring.
- 13) Do not discharge bituminous material into borrow pits or gutters.
- 14) Do not permit traffic to travel over the tacked surface until bituminous tack coat is cured or is not picked up by traffic.

Section 11.13 BITUMINOUS ASPHALT CEMENT PAVEMENT

Over the dry, dust-free compacted base course the Developer/Contractor shall place and compact a bituminous asphalt cement surface course. The surface course shall consist of a mixture of mineral aggregate and binder. Gradation of aggregate shall conform to the following:

Sieve Size	Percent Passing
1/2 inch	100
3/8 inch	66-91
No. 4	42-58
No. 16	17-31
No. 50	9-21
No. 200	4-8

The Developer/Contractor shall establish a mix gradation, and the amount of bituminous material shall be subject to the approval of the Public Works Representative/Engineer and shall meet the requirements of the gradation selected. There shall be between 3% and 5% air voids in the mix.

The bituminous material for the surface course shall be PG 58-22, PG 58-28, or PG 64-22 penetration asphalt cement conforming to the requirements of ASTM D-445. 85-100 penetration asphalt cement conforming to the requirements

of ASTM M20-60 may be used when specifically approved by the Public Works Representative/Engineer.

The bituminous surface course shall be mixed at a mixing plant and spread and compacted on the prepared base in conformance with the lines and dimensions shown on the Improvement Drawings, Standard Drawings, and in accordance with these Specifications.

The bituminous mixtures shall be spread with self-propelled mechanical spreading and conditioning equipment capable of distributing at least a 12-foot width. The mixture shall be spread and struck off in such a manner that the finished surface shall result in a uniform smooth surface. The longitudinal joints in succeeding courses shall be offset at least 6 inches transversely to avoid a vertical joint through more than one course.

The temperature of the bituminous mix shall be between 270° F and 325° F when placing.

After the mixture has been spread, the surface shall be rolled in longitudinal direction commencing at the outside edge or lower side and proceeding to the higher side. Each pass of the roller shall overlap the preceding pass at least one-half the width of the roller. Rolling shall continue until 95% of the laboratory density as determined in accordance with ASTM Designation D1559 for the bituminous mixture being used has been obtained. Density tests shall be done following the procedures of ASTM D2950.

Rolling operations shall be conducted in such a manner that shoving or distortion will not develop beneath the roller.

The surface of the pavement, after compaction, shall be uniform and true to the established grade. When tested with a ten-foot straight edge placed on the surface of the pavement, at any point, the surface shall not deviate more than one-eighth of an inch from the lower edge of the straight edge. All high and low spots shall be remedied immediately by removing the wearing course material over the affected areas and replacing it with fresh, hot wearing course and surface finish material and immediately compacting it to conform with surrounding area. The asphalt surface shall be one-half inch (1/2") higher than the lip of gutter.

It is the responsibility of the Developer/Contractor to control traffic. All traffic shall be kept off the completed surface for a minimum period of 24 hours.

No bituminous surface course shall be placed between Oct. 10th and March 31st unless the temperature of the air or roadbed is 50° F and rising, during rainy weather, when the base is wet, or during other unfavorable weather conditions as determined by the Public Works Representative **and** City Engineer. The air temperature shall be measured in the shade.

Reclaimed (or Recycled) Asphalt Pavement (RAP) may be used in the asphalt mix design. Submit proposed mix design of any asphalt concrete pavement containing RAP. Modify asphalt binder grade as necessary to account for the effect of RAP on viscosity.

A maximum of 15% RAP – Reclaimed (or Recycled) Asphalt Pavement may be used in the asphalt mix design.

Section 11.14 ADJUSTING MANHOLES AND VALVE BOXES TO FINAL GRADE

This section covers the requirements for adjusting manholes and valve boxes to final grade. Adjustable manhole frames are required for any manhole being installed under a pavement or concrete section. The adjustment shall be made with cast-iron ring inserts, concrete grade rings, cast-in-place concrete rings or Adjustable Manhole Frames. Cast-in-place concrete rings shall be constructed and Adjustable Manhole Frames shall be adjusted after the asphalt surface has been placed.

When concrete rings are used the concrete shall conform to the requirements of Division 8. Concrete shall be Class AA(AE).

Manholes and valves in asphalt surfaces shall have the cast iron ring and cover constructed such that the cast iron ring is one-quarter inch (1/4"), range no less than one-sixteenth inch (1/16") and no greater than one-half inch (1/2"), lower

than the existing or new pavement. Manhole rings shall be set to the grade and slope of the road – adjust or shim and grout ring into place.

Where manholes are to be raised this is to be done as specified in Division 5 MANHOLES.

Rings and covers shall be protected during backfilling and compaction of the soil and during the placing or replacing of road surfaces. Any ring or cover loosened from the manhole section shall be reset in cement mortar and any ring or cover damaged or broken shall be replaced by the Developer/Contractor at its expense.

Valve boxes shall have concrete collars placed around them. Existing or new asphalt around the valve box shall be removed with a round hole saw, no jackhammering of asphalt is allowed for concrete collar placement, road base around the valve box shall be recompact, and the concrete collar shall be placed.

Section 11.15 PAVEMENT CRACK SEAL

This section covers filling and sealing cracks in asphalt concrete pavements. Crack filling and sealing shall comply with the requirements of ASTM D 5078: Standard Specification for Crack Filler for Asphalt Concrete and Portland Cement Concrete Pavements and ASTM D 3405: Joint Sealant, Hot-Applied, for Concrete and Asphalt Pavements. Crack filling is defined as the placement of materials into cracks to substantially reduce infiltration of water and to reinforce the adjacent pavement. The crack receives no special preparation other than cleaning. Crack sealing is the placement of specialized materials in cracks or above to prevent the intrusion of incompressible material and water into the crack. The crack receives unique crack configuration preparation. Potholes are cracks wider than 1-inch. The Developer/Contractor shall submit manufacturer's certification of compliance at least 5-days prior to doing the crack sealing.

Sub-section A. Quality Assurance:

The following guidelines shall be followed to assure the quality of the work:

- 1) Deliver packaged material in unopened packages with labels clearly indicating the following:
 - a) Name of manufacturer
 - b) Manufacturer's product name or product number
 - c) Manufacturer's batch or lot number
 - d) The application temperature range
 - e) The recommended application temperature and the safe heating temperature range
- 2) Do not use crack repair product that has been over-heated, suffered prolonged heating or which ravel or can be pulled out by hand after placement.
- 3) Do not mix different manufacturer's brands or different types of crack repair material.
- 4) Do not depress crack repair product temperature at the wand tip below the manufacturer's recommended application temperature when loading product into product tank.
- 5) Rework defective work.

Sub-section B. Filler and Sealer Material:

The filler shall be asphalt emulsion. The sealer shall be hot applied rubber or hot applied rubberized asphalt. Crack treatment materials shall meet the following requirements:

Material Type	ASTM	Application
Hot-applied Thermoplastic Materials		
Asphalt Rubber	D 5078	Sealing (possibly filling)
Rubberized Asphalt	D 1190, D 3405	Sealing
Cold Applied Thermoplastic Materials		
Asphalt Emulsion	D 977, D 2397	Filling

Sub-section C. Equipment:

The following equipment shall be used to apply the materials.

- 1) Sealant heating equipment shall be indirect heating using double boiler or circulating hot oil heat transfer for heating the product. Unit must have means of constant agitation.
- 2) Do not use direct heat transfer units (tar pots).
- 3) Hot compressed air lance that provides clean, oil-free compressed air at a volume of 100 cubic feet per minute at a pressure of 120-pounds per square-inch at the lance tip.

Sub-section D. Advanced Preparation:

Prior to the crack repair the Developer/Contractor shall;

- 1) With the Public Works Representative/Engineer identify the locations that are to have crack repair.
- 2) Notify neighborhood of the date and time that crack repair will take place at least 48-hours in advance of when the repairs will begin.
- 3) Allow at **least one week** for repaired cracks to cure and harden before placing thin overlays.
- 4) Repair potholes or failed spots full depth.

Sub-section E. Application:

- 1) Immediately before sealing the joints, blow cracks clean, clean 6-inches on both sides of the joint, remove foreign matter, loosened particles, and weeds.
- 2) Use a HCA (hot compressed air) heat lance when surfaces are wet or when air temperature is less than 40 degrees F. Do not burn the surrounding pavement. Fill cracks immediately after heating with the air lance or reheat.
- 3) Fill each crack to within 1/4-inch of the existing surface.
- 4) If a thin pavement (chip seal) is to be applied, remove crack overfill by squeegee.
- 5) Use an appropriate backer rod in the joint opening where the depth and width of the joint opening are greater than 2-inches and 1/2-inch respectively.
- 6) Place sand on surface of crack product if traffic or construction activities are likely to cause pull out. The sealant material picked up or pulled out shall be replaced by the Developer/Contractor at their expense.
- 7) The Developer/Contractor will remain liable for any damage to the traveling public resulting from sealant application or sealant pull-out. Developer/Contractor shall repair vehicles or other property damaged by the crack repair operation.

Sub-section F. Backer Rod:

Use closed-cell, polyethylene-foam rods conforming to the following requirements:

Backer Rod Requirements and Test Methods		
Diameter	Joint width + 1/8-inch	
Density	2 lbs/ft ³	ASTM D 1622
Tensile Strength	25 psi	ASTM D 1623
Absorption	0.5 percent by volume	ASTM D 509
Compression Deflection	25 percent at 8 psi	ASTM D 1621

Section 11.16 CHIP SEAL

Chip seal surface improvements shall only be performed by the City and is not an approved asphalt preservation method for placement prior to the end of the warrantee period.

Prior to placing the seal coat all areas of trench settlement shall be repaired and brought to grade. The seal coat is required to provide a paving asphalt and cover aggregate evenly spread as a uniform, skid-resistant roadway surface after all asphalt cuts and trench settlements have taken place so as to prevent water penetrating the asphalt surface through cracks along the edges of trench cuts and settlement.

All asphalt settlement or potholes shall be repaired by saw cutting a minimum of one-foot (1') beyond the area that is settled (see Standard Drawing Number 10), removing the existing asphalt, filling the settled area with road base compacted to 95% of the maximum density, and re-asphalting to thickness of the existing asphalt or 3-inches, whichever is greater. The surface of the patch, after compaction, shall be uniform and true to the existing grade on all sides. When tested with a ten-foot straight edge placed on the surface of the pavement, at any point, the surface shall not deviate more than one-eighth of an inch from the lower edge of the straight edge.

Sub-section A. Submittals:

Ten days prior to use submit a mix design that consists of the following:

- 1) Select type and grade of emulsified asphalt to be used per ASTM D 3628 and as specified herein..
- 2) Aggregate gradation test results.
- 3) Results of asphalt/aggregate compatibility test.
- 4) List of asphalt additives.

Submit a list of equipment to be used. Prior to placing emulsified asphalt submit a bill of lading showing:

- 1) Weight of emulsified asphalt supplied by vendor.
- 2) Weight of emulsified asphalt after water has been added as required for application purposes.

Upon request of the Public Works Representative/Engineer submit a written quality control inspections and testing report describing source and field quality control activities performed by Developer/Contractor and suppliers.

Sub-section B. Quality Assurance:

The following guidelines shall be followed to assure the quality of the work:

- 1) Determine paving asphalt weights by mix design.
- 2) Do not change source.
- 3) Reject coating products that do not meet the requirements of this Section.
- 4) Remove any product found defective after installation and install acceptable product at the Developer/Contractors expense.

Sub-section C. Paving Asphalt:

The paving asphalt shall be petroleum asphalt uniformly emulsified with water, homogeneous throughout, and when stored shows no separation within 30-days after delivery. Frozen emulsions are not accepted. The emulsion shall be the following:

- 1) Cationic (breaks chemically) meeting the requirements of ASTM D 2397 Standard Specification for Cationic Emulsified Asphalt.

Use of any of the following additives to match aggregate particle charges, weather conditions, and mix design

- 1) Anti-strip to change or neutralize particle charges.
- 2) Enhancer to promote greater film thickness on the aggregate.
- 3) High Float Agent to improve temperature susceptibility of the asphalt and impart a gel structure to the asphalt.
- 4) Polymer to reduce stripping, improve coating, decrease temperature susceptibility and increase stability of mix.
- 5) Rejuvenator to adjust the penetration of the base asphalt or soften reclaimed asphalt.

Sub-section D. Cover Material:

Use crusher processed virgin aggregate consisting of natural stone, gravel, or slag meeting the following requirements:

Chip Seal Cover Material Properties		
Fractured faces	ASTM D 5821	> 60% by weight with at least 2 mechanically fractured faces or clean angular faces.
Soundness	ASTM C 88	For combined course and fine aggregate < 12% using Na ₂ SO ₄ < 18% using MgSO ₄
LA wear (see Note 1)	ASTM C 131	< 30% wear of aggregate
Polishing (see Note 1)	ASTM D 3319	> 38
Flat or Elongated Particles (3:1 ratio)	ASTM D 4791	10% maximum for material on 3/8-inch sieve
Friable Particles	ASTM C 142	< 3% by weight aggregate passing the No. 4 sieve`
Note 1: The Public Works Representative/Engineer has the right to waive this requirement if aggregates having higher values are known to be satisfactory.		

Grade with the following limits to meet the specified test standard in ASTM C 136, portion retained on the No. 4 sieve clean and free of clay coatings, and clay content determined by washing per ASTM C 117:

Sieve Size	Grade B Percent Passing	Grade C Percent Passing
1/2 in.	- -	100
3/8 in.	- -	70 - 90
No. 4	100	0 - 5
No. 8	85 - 100	0 - 3
No. 16	10 - 25	- -
No. 50	0 - 5	- -
No. 200	0 - 2	0 - 2

Sub-section E. Preparation:

The following requirements shall be strictly followed. Any exceptions or deviations must first be approved by the Public Works Representative/Engineer.

- 1) Wait at least 7-days before placing seal coat on newly patched surfaces.
- 2) Lay seal coat if air and roadbed temperatures in the shade is greater than 70° F. and rising. Allow four weeks of warm weather cure time. This generally limits performance of work from May 15 to August 31.
- 3) Do not lay seal coat if pavement surface is above 120° F.
- 4) Do not lay seal coat during rain or unsuitable weather.
- 5) Locate and protect all street fixtures.
- 6) Use reflective tabs to mark roadway striping before applying asphalt.
- 7) Protect manholes, valve boxes, inlets, and other service entrances. Install invert covers.
- 8) Notify adjacent property owners of the day and time that the paving will take place. Notify them that

- vehicles will need to be moved from the street or they will be towed away. These notices shall be posted a minimum of 48 hours in advance of paving. Notification shall follow the requirements of Division 1, Section 1.14.
- 9) Should the work not occur on the specified day, a new notice shall be posted.
 - 10) Protect trees, plants, and other ground cover from damage. Prune trees to allow equipment passage underneath. Repair tree damage at no cost to the Owner or City.
 - 11) Direct traffic through work to provide worker and public safety. Following the requirements of Division 1, Section 1.12, Public Safety and Convenience. Provide flaggers as required.
 - 12) All potholes, raveled areas, trench settlement, and low areas shall be repaired. Cracks shall be sealed. Crack sealing shall be allowed to thoroughly dry before cleaning and excess asphalt removed.
 - 13) Remove vegetation from cracks, edges, and joints. Remove loose material, mud spots, sand, dust, oil, vegetation, and other objectionable material from pavement surface. Water flushing will not be permitted if pavement surface is cracked.
 - 14) Run a distributor truck test strip. Show uniform application of bituminous material. Show triple pass of distributor bar.

Sub-section F. Application:

The following criteria shall be followed when applying the chip seal:

- 1) Mask off the end of streets and intersections to provide straight lines. Make straight lines along lip of gutter and shoulders. Keep lap lines out of wheel path.
- 2) Keep viscosity between 50 and 100 centistokes per ASTM D 2170 during application.
- 3) Apply cover aggregate within +1 to -2 pounds per square yard. Use a damp chip but not saturated (water running out of the back of the haul truck means the chips are too wet). Maintain a distance of not more than 100-feet between the distributor and the chip spreader. Spread larger particles first. Hand brook the cover material, if necessary, to distribute the aggregate uniformly over the surface.
- 4) If bleeding occurs, apply a blend of 25 to 50-percent hydrated lime with sand (blotting material). Use sand to cool chips.
- 5) Expose all street fixtures after seal coat operations.

Sub-section G. Rolling:

- 1) Use a rubber tired roller to seat aggregate. Make at least 2 complete rolling coverages.
- 2) Complete rolling before the bituminous material cools or hardens.
- 3) Keep traffic off at least 4-hours or until moisture leaves the remaining chips. Sweep surface before allowing uncontrolled traffic on chips.

Sub-section H. Fog Seal:

The fog seal shall be applied to the chips within 24-hours of placing chips. Keep viscosity between 50 and 100 centistokes per ASTM D 2170 during application.

Sub-section I. Cleanup and Repair:

Upon completion of the work the Developer/Contractor shall:

- 1) Remove spatter or mar from curb, gutter and sidewalk.
- 2) Remove any product found defective after installation and install acceptable product.
- 3) Fill any joints or cracks that are not covered by the coat. Leave no streaks, holes, bare spots, or cracks through which liquids or foreign matter could penetrate to the underlying pavement.
- 4) Repair any damage caused by construction.

Sub-section J. Acceptance:

Opening to traffic does not constitute acceptance. Random samples will be taken by an independent testing laboratory, the cost of which will be paid by the Developer/Contractor. Acceptance is on a block-by-block basis. The samples must meet the following requirements:

- 1) Aggregate (sampled from the hauling equipment) will be accepted if the following conditions are met. There shall be one test per lot. A lot size is one days production with 500 ton sub-lots.
 - a) The average gradation of each sieve for the lot is within the target gradation band for that sieve.
 - b) The number of individual aggregate samples in each sub-lot outside the target gradation band does not exceed 2.
 - c) No aggregate sample is outside the target gradation band by more than 2% on any one sieve.
 - d) No tolerance will be allowed for the minus 200-portion of cover material
- 2) Paving asphalt application shall be uniform with no ridging.
- 3) Aggregate Embedment and Asphalt See-Through: After rolling and evaporation random sampling reveals large particles are embedded in the paving asphalt on their flat side to a depth of 50% to 70%. No more than 15% black (asphalt) can be seen through newly laid and compacted rock chip after sweeping.

Section 11.17 PAVEMENT MARKINGS

This section covers pavement markings on all streets open to public travel.

Pavement markings shall conform to the latest edition of the Manual on Uniform Traffic Control Devices.

Sub-section A. Materials:

Pavement marking paint, glass beads and pavement marking materials shall conform to the latest edition of the UDOT Standard Specifications.

Sub-section B. Preparation:

Remove dirt, loose aggregate and other foreign material and follow manufacturer's recommendations for surface preparation.

Sub-section C. Application:

Apply pavement marking paint and glass beads at rates contained in the latest edition of the UDOT Standard Specifications.

Apply pavement marking materials according to the manufacturer's recommendations.

Apply acrylic water based pavement marking paint only when air and surface temperatures are 50° F and rising.

Apply paint and pavement marking materials within 2 inches of the proper locations. Remove and reapply paint or markings that are installed outside this tolerance.

Sub-section D. Removing Pavement Markings:

Remove pavement marking paint using either high pressure water spray or sandblasting using equipment specifically designed for the removal of pavement marking material.

Do not use shot blasting and grinding to remove pavement markings.

Do not obscure pavement markings by covering with black paint or any other material, in lieu of removing pavement markings.

DIVISION 12

CONCRETE CURB, GUTTER AND SIDEWALK

Section 12.01 GENERAL

This section covers installation of curb and gutter, sidewalk, combination of curb, gutter and sidewalk, cross gutter, drive approaches, handicap ramps and curb returns. All improvements shall be constructed to the dimensions and thickness shown on the Standard Drawings.

All compaction testing must be completed no less than 24 hours prior to the placement of any asphalt or concrete within the roadway and sidewalk.

No surface improvements (i.e. Roadbase, asphalt, curb, gutter, sidewalk...) shall be installed until all conduits and public utility crossings (i.e. Power conduits, gas line conduits...) are fully and completely installed.

Section 12.02 CONCRETE

Concrete shall be Class AA(AE) and shall meet all of the requirements of Division 8, Portland Cement Concrete. Under no condition shall the water cement ratio exceed 0.53.

Section 12.03 GRADE

Minimum flow line grade shall be 0.5 percent. Grade stakes for curb, gutter and/or sidewalk shall be placed every 25-feet around curves, 50-feet on tangent sections, at $\frac{1}{4}$ deltas and at the edges of the landings on curb returns. Grade stakes shall be placed at all PC's, PT's, PCR's, VPC's, and VPT's. Grade stakes shall also be set at the point of change in grade not requiring a vertical curve. Grade stakes and cut sheets shall have the centerline station of the street written on them that are the same as the stationing shown on the improvements drawings.

After construction, gutters shall be checked by flowing water. The Public Works Representative/Engineer shall be present during the flow test. Any high spots or depressions (which exceed 0.02 feet) shall be repaired by grinding high spots to the correct grade and/or removing concrete and replacing to the correct grade. Puddling shall not stand from flow line past lip of gutter.

Section 12.04 FORMS

All forms shall be steel, except at curves with a radius smaller than 200 feet. They shall be of a size to match the sections shown on the Standard Drawings. Forms shall be held firmly in place with stakes or other approved means and shall be true to line and grade.

All forms shall be clean and coated with a light oil to prevent the concrete from adhering to them. Clamps, spreaders and braces shall be used where required to insure rigidity in the forms.

Forms shall not vary from vertical grade by more than 0.02 feet and from horizontal alignment by more than 0.02 feet. All forms shall have smooth even lines in both the horizontal and vertical plane.

Forms for curved sections shall be so constructed and placed that the finish surface of walls and edge of sidewalks, curbs and gutters will not deviate from the arc of the curve.

Section 12.05 SUBGRADE PREPARATION

The Developer/Contractor shall grade to the line and grade approved by the City. **No concrete shall be placed without approved cut sheets.** The sub-grade shall be properly shaped to conform to the cross section shown on the Standard Drawings, graded and compacted. Compaction shall meet the requirements of Division 7 Earthwork.

All excess material excavated by the Developer/Contractor shall be removed from the site. Removal of the excavated material shall be done before or immediately after the concrete is placed. The Developer/Contractor shall maintain adequate barricades and other devices to protect the public until excavated material is removed.

Placement of concrete on unsuitable materials shall not be permitted. The subgrade surface shall have a 6-inch road base foundation as shown on the Standard Drawings. Prior to the placing of concrete, the subgrade shall be compacted using a mechanical foot compactor, with compaction being at least ninety-five percent (95%) of the maximum dry density as determined by AASHTO T-180 (Modified Proctor). The surface shall be proof rolled prior to placing any concrete and no concrete shall be placed until the surfaces have been inspected and approved by the Public Works Representative/Engineer.

All trails to be constructed of bituminous asphalt cement pavement shall have the subgrade sterilized directly below the trail prior to roadbase being placed. The method of sterilizing shall be approved by the Public Works Representative/City Engineer.

Section 12.06 CONSTRUCTION OF CURB, GUTTER AND SIDEWALK

Concrete curb, gutter and sidewalk may be constructed by first constructing the curb and gutter and then constructing the sidewalk behind it. If this method is used the joint between the back of curb and front edge of sidewalk shall be sealed. The curb and gutter may be placed using stationary forms or the slip method of forming. No sidewalk shall not be constructed until after all public utilities have been installed.

Monolithic curb, gutter and sidewalk may be constructed. Stationary forms can be used to place combination curb, gutter and sidewalk. The slip form method can be used if it can be demonstrated that the tolerances specified herein can be met.

Curb and gutter to be installed with bituminous asphalt cement pavement shall have contraction joints placed every 10 feet by use of 1/8-inch steel template of the exact cross section of the curb and gutter. Where dividing plates are used joints shall have a minimum of 2-inches of concrete under the plate, or the joint will be sealed with an approved sealant. Remove the templates as the concrete takes initial set. Cut the joint 1-1/2 inches deep when using the slip form method to place the concrete. Use 1/2-inch thick, pre-molded, expansion joint filler at curb and gutter radii, where the curb and gutter abuts a solid object and at intervals not to exceed 30 feet, unless otherwise specified by the Public Works Representative/Engineer. When a slip forming method is used to install curb and gutter, expansion joints shall be a maximum spacing of 100 feet.

Joints in sidewalk, when placed separately and adjacent to the curb shall match the contraction and expansion joints in the curb and gutter as well as where the sidewalk abuts a solid object. Sidewalks not placed adjacent to the curb shall have contraction joints at 5-foot intervals. The joints shall be approximately 3/16 inch wide and approximately one-half of the total slab thickness in depth. Expansion joints shall be 1/2-inch thick. They shall be placed every 30 feet and where new sidewalk adjoins existing sidewalks or abuts a solid object.

Material for 1/2-inch expansion joints shall be as specified in AASHTO M-153 and AASHTO M-213, and shall be installed with its top approximately 1/4-inch below the concrete surface.

After the concrete placed for a sidewalk has been brought to the established grade and screeded, it shall be float finished, edged and then given a light broom finish. In no case shall dry cement or a mixture of dry cement and sand be sprinkled on the surface to absorb moisture or hasten hardening. Surface edges of all slabs shall be rounded to a radius of 1/2 inch.

After concrete has been placed in curb and gutter forms, it shall be consolidated so as to insure a thorough mixture, eliminate air pockets, and create uniform, smooth sides. As the concrete takes its initial set the forms shall be removed and all exposed surfaces shall be float finished, edged and broomed lightly. The curb and gutter shall be constructed to the dimensions shown in the Standard Drawings.

The top and face of the curb and also the top of the apron on combination curb and gutter must be finished true to line

and grade and without any noticeable irregularities of surface. The surface or face of the curb and gutter shall not vary more than 1/4 inch from a straight edge ten feet in length, placed on the curb parallel to the street center line nor shall any part of the exposed surface present a wavy appearance.

Section 12.07 CONCRETE CURB WALL

Concrete curb wall shall be Class AA(AE) and shall meet all of the requirements of Division 8, Portland Cement Concrete.

Reinforcing steel shall meet the requirements of Division 9, Reinforcing Steel.

Excavation for and backfill around the curb walls shall meet all the requirements of Division 7, Earthwork.

The curb walls shall be constructed to the dimensions and grades shown on the Standard Drawings or improvement drawings or as determined by the Public Works Representative/Engineer.

Section 12.08 6-INCH CONCRETE DRIVE APPROACH

The concrete to be used for the drive approach shall be Class AA(AE) and shall meet the requirements of Division 8, Portland Cement Concrete.

The drive approach shall be a minimum of 6-inch thick. They shall be constructed to the dimensions shown on the Standard Drawings. The concrete shall be finished as described above for sidewalks.

The drive approaches shall have a compacted 6-inch untreated base course under them.

Section 12.09 ACCESSIBILITY STANDARDS IN PUBLIC RIGHTS-OF-WAY

This section sets guidelines for accessibility in public rights-of-way. These guidelines are to be applied during the design, construction, and alteration of improvements in public rights-of-way. These guidelines are to be followed inasmuch as they are technically feasible. Every attempt should be made to comply with the current guidelines of the "Americans with Disabilities Act" (ADA).

The construction of curb ramps and drive approaches shall conform to the Standard Drawings.

The following definitions apply:

- a) The pedestrian access route is an accessible corridor for pedestrian use within the public right-of-way.
- b) Pedestrian crossings are those locations in which pedestrians cross streets.
- c) A ramp is a portion of the pedestrian access route that makes a vertical transition between two flatter surfaces. It is sloped in the direction of travel. It does not include the side flares that exist on a perpendicular curb ramp.
- d) The side flare is the portion of a perpendicular curb ramp that transitions between the plane of the ramp surface and the plane of the flatter adjacent sidewalk.
- e) The term perpendicular curb ramps refers to all features associated with a ramp whose running slope is perpendicular to the curb line.
- f) The term parallel curb ramps refers to all features associated with a ramp whose running slope is in the direction of sidewalk travel.
- g) Blended transitions are locations along the pedestrian access route in which the street and the sidewalk are

at the same level.

- h) Detectable warning is a surface feature built in or applied to walking surfaces or other elements to warn of hazards on a circulation path.

The pedestrian access route shall not be less than 4 feet wide, not including the curb, and shall have a cross slope of not more than 2%.

Concrete surfaces shall have a broom finish to increase slip resistance.

Sub-section A. Sidewalks:

The cross slope shall not exceed 2%.

Changes in level/elevation (vertical rises between adjacent surfaces) shall meet the following requirements:

- 1) Differences of up to $\frac{1}{4}$ inches can remain without beveling.
- 2) Differences of over $\frac{1}{4}$ inch but no more than $\frac{1}{2}$ inch must be beveled with a maximum grade of 2:1 (50%).
- 3) Differences of over $\frac{1}{2}$ inch must be removed or a ramp must be created having a maximum grade of 12:1 (8.33%).

Sub-section B. Curb Ramps:

Curb ramps shall be provided wherever a pedestrian access route crosses a curb.

The ramp grade shall not exceed 12:1 (8.33%).

The cross slope of the ramp shall not exceed 50:1 (2%), except that on perpendicular curb ramps at midblock crossings, the cross slope may match the slope of the adjacent street.

The minimum ramp width shall be 48 inches.

No lip shall exist at the bottom of curb ramps.

Sub-section C. Landings:

A landing shall exist at the top of curb ramps. The landing shall not have a slope in excess of 2% in any direction, and shall be a minimum of 48 inches by 48 inches in size. Parallel curb ramps and blended transitions shall have a landing at the bottom of the ramp (still in the sidewalk, not in the street) meeting the same criteria.

At the foot of diagonal curb ramps (ramps located in the curb return, whose running slope is directed diagonally into the intersection), a 48-inch by 48-inch landing of clear space must exist, beyond the curb line, entirely contained within the crosswalks, and outside of the vehicular travel lanes.

Sub-section D. Side Flares:

The slope of side flares on perpendicular curb ramps shall not exceed 10:1 (10%).

If it is not technically feasible to achieve a 4-foot landing (measured in the direction of the running slope of the ramp) at the top of a perpendicular curb ramp, the landing may be reduced to 3 feet, in which case the slope of the side flares shall not exceed 12:1 (8.33%).

Sub-section E. Built up Curb Ramps:

Built-up curb ramps shall be located so that they do not project into vehicular traffic lanes.

Sub-section F. Obstructions:

Curb ramps shall be located or protected to prevent their obstruction by parked vehicles.

Sub-section G. Location of Marked Crossings:

Curb ramps at marked crossings shall be wholly contained within the markings, excluding any flared sides.

Sub-section H. Diagonal Curb Ramps:

If diagonal (or corner type) curb ramps have returned curbs or other well defined edges, such edges shall be parallel to the direction of pedestrian flow. The bottom of diagonal curb ramps shall have a forty-eight (48) inch minimum clear space. If diagonal curb ramps are provided at marked crossings, the forty-eight (48) inch clear space shall be within the markings. If diagonal curb ramps have flared sides, they shall also have at least a twenty-four (24) inch long segment of straight curb located on each side of the curb ramp and within the marked crossing.

Sub-Section L. Curb Ramps Associated with Trails.

Any curb ramps associated with an asphalt trail system shall be installed only after the asphalt trail has been constructed

Sub-section J. Detectable Warnings:

Detectable warning panels shall be placed at ramps and other locations in which the pedestrian access route crosses streets. They are intended to warn visually-impaired people of potential hazards by indicating the transition from sidewalk to street.

The detectable warning panels shall be cast-in-place and shall be yellow polymer composite/fiberglass.

They shall consist of truncated domes aligned in a square grid pattern having the following characteristics:

- 1) Base diameter of 0.9 inch – 1.4 inch
- 2) Top diameter of 50%-60% of base diameter
- 3) Height of 0.2 inch
- 4) Center-to-center spacing of 1.6 inch – 2.4 inch

The detectable warning shall be 2 feet deep (measured in the direction of pedestrian travel). They shall run across the full width of ramps or blended transitions. They should be set back 6" to 8" from the flowline of the gutter.

The detectable warning panel shall be installed so that it is flush (at the base of the truncated domes) with the adjacent concrete.

Sub-section K. Islands:

Any raised islands in crossing shall be cut through level with the street or have curb ramps at both sides and a level area at least forty-eight (48) inches long between the curb ramp in the part of the island intersected by the crossing.

Sub-section L. Pedestrian Crossings:

Where crosswalks are marked, they shall be at least 8 feet wide.

The foot of a curb ramp shall be wholly contained within the crosswalk markings.

The cross slope (measured perpendicular to the direction of pedestrian travel) of marked or unmarked crosswalks is limited to 2%, except at mid-block crossings.

The counterslope of the gutter or street surface at the bottom of a ramp or blended transition (measured in the direction of pedestrian travel) shall not exceed 5%.

The maximum running slope (measured in the direction of travel) for crosswalks is 5%.

Section 12.10 LANDSCAPE RESTORATION

Areas of new construction that cover or disturb existing landscaped areas with fills and cuts or areas disturbed by construction of retaining walls shall have the landscape restored. Areas that have lawn or flower beds shall be restored including sprinkling systems that might be damaged or relocated because of construction. Lawn covered or removed shall be replaced by sod.

The replaced topsoil shall be fertile, sandy loam topsoil, obtained from well-drained areas. It shall be without admixture of subsoil or slag and shall be free of stones, lumps, sticks, plants or their roots, toxic substances or other extraneous matter that may be harmful to plant growth and would interfere with future maintenance. Topsoil pH range shall be 5.3 to 6.0.

DIVISION 13

STORM DRAINS

Section 13.01 GENERAL

This section covers installation of storm drainpipe, manholes, and curb face inlet boxes. All improvements shall be constructed to the dimension and thickness shown on the Standard Drawings.

Section 13.02 PIPE INSTALLATION

Installation of pipe shall be in an open trench unless otherwise shown. Trench and backfill shall meet the requirements of Division 2, Trench Excavation and Backfill.

Section 13.03 PIPE

Pipe and pipe laying shall meet the requirements of Division 4, Concrete Pipe, Division 4A, PVC Plastic Pipe, Division 4B, Polyethylene Corrugated Pipe, Division 4C, Polyethylene Corrugated Pipe with Water Tight Joints. Pipe shall be laid with the bells up grade. The minimum size pipe used in a storm drain shall be fifteen inches (15").

Section 13.04 MANHOLES

Manholes shall meet the requirements of Division 5, Manholes. Where the size of the storm drain does not permit use of manholes, precast or cast-in-place reinforced concrete boxes shall be used. Concrete used in precast or cast-in-place boxes shall be Class AA(AE).

Section 13.05 CONCRETE

Concrete shall meet the requirements of Division 8, Portland Cement Concrete.

Section 13.06 REINFORCING STEEL

Reinforcing steel shall meet the requirements of Division 9, Reinforcing Steel.

Section 13.07 STORM DRAIN INLET BOXES

This section covers the types of inlet boxes and grates that may be used. Combinations of single inlets may be required depending on the design capacity of each inlet.

Sub-section A. Concrete inlet boxes:

The concrete to be used for the storm drain inlet boxes shall be Class AA(AE). The boxes shall be built to the dimensions and reinforced as shown on the Standard Drawings. The boxes may be precast or cast-in-place. Pipes connecting to the inlet boxes shall be flush with the inside wall of the box and grouted inside and outside of the boxes. The grout and pipe inside the box shall be flush with the inside wall.

Excavation and backfill of the boxes shall meet the requirements of Division 7, Earthwork.

The storm drain inlet grate and frame shall be a D & L Supply I-3518 single unit with curb box with type "V" grate or equal. Grates and frames are to be dipped in cold tar epoxy following fabrication. Following construction of the curb and gutter improvements and before the final inspection each inlet box shall have a decal mounted on the curb face adjacent to the inlet box. The decal shall be purchased from the City by the Developer.

Sub-section B. PVC inlets:

PVC surface drainage inlets shall be of the road and highway structure type. The **ductile iron frame, grate** for each of these structures are considered an integral part of the surface drainage inlet and shall be furnished by the same manufacturer. The road and highway structure shall be as manufactured by Nyloplast a division of Advanced Drainage Systems, Inc. or prior approved equal.

Materials: The road and highway structure shall be manufactured from PVC stock, utilizing thermo-molding process to reform the pipe stock to the specified configuration. The drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the specified pipe system. The joint tightness shall conform to ASTM D3212 for joints for drain and sewer plastic pipe using flexible elastomeric seals. The pipe bell spigot shall be joined to the main body of the structure. The pipe stock used to manufacture the main body and pipe stubs of the curb inlet basin shall meet the mechanical property requirements for fabricated fittings as described by ASTM D3034, Standard for Sewer PVC Pipe and Fittings; ASTM F1336, Standard for PVC Gasketed Sewer Fittings.

The grate and frame for all road and highway structures shall be ductile iron and shall be made specifically for each so as to provide a round bottom flange that closely matches the diameter of the PVC basin body. The grate and frame shall be capable of supporting H-25 wheel loading for heavy-duty traffic. The metal used in the manufacture of the castings shall conform to ASTM A536 grade 70-50-05 for ductile iron.

Installation: The specified PVC road and highway structure shall be installed using conventional flexible pipe backfill materials and procedures. The backfill material shall be crushed stone or other granular material meeting the requirements of Class 1 or 2 materials as defined in ASTM D2321. The road and highway structure shall be bedded and backfilled uniformly in accordance with ASTM D2321. An 8-inch to 10-inch thick concrete ring will be poured under the frame and grate as recommended by details provided by the manufacturer. The road and highway structure body will be cut at the time of final grade so as to maintain a one piece, leak proof structure. No brick, stone, or concrete block will be used to set the frame and grate to the final grade height.

Section 13.08 PIPE CONNECTING INLET BOXES TO EXISTING STORM DRAINS

The pipe to be used for connecting a new inlet box to an existing storm drain shall be of the same type of pipe as the existing pipe to which it is being connected. Where possible such connections shall be made by installation of a manhole. The Public Works Representative/Engineer shall approve connection locations and methods.

Connections to concrete pipe shall be by coring a hole in the pipe and then grouting the connecting pipe to the concrete pipe. Connections to PVC or HDPE pipe shall be as per manufacture's recommendations. These recommendations will be reviewed with the Public Works Representative/Engineer prior to construction.

DIVISION 14**UTAH DEPARTMENT OF TRANSPORTATION
RIGHTS-OF-WAY****Section 14.01 GENERAL**

Work to be performed within UDOT rights-of-way shall be done in accordance with "SPECIFICATIONS FOR EXCAVATION ON DEPARTMENT OF TRANSPORTATION RIGHT-OF-WAY", latest revision. The Developer/Contractor shall be responsible to obtain all necessary permits and meet any bond requirements imposed by that agency.

Section 14.02 UTILITY LINE AGREEMENT

The improvements to be placed along or across UDOT rights-of-way are subject to the conditions of Utility Line Agreements between the UTAH DEPARTMENT OF TRANSPORTATION and SANTAQUIN CITY. The Developer/Contractor is bound by all conditions of the Agreement. The Developer shall be responsible for completing the Utility Line Agreement and furnishing the necessary Improvement Drawings and other information, including meeting with UDOT to insure requirements are met, required by UDOT. The Developer shall then submit the completed agreement to the City for signature and forwarding to UDOT. The Developer/Contractor shall not proceed with any work in a UDOT right-of-way until it has obtained a permit from UDOT, posted the required bond (if one is required) and provided any other information, such as traffic control plans, required by UDOT.

Section 14.03 INSPECTION FEES

The Developer/Contractor will pay UDOT fees for any UDOT inspectors.

DIVISION 15**CASINGS****Section 15.01 GENERAL**

This division defines the materials and construction requirements for steel casings under canals, railroad tracks, highways and Interstates. All construction operations shall be subject to the approval of the Canal Company, Railroad Company or UDOT whose facility is being crossed. The Developer/Contractor shall make application to and secure permission from the canal, Railroad Company or UDOT before commencing work within the right-of-way. The Developer/Contractor shall provide all insurance and the services of all watchmen and flagmen required by the Canal Company, Railroad Company or UDOT. The Developer/Contractor will pay the Canal Company, Railroad Company and UDOT for their inspection services.

Section 15.02 MATERIALS

The casing shall be welded steel pipe conforming to ASTM Designation A139, Grade A. The minimum casing pipe wall thickness shall be as shown below, or as specified on the project drawings, which ever is greater.

Casing Diameter	Minimum Wall Thickness	
12" or less	.3750"	3/8"
Over 12" – 18"	.3750"	3/8"
Over 18" – 22"	.3750"	3/8"
Over 22" – 28"	.4375"	7/16"
Over 28" – 34"	.5000"	1/2"
Over 34" – 42"	.5625"	9/16"
Over 42" – 48"	.6250"	5/8"

Section 15.03 CONSTRUCTION METHODS

The steel pipe casing shall be jacked under the railroad tracks, highway or Interstate using methods submitted to the Public Works Representative/Engineer for review by the Public Works Representative/Engineer. Circular pipe joints shall be field welded as the jacking process progresses. The pipe interior shall be completely excavated and cleaned prior to installation of the carrier pipe.

Steel pipe casing shall be installed by open cut or jacking under canals. These installations shall be as per details approved by the canal company.

All required approach trenches or working pits shall be excavated and shored as defined in Division 2, Trench Excavation and Backfill. Provisions shall be made for a drain sump in one corner of the working pit to allow for the accumulation and pumping of seepage water, if ground water is expected to be encountered.

Section 15.04 LINE AND GRADE

Casings shall be installed accurately to the line and grade shown on the Improvement Drawings. Casings shall be installed to grade with sufficient accuracy to permit installation of the carrier pipe to the design grade shown on the Improvement Drawings or to the cover depth required. The Developer's Engineer will provide base lines and bench marks at each casing location. Instrument checks of the line and grade shall be made by the Developer/Contractor at intervals sufficient to maintain the casing on line and grade.

Section 15.05 CARRIER PIPE INSTALLATION THROUGH CASINGS

The carrier pipe shall be installed to the grade shown on the Drawings. Casing spacers shall be fastened to the carrier pipe and spaced as per the manufacturer's recommendations. Do not fill the casing with sand.

Section 15.06 CASING SPACERS

Factory manufactured casing spacers shall be installed according to the manufacturer's recommendations on all carrier pipes passing through a casing pipe. Wooden skids will not be allowed as an alternative.

Casing spacer shall be a two-piece shell made from T-304 stainless steel of a minimum 14 gauge thickness. Each shell section shall be lined with a 0.090" thick material that prevents slippage. Bearing surfaces (runners) shall be ultra high molecular weight polyethylene (UHMW) or similar material to provide abrasion resistance and a low coefficient of friction (0.12). The runners shall be attached to support structures (risers) at appropriate positions to properly support the carrier within the casing and to ease installation. Risers shall be made of 10 gauge T-304 stainless steel. Bottom risers 6" and over in height shall be reinforced.

Standard positioning within the casing pipe shall be sized such that the height of the risers and runners are to provide not less than three-fourths inch between the casing pipe and the outside diameter of the bell of the carrier pipe.

Centered & Restrained positioning within the casing pipe shall be sized such that the height of the risers and runners are to center the carrier pipe in the casing pipe with a top clearance of one-half inch minimum.

Restrained positioning within the casing pipe shall be sized such that the height of the risers and runners are to provide not less than three-fourths inch between the casing pipe and the outside diameter of the bell and a top clearance of one-half inch minimum.

When casings cross railroad or UDOT facilities, meet the clearance requirements cited above or the following, whichever is larger:

- a) Railroad facilities: The inside diameter of the casing shall be no less than 2 inches greater than largest outside diameter of carrier pipe, joints or couplings.
- b) UDOT facilities: Provide a minimum clearance of 2 inches between the outside of the barrel of the carrier pipe and the inside of the casing.

All welds and metal surfaces shall be chemically passivated and all hardware is to be stainless steel.

Section 15.07 CASING END SEALS

Casing end seals shall be used to prevent debris, soils and seepage from entering the casing. Both ends of all casings shall be sealed between the casing and carrier pipe.

Casing end seals shall be made of neoprene rubber or nitrile and secured with T-304 stainless steel bands.

Casing end seals shall be of the pull-over or wrap-around type. Where practical, use the pull-over type. Where existing utilities make this impractical, the wrap-around type may be used, provided the edge of the wrap is sealed with butyl mastic or other approved sealer to prevent seepage.

DIVISION 16

DETENTION BASINS

Section 16.01 GENERAL

This section covers the construction of detention basins primarily used for storm water detention. Basins shall be constructed, have sprinkler systems installed, and landscaped according to the requirements of this section.

Section 16.02 EARTHWORK

This work shall consist of the shaping and compacting of the subgrade in accordance with these specifications and in conformity with the lines, grades, and typical cross sections shown on the Improvement Drawings or as established in the field by the Developers Engineer. Earthwork shall be performed in conformance with Division 7 Earthwork. No part of the bottom of the basin shall have a slope of less than 3%. Within 10-feet of the outlet, the slope of the basin bottom must not be flatter than 5% unless a concrete apron is constructed around the outlet. Excluding the area within 10-feet of the outlet the maximum depth of the basin is 3-feet unless otherwise approved by the Development Review Committee (DRC). Side slopes shall not be steeper than 3-feet horizontal to 1-foot vertical (3:1) except where retaining structures are used.

Section 16.03 CONCRETE AND REINFORCING STEEL

Concrete used for any structures in the basin shall be Class AA(AE) and shall meet the requirements of Division 8 Portland Cement Concrete. Reinforcing steel shall be Grade 60 reinforcing steel meeting the requirements of Division 9 Reinforcing Steel.

Section 16.04 PIPING

Storm drain pipes are to continue through detention areas to allow low flows to pass through the storm drainage system without having to come to the surface. These low flows must still pass through the outlet restriction that limits runoff rates. Pipe shall meet the requirements of Division 4 Concrete Pipe, Division 4B PVC Plastic Pipe, or Division 4C Polyethylene Corrugated Pipe with Water Tight Joints. Trenching shall meet the requirements of Division 2 Trench Excavation and Backfill.

Section 16.05 TOPSOIL

Topsoil materials and placement shall meet the requirements of Division 20, Landscaping.

If the native topsoil at the site is of adequate quality for use as the final topsoil layer the Contractor shall remove the top 6 inches of soil, after clearing the area for the basin, and stockpile it for later use as the finished surface. Otherwise, imported topsoil shall be used.

Following removal of the topsoil, the site shall be constructed to the appropriate grades shown on the Improvement Drawings not including the topsoil. The Contractor shall make allowance in the grading for 6 inches of topsoil to be added as the finished surface. Any excess material from the grading of the site will be the responsibility of the Developer/Contractor to dispose of properly.

DIVISION 17**CONDUIT****Section 17.01 GENERAL:**

This Division covers furnishing and installing utility and telecommunications conduit.

Section 17.02 UTILITY CONDUIT:

Developers shall be responsible to install utility conduits for placement of public utilities and street lighting: Two – two-inch (2”) (initially empty) communications conduits shall be installed parallel and congruent to all primary and secondary power conduits such that communication lines can serve all lots individually. Communications service boxes labeled “Communications” shall be installed above the communications conduits directly adjacent to all power boxes (i.e.: ground sleeves, transformers, etc.).

Sub-section A. Materials:

The conduit shall be of the material specified by each utility company.

Sub-section B. Location:

Conduits shall be installed at locations established by utility company engineers and approved by the City. Excavation shall be at depth and standards of utility companies. Conduits shall have bends attached to each end and placed vertically out of the ground for location verification. Conduits within street rights-of-way shall have a minimum of 18” cover below finished street grade.

Conduit clusters shall be installed at all intersections. The cluster shall consist of four (4) 4 inch conduits and one 6 inch conduit spaced 3’ away.

Sub-section C. Magnetic Locator Tape:

All utility conduits shall include a 3” magnetic locator tape installed in the pipeline trench approximately 12” below the ground surface, with appropriate cautionary wording printing on the tape to identify the type of utility present.

Section 17.03 INSTALLATION:**Sub-section A. Cutting:**

Cutting of conduit for closure pieces or for other reasons shall be done in a neat and workmanlike manner by a method recommended by the manufacturer.

Sub-section B. Dewatering of Trench:

Where water is encountered in the trench, it shall be removed during conduit laying operations and the trench so maintained until the ends of the conduits are sealed. See "Control of Groundwater" in Division 2 Trench Excavation and Backfill.

Sub-section C. Laying of Conduit:

The conduit shall be inspected for defects before installation. Any defects shall be repaired or the conduit shall be replaced, whichever is deemed necessary by the Engineer.

All conduits shall be laid and maintained to the required lines and grades. The Contractor shall be responsible

to install the conduit line to the alignment set by the Engineer or as shown on the Drawings.

The Contractor shall take the necessary precautions such that foreign materials do not enter into the conduit. No debris, tools, or other materials shall be placed in the conduit during laying operations. When laying of conduit is not in progress, the conduit shall be closed by a watertight plug.

Maximum vertical or horizontal deflections of conduit are not to exceed a ratio of 10:1 along its length (e.g. no more than 4" deflection per 40" length.)

Install all conduit bends to have a radius that is:

1. Not less than 10 times the inside diameter of the conduit.
2. Not less than the minimum bend radius called out on the plans.

At no time shall the conduit be deformed to make a bend.

The minimum separation between conduits shall be 3".

The minimum separation between the conduit and trench wall shall be 1.5".

Sub-section D. Bedding:

All conduits shall be protected from lateral displacement and possible damage resulting from impact or unbalanced loading during backfilling operations by being adequately bedding.

In the event trench materials are not, in the judgment of the Engineer, satisfactory for conduit bedding, imported granular bedding will be required. See Division 2 of these specifications.

DIVISION 18**RESIDENTIAL & SMALL COMMERCIAL PUMP SYSTEMS****Section 18.01 GENERAL:**

For all building sites in which the improvement plans designate a pumped service or for any owner wishing to construct a structure on a portion of a lot or parcel for which gravity service was not provided, the owner shall install a sewage pump as specified herein for the purpose of lifting sewage to the public sewer.

A pumped sewer service shall consist of a gravity sewer, a waste water holding tank, one or more pumps, a force main, electrical controls, and an alarm system. The pump and holding tank shall be installed in a location such as to be reasonably accessible for inspection and maintenance. If the holding tank is located outside of the building foundation it shall not be located within 5 feet of any building used as a dwelling, within 10 feet of any property line or within 50 feet of any lake, stream, or reservoir. Where installed, such installations shall be maintained by the owner at the owner's expense.

A duplex pump system is suggested for residential applications when more than one residence is served by the same pump system. Commercial enterprises which contain public restroom facilities shall be required to operate and maintain a duplex pump system.

Sub-Section A. Installation:

- 1) **Gravity Pipeline:** The gravity sewer lateral from the building sewer to the waste water holding tank shall be tested in accordance with Section 4.07 or 4A.08 TESTS. Pipe must be grouted or sealed to a watertight condition at the point of holding tank penetration.
- 2) **Waste Water Holding Tank:** The holding tank shall be a solid impervious walled container. All openings in the walls of the tank, including pipe or conduit penetrations, are to be sealed to prevent inflow of surface water, infiltration of ground water, or exfiltration of contained wastewater. The tank shall have a minimum capacity of 150 gallons. The tank shall be vented with a 1 1/4 inch minimum vent line. The tanks shall be buried to a depth such that the top cover of the tank is 18 inches below finished grade. A weatherproof housing, with adequate insulation, shall be installed and extended to 6 inches above finished grade. It shall be the owner's responsibility to determine groundwater conditions that may cause the tank to float when empty and to provide the appropriate solutions to prevent it. Internal ballast that reduces the tank capacity below 150 gallons will not be acceptable.
- 3) **Pumping Equipment:** Pumps shall be centrifugal of the non clog or grinder type. Pumps shall be capable of passing a minimum of a 2-inch diameter sphere. Pumps and motors shall be sized so as to maintain a minimum of 4-feet per second flow velocity throughout the entire discharge piping system when a maximum of one pump is pumping under actual installed conditions. A copy of the pump specifications and pump curve shall be required and made available to the City inspector before testing is allowed.
- 4) **Electrical:** The electrical control cabinet shall be isolated from the holding tank. All wiring, controls, conduits, boxes, etc. shall meet or exceed National Electrical Code (NEC) requirements for materials, ratings, placement, and installation, etc.. All equipment located in the holding tank shall be U.L. approved for its specific and proper use. All wiring in the area above the holding tank shall be provided with protection from physical damage by a combination of cable routing and/or conduits. Any wiring which hinders entry or view into the holding tank when opened will not be acceptable. All electrical connections shall be in an approved electrical junction box. All conduits leaving the holding tank, or the enclosed area above or surrounding the holding tank, shall be sealed. A circuit disconnecting means for all circuits must be located within sight of the holding tank unless a lockout device is installed on the disconnecting means for each individual circuit attached to or related to the pump system at the holding tank.

- 5) **Alarm System:** The holding tank and electrical controls shall include an alarming system that produces an audible and visual alarm when the liquid level in the holding tank exceeds a predetermined safe level. The audible and visual devices indicating such an alarm state shall be located at all inhabited buildings or structures served by the sewage system with the intent to notify the occupants of the possibility of a wastewater spillage. The alarms system power shall be supplied through a dedicated circuit, separate from the pump power supply. It is recommended that the alarm system include a battery backup to allow the alarm to function during an electrical power outage.
- 6) **Discharge Piping:** The discharge pipeline shall be ductile iron, polyvinyl chloride (PVC), polyethylene, or an approved pressure rated material designed for wastewater. The piping shall be pressure class 130 minimum and rated for the pressure service being installed. The pipeline size shall be **2 inch diameter minimum** and not be of a size smaller than the pump discharge port. The discharge pipeline shall be fitted with an approved pressure rated sewer check valve and a gate valve. The discharge pipeline shall also include a 1/4 inch pressure test port located between the check portion of the check valve and the gate valve. The gate valve shall be located on the discharge side of the check valve. Both valves and the test port may be located in an accessible area inside or outside of the holding tank in such a manner that they are accessible for operation and maintenance or repairs. If both valves and the test port are located inside the wet well, an additional gate or ball valve shall be installed on the discharge pipeline, adjacent to the wet well/weatherproof insulated box. Additional gate/ball valve shall be boxed separately and brought to grade. It is recommended that valves are installed with unions.

All discharge pipelines are required to have a tracer wire installed adjacent to the sewer pressure pipe. Tracer wire shall consist of 10 AWG minimum with THW, THHW, TW, THWN, or other approved wet location insulation. Wire shall be attached to the top of the force main with tape at appropriate intervals. Wire shall be continuous between vaults and other access points where excess wire shall be spooled to provide connection points. Splices shall incorporate approved underground splice kits. Each run of tracer wire shall be tested for continuity following backfill.

In cases where the service lateral stubbed to the property line is a force main (positive slope), the tracer wire following the private force main discharge piping shall be brought to the surface and boxed to grade at the property line. It is recommended that the tracer wire be placed in conduit where it surfaces through the ground at the property line.

Discharge pipelines shall have a trench cutoff block located every 50 linear feet of pipe, at changes in pipeline type and/or grade, and at the pump tank. Thrust blocks shall be located at all fittings that change the direction of the pipe. Thrust blocks shall be constructed of concrete with a minimum size of 2 cubic feet.

A siphon break shall be installed on the discharge pipeline at its connection point to the gravity sewer. A cleanout shall be placed in the discharge pipeline at the property line, if the siphon break can be placed in a practical manner such that sufficient gravity slope can be maintained from the property line to the sewer main pipeline.

Sub-Section B. Inspection and Testing:

The gravity portion of the pipeline from the building to the holding tank shall be tested in accordance with Section 4A.08 TESTS.

A visual inspection shall be performed to check the following:

- 1) Proper venting of the holding tank.
- 2) An acceptable weather proof, insulated box with an insulated lid directly above the holding tank.
- 3) A weather tight seal on the holding tank lid and at all pipe or conduit penetrations.

The discharge pipeline shall be pressured tested with air or water to a pressure of 150 percent of the calculated maximum possible working pressure (the Total Dynamic Head, TDH) for the installed pump. The maximum possible working pressure for the system can be assumed to occur at the pump's shut off point. The pump shut off point can be obtained from the pump's performance curve by following the curve to the point at which it meets the axis representing the head of liquid. The pressure must remain constant for 10 minutes. The required test equipment shall be provided by the owner or owner's agent and be acceptable to Santaquin City.

The electrical system and controls shall be inspected and approved by the local governing authority for the building electrical inspection. Pumping and alarm tests shall only be performed after the electrical system has been inspected and approved by the proper authority. The City Inspector shall require proof of such approval before starting any of the following functional tests:

- 1) The pump shall be started and stopped so the check valve can be tested for proper operation.
- 2) The pumping system shall be tested for a discharge pipeline velocity of 4 feet per second. The flow velocity test shall be performed with the discharge pipeline full of water and the pumping system functional under normal operating conditions.
- 3) The pump shall be run to pump down the holding tank to allow a visual inspection of the tank and to check it for leaks.
- 4) The alarm system shall be checked for proper function of audio and visual alarms.

Septic tanks converted for use as holding tanks shall be air, water, or vacuum tested. The test shall be the same as specified for sanitary sewer pipelines, manholes, and grease and sand oil interceptors. If the converted septic tank fails the test, it shall be abandoned in accordance with City requirements and a new holding tank meeting the requirements for Residential Pump Systems shall be installed in its place.

Sub-Section C. Deviation from Requirements:

Any deviation from the above stated requirements shall be approved in writing by the Santaquin City Engineer.

DIVISION 19

STREET LIGHTING

Section 19.01 GENERAL

This division describes the design and installation of street lights.

Parts equivalent to the specified Hadco and Mountain States Lighting parts may be approved by the Public Works Representative/City Engineer.

Developers of land are responsible for payment for street lights. Santaquin City installs street lights in Santaquin.

If the developer/contractor will be installing the street light bases and conduit, the developer/contractor shall submit a bond for the installation of the bases, conduits and wire for an amount determined by the Public Works Representative/City Engineer.

Section 19.02 STREET LIGHTS ALONG LOCAL AND COLLECTOR STREETS

Refer to Standard Drawing L1 for a detail of the street light to be used along local and collector streets.

Sub-section A. Placement

Street lights along collector streets are placed at intersections and between intersections as needed so spacing does not exceed 350 feet. They are to be placed in the planter strip with the center of the pole 30" from the back of the curb.

Street lights along local streets are placed at intersections and between intersections as needed so spacing does not exceed 500 feet. They are to be placed in the planter strip with the center of the pole 30" from the back of the curb.

Installation of street lights along local and collector streets occurs at the time that land is subdivided along new or existing streets.

Sub-section B. Luminaire

The luminaire shall be a polyacrylic acorn style light. It must have a 10 year warranty against yellowing.

Sub-section C. Pole and Base

The pole shall be a tapered, black, steel, one-piece construction, 14' tall pole.

The base shall be a 29" high, 17" diameter, fluted, black decorative high density elastomer base (76 lbs per cubic foot – ½" minimum thickness) with with a "SANTAQUIN CITY" logo cast in the top ring.

Sub-section D. Lamp

The lamp shall be a Type 3 Optics LED assembly with 40 total LED's.

Sub-section E. Installation

The foundation shall be a cast-in-place concrete foundation, and shall be installed in accordance with Division 7, Earthwork, Division 8, Portland Cement Concrete, and Division 9, Reinforcing Steel.

Section 19.03 STREET LIGHTS ALONG MAIN STREET

Refer to Standard Drawings L2 and L4 for details of the street light to be used along Main Street.

Sub-section A. Placement

Street lights along Main Street are placed at intersections and between intersections as needed so spacing does not exceed 200 feet.

Installation of street lights along Main Street occurs at the time sites are developed.

Sub-section B. Luminaire

The luminaire shall be an acrylic teardrop style light. It must have a 10 year warrantee against yellowing.

Sub-section C. Pole and Base

The pole shall be a tapered, fluted, black, steel, one-piece construction, 20' tall pole. A 120 Volt AC receptacle, two 30" banner arms, a flag holder, and a plant holder shall be mounted on the pole. The pole shall also have a hole with grommet for irrigation water tubing to hanging plant.

The base shall be a 38" high, 22" diameter, fluted, black decorative high density elastomer base with a "SANTAQUIN CITY" logo cast in the top ring.

Sub-section D. Lamp

The lamp shall be a Type 3 light distribution LED assembly with 80 total LED's.

Sub-section E. Installation

The foundation, installation and electrical connections shall meet the requirements of UDOT Highway Luminaire Pole Ground Mount Standard Drawing SL14 and Luminaire Slip Base Details Standard Drawing SL15, or replacement sheets containing similar but updated information as may be produced by UDOT from time to time.

Section 19.04 STREET LIGHTS ALONG ARTERIAL STREETS

Refer to Standard Drawings L3 and L4 for details of the street light to be used along arterial streets.

Sub-section A. Placement

Street lights along arterial streets are placed at intersections and between intersections as needed so spacing does not exceed 500 feet. They are to be placed in the planter strip with the center of the pole 30" from the back of the curb.

Installation of street lights along arterial streets occurs at the time sites are developed.

Sub-section B. Luminaire

The luminaire shall be an acrylic teardrop style light. It must have a 10 year warrantee against yellowing.

Sub-section C. Pole and Base

The pole shall be a tapered, fluted, black, steel, one-piece construction, 20' tall pole. A 120 Volt AC receptacle insert shall be mounted on the pole. The pole shall also have a hole with grommet for irrigation

water tubing to hanging plant.

The base shall be a 38" high, 22" diameter, fluted, black decorative high density elastomer base with a "SANTAQUIN CITY" logo cast in the top ring.

Sub-section D. Lamp

The lamp shall be a Type 3 light distribution LED assembly with 80 total LED's.

Sub-section E. Foundation

The foundation shall be a cast-in-place concrete foundation (see Standard Drawing L4), and shall be installed in accordance with Division 7, Earthwork, Division 8, Portland Cement Concrete, and Division 9, Reinforcing Steel.

DIVISION 20

LANDSCAPING

Section 20.01 GENERAL

This division describes requirements relative to topsoil, irrigation systems, seeding, turf and trees.

Section 20.02 TOPSOIL REQUIREMENTS AND PLACEMENT

Topsoil shall be fertile, sandy loam topsoil, obtained from well-drained areas. It shall be without admixture of subsoil or slag and shall be free of stones, lumps, sticks, plants or their roots, toxic substances or other extraneous matter that may be harmful to plant growth and would interfere with future maintenance. Topsoil pH range shall be 5.3 to 6.0. Native topsoil at the site may be used as the final topsoil layer if it is of adequate quality. Where topsoil is required a 6" layer of topsoil shall be placed.

After grading scarify the subsoil to a depth of 3 inches where topsoil is to be placed. Smooth the subsoil; it shall be firm, but not compacted to a specified density. Repeat these measures in areas where equipment used for hauling and spreading topsoil has compacted the subsoil.

Following site grading and placing of topsoil, smooth the surface to eliminate uneven areas and low spots, then rake as necessary to have sod placed on it or to be hydro-seeded. Maintain lines, levels, profiles, and contours. Make changes in grade gradual. Blend slopes into level areas. Place topsoil during dry weather and on dry unfrozen subgrade. Remove any vegetable matter and foreign non-organic material from topsoil while spreading.

Section 20.03 GRAVEL DRIVE APPROACHES

All gravel driveway extensions shall have a minimum of 4 inches of one half (1/2) inch angular gravel over a Mirafi 600 or equivalent fabric. No pea-gravel or rounded type gravel materials are allowed.

Section 20.04 IRRIGATION SYSTEM – MATERIALS

The following are minimum requirements and shall govern, except that all local, state and/or federal codes and ordinances shall govern when their requirements are in excess hereof.

Sub-section A. Basic Irrigation Requirements:

This criterion applies to the entire system, per plans and specifications. The irrigation system shall be under fully automatic operation prior to any planting. The irrigation installation work shall be carefully correlated with other site developments so as not to damage any irrigation system components.

The Developer/Irrigation Contractor is required to install, adjust and maintain his finished work at his expense before final acceptance. A qualified irrigation contractor regularly engaged in landscape construction is preferred to complete all work.

The Developer/Irrigation Contractor shall provide labor, materials, equipment and services necessary to complete the irrigation work as defined in these specifications and as indicated on the Improvement Drawings. The Contractor shall coordinate work of this section with work of all related trades and subcontractors to assure smooth progression of work. Work shall include, but is not limited to:

1. Completing the irrigation system as shown on the Improvement Drawings.
2. Verifying the underground utility locations.
3. Protecting and/or restoring all existing improvements.
4. Trenching and backfilling for all pipes, valves and drain pits specified.
5. Furnishing and installing all filter mains, laterals, risers and fitting, heads, quick-coupling valves,

- gate valves, control valves, controllers, electric wire, controls, etc., and all necessary specialties and accessories.
6. Furnishing and installing all sleeves beneath walkways, roads, and driveways where required.
 7. Testing of irrigation system.
 8. Regulating and adjusting all heads, and programming controller.

A two year warranty of the system (materials and installation) shall be provided.

Sub-section B. Pipe:

All piping shall be from virgin parent material. The pipe shall be homogeneous throughout and free from visible cracks, holes, foreign materials, blisters, deleterious wrinkles and dents. All pipes shall be National Sanitation Foundation (NSF) approved.

1. Pipe shall be Polyvinyl Chloride (PVC) 1120 Schedule 40, sized as shown on the Improvement Drawings.
2. Type I, Grade I, Pressure Rated Pipe.
3. Materials shall meet the requirements set forth in ASTM D-1784-60T.
4. Outside diameter of pipe shall be the same size as iron pipe.
5. Pipe shall be marked at intervals (not to exceed 5') with the following information:
Manufacturer's name or trade mark, nominal pipe size, schedule, PVC type and grade (i.e. PVC 1120), SDR rating class, working pressure at 73 degrees F. and (NSF) approval.
6. PVC Type I shall not be threaded.
7. Caution should be utilized in handling Type I pipe due to the possibility of cracking or splitting when dropped or handled carelessly.
8. When connection is plastic to metal, male adapters shall be used.
9. Piping for sleeving shall be high impact type pipe, polyvinyl chloride (PVC) 2110, minimum schedule 40.
10. Joint primer shall meet the requirements of ASTM F-656 and the joint glue shall meet the requirements of ASTM D-2564.

Sub-section C. Fittings:

Fittings for pipe shall meet the following requirements:

1. Fittings for solvent-weld PVC pipe shall be Schedule 40 or 80 polyvinyl chloride (PVC), Type 1, to meet ASTM D2466 and D2467 (latest revisions) NSF approved.
2. Threaded PVC nipples shall be Schedule 80.
3. Flexible swing pipe elbows.
4. Pre-manufactured swing joint for Quick Couplers.

Sub-section D. Automatic Controller:

The Developer will check with the Public Works Director prior to purchasing an automatic controller. Unless directed otherwise the automatic controller will be a Hunter – controller with stainless steel pedestal mount – ICC, with TBOS battery operated module. The controller shall be housed in a NEMA Type 4, weatherproof, watertight enclosure with lockable access door. The enclosure shall be at grade or pedestal mounted as determined by the Public Works Director.

Sub-section E. Automatic Control Valve:

Automatic control valves shall be Rainbird scrubber valves – PESB meeting the following criteria:

1. Slow and smooth opening and closing with a flow control and bleed screw.
2. Highly efficient, totally encapsulated 24 VAC solenoid.

3. High – strength rubber or synthetic rubber diaphragm.

Sub-section F. Rotary Sprinkler:

Check with the Public Works Director prior to installation of sprinkler. The rotary sprinkler shall be a Hunter – I-20-ADV Series with bodies made of plastic and stainless steel materials meeting the following criteria:

1. Pop-up risers of 4-inches.
2. Stainless steel retraction spring.
3. Ratcheting mechanism.

Sub-section G. Plastic Nozzles:

Plastic nozzles shall meet the following criteria:

1. Radius pattern fixed for full circle or Variable Arc Nozzle (VAN) for any pattern less than 360 degrees.
2. Matched precipitation rates.
3. Stainless steel adjustment screw.
4. Filter screen.

Sub-section H. Valve Box:

Valve boxes are to be injection-molded of polyesters and fibrous inorganic temperature resistant components. Box and lid are to be green, rectangular, with a snap lock tab on cover. The box shall have an attached sign or embossed to or on the cover the words “IRRIGATION”. A Carson 1419 (12” x 17” x 12” tall) box meets these requirements.

1. For Remote Control Valve: Shall be rectangular in shape and sized to provide adequate clearance to operate and service valve.
2. For Shut-off Valves: Shall be round approximately nine inches (9”) inside diameter by ten inches (10”).

Sub-section I. Control Wire, Wire Connectors and Sealing Cement:

Wire: Solid copper wire, UL Approved for direct burial in ground. Minimum gauge: #14 UF. (#12 UF for runs over 1,000 LF). Common ground wire shall be white. All other wire shall be yellow, red, or orange. Splicing materials: 3M Direct Bury (DBY) splice kits as manufactured by 3M Corporation, Austin, TX (512) 984-5657.

Sub-section J. Valves and Couplers:

Isolation valves shall be full port 3-piece ball valve of heavy duty bronze construction rated to 150 psig. The manual main line isolation valve shall be a bronze bodied stop and waste valve of a size matching the service line. Gate valves shall be bronze solid wedge F.I.P. thread, both ends, 150 psig maximum working pressure, cold water, non-shock service and wheel handle.

Quick couplers shall be constructed of heavy-duty brass with a one-inch two-piece body design.

Sub-section K. Main Line Connections:

If the water supply is from the secondary water system the service connection shall meet the requirements of Division 3 Section 3.05, Pressure Irrigation Service Connection. The service line shall have a 30 micron inline filter.

If the water supply is from the culinary water system the service connection shall meet the requirements of Division 3A Section 3A.05 Water Service Laterals. In addition the service shall have a double check valve assembly for installation below ground. This service shall also have a water meter.

Section 20.05 IRRIGATION SYSTEM – INSTALLATION

All landscape and irrigation Improvement Drawings shall be checked and approved by the Public Works Director before work can begin. The location of the pedestal mount controller or TBOS controller will be determined by Santaquin City. The Developer/Contractor shall verify and have marked the location of all utilities and underground obstructions. Full and complete coverage is required. Developer/Contractor shall make any necessary minor adjustments to layout as required to achieve full coverage of irrigated area. Sleeves are required only when shown or called for on the Improvement Drawings. Sleeves are required for electrical wire placed under paved surfaces. Install sleeves prior to commencement of paving. Layout and stake locations of system components prior to beginning installation. Make any changes in routing necessary to avoid obstructions and obstacles.

Where called for piping shall be installed at location shown on the Improvement Drawings. Do not install pipe directly over another line in the same trench. It shall be the Contractor's responsibility to install all sprinkler heads in the location shown in order to assure proper coverage of all areas. In no case shall spacing of sprinkler heads exceed distance shown on the Improvement Drawings and/or those specified. Pipe sizes shall conform to those shown on the drawings. No substitutions of smaller pipe sizes will be permitted, but substitutions of larger sizes may be approved.

All pipe damaged or rejected because of defects shall be removed from the site at the time of said rejection. Install irrigation system after completion of site grading.

Sub-section A. Trenching:

Perform all excavations as required for installation of work included under this Section, including shoring of earth banks, if necessary. Restore all surfaces, existing underground installation, etc., damaged or cut as a result of the excavations, to their original condition.

Should utilities not shown on the plans be found during excavations, Contractor shall promptly notify Engineer for instructions as to further action. Failure to do so will make Contractor liable for any and all damage thereto arising from his operations subsequent to discovery of such utilities. Indicate such utility crossings on the record drawings promptly.

Trenches shall be open, vertical sided construction wide enough to provide free working space around work installed and to provide ample space for backfilling and compacting.

When Two (2) pipes are to be placed in the same trench, a two-inch (2") minimum space is to be maintained between the pipes. The Contractor shall not install two pipes with one directly above the other. Depth of trenches shall be sufficient to provide a minimum cover of 12-inches above the top of the pipe (see Standard Drawing 32.) Trenches located under sidewalk, curb, and gutter, or paving shall be compacted in layers of 95% compaction.

The Contractor shall cut trenches for pipe to required grade lines and compact trench bottom to provide accurate grade and uniform bearing for the full length of the line. All laterals and mainline shall be sufficiently sloped to provide positive drainage through drain valves.

The Developer/Contractor shall be held responsible for any damages caused by these operations and shall immediately repair or replace damaged parts.

Sub-section B. Pipe Installation:

Install pipes and fittings in accordance with manufacturers latest printed instructions. Clean all pipes and fittings of dirt, scales and moisture before assembly. All pipe, fittings, and valves, etc., shall be carefully placed in the trenches. Interior of pipes shall be kept free from dirt and debris and when pipe laying is not in progress, open ends of pipe shall be closed by approved means. Lay pipe in the trench in a snake-like manner with bell ends facing upstream. All lateral connections to the mainline as well as all other connections shall be made to the side of the mainline pipe.

1. Solvent-Welded Joints for PVC Pipes.

Use solvents and methods by pipe and solvent manufacturers.

Cure joint a minimum of one hour before applying any external stress on the piping and at least twenty-four (24) hours before placing the joint under water pressure, unless otherwise specified by manufacturer.

2. Threaded Joints for PVC Pipes.

Use Teflon tape on all threaded PVC fittings. When connection is plastic to metal, male adapters shall be used. The male adapter shall be hand tightened, plus one turn with a strap wrench.

3. Laying of Pipe.

Pipes shall be bedded in at least two inches (2") of finely divided material with no rocks or clods over one inch (1") diameter to provide a uniform bearing.

Plastic pipes shall be cut with PVC pipe cutters or saw, or in a manner so as to ensure a square cut. Burrs at cut ends shall be removed prior to installation so that a smooth unobstructed flow will be obtained.

All plastic-to-plastic joints will be solvent-weld joints or slip seal joints. All plastic pipe and fittings shall be installed as outlined and instructed by the pipe manufacturer and it shall be the Contractor's responsibility to make arrangements with the pipe manufacturer for any field assistance that may be necessary. The Contractor shall assume full responsibility for the correct installation.

4. PVC Sleeves

All PVC sleeves shall be a minimum of twice (2x) the diameter of the pipe to be sleeved.

All PVC control wire conduit shall be of sufficient size to hold the required quantity of control and common wires. Electrical wires are not to be placed in the same sleeve with water pipes.

5. Thrust Blocks.

Concrete thrust blocks must be provided on the thrust side of the mainline pipe wherever the pipe line:

- a. Changes direction, as at tees or bends.
- b. Dead ends.
- c. Any other spot where thrust is to be expected.

6. Shut-off Valves.

Shut-off valves shall be located per Improvement Drawings. All shut-off valves shall be located in

valve boxes.

7. Irrigation Control Valves.

Install control valves in valve boxes grouping together where practical. Place no closer than twelve inches (12") to walk edges, buildings and walls.

Valves shall be installed as shown in details and in accordance with manufacturer's instructions and the specifications.

8. Valve Boxes.

Valve boxes shall be set with grade and flush with top of turf in lawn areas and three inch (4") above soil grade in ground cover and shrub bed areas (to allow for 4" of bark mulch). Place them parallel or perpendicular to adjacent curbs, sidewalks, or driveways. Place aggregate sump (minimum of 3 cubic feet of 1" washed gravel) for drainage at valve boxes.

9. Sprinkler Heads.

All sprinkler heads shall be adjusted for the proper application of water. Make adjustments where possible to prevent over-spraying onto walks, pavement or buildings.

Sprinkler heads shall be set perpendicular to finished grade unless otherwise designated on the Improvement Drawings (see Standard Drawings.)

10. Drain valves.

All laterals shall be provided with King Brother automatic drain valves.

Drain valves are to be provided at sufficient intervals to provide complete drainage of all piping. Place one cubic foot of 1" washed gravel under drain.

11. Control Wiring.

All electrical equipment and wiring shall comply with local and states codes and be installed by those skilled and licensed in the trade. Wiring shall occupy the same trench and shall be installed along the same route as pressure supply or lateral lines wherever possible, and shall have a minimum of twelve-inch (12") cover. Control wires shall be installed to the side of the main line whenever possible. Placement over pipes is not permitted.

Where more than one (1) wire is placed in a trench, the wiring shall be taped together at intervals of ten feet (10'). Use a white wire for the common connection and different wire for the control wires. Coil an additional 12-inches of wire at each automatic control valve. An expansion curl shall be provided within three feet (3') of each wire connection and at least every one hundred feet (100') of wire length. Expansion curls shall be formed by wrapping at least five (5) turns of wire around a one-inch (1") diameter pipe, then withdrawing pipe.

Only splice wires inside a valve box. Control wire splices at remote control valves to be crimped and sealed with specified splicing materials. Line splices will be allowed only on runs of more than 500 feet. The connector shall be 3MDBY splice kit by 3M Corporation. Use one splice per connector sealing packs. The main line shall have two (2) spare wires installed its entire length and to the automatic controller. Label each end "spare wire".

12. Closing of Pipe, Flushing of Lines, and Testing.

Thoroughly flush out all water lines under a full head of water before installing heads, valves, quick

coupler assemblies, etc. Flush main lines before installing control valves. Flush laterals before installing sprinklers. Maintain flushing for a minimum of three (3) minutes at the valve located furthest from water supply. After flushing, cap or plug all openings to prevent entrance of materials that would obstruct the pipe or clog heads. Leave in place until removal is necessary for completion of installation.

Notify the Public Works Director 24 hours in advance of pressure testing the main line. Before backfilling and after air pockets have been vented from the lines, subject all supply and pressure irrigation lines to a hydrostatic pressure test by maintaining full water pressure for 3 consecutive hours.

Upon completion of testing, completely assemble and adjust sprinkler heads for proper distribution. All sprinkler heads shall be set perpendicular to finished grades unless otherwise designated on the Improvement Drawings, or otherwise specified. Sprinkler heads adjacent to walls, curbs and other paved areas, shall be set to grade. Sprinkler heads, which are to be installed in lawn areas where the turf has not yet been established shall be set one inch (1") above the proposed finish grade. Heads installed in this manner will be lowered to grade when the turf is sufficiently established to allow walking on it without appreciable destruction. The Developer/Contractor shall do such lowering of heads.

13. Irrigation Installation Inspection.

Notify the Santaquin City Public Works Director to schedule the Inspection after the irrigation system is completely installed and functional.

Section 20.06 SEEDING OR TURF

This section covers the seeding or turf placement. The Developer/Contractor has the choice of which material to use.

Sub-section A. Seeding:

The Developer/Contractor may revegetate the areas on which topsoil has been placed by hydro-seeding with mulch. Do not sow immediately following rain, when ground is too dry, too hard, or during windy periods without first loosening the surface. The hydro-seeding mix shall meet the following requirements:

Park seed/mulch mixture:

1. Limousine Kentucky Blue Grass: 20 percent
2. Liberty Kentucky Blue Grass: 20 percent
3. Marquis Kentucky Blue Grass: 20 percent
4. Washington Kentucky Blue Grass: 20 percent
5. Two types of Perennial Rye: 20 percent
6. 15 pounds per 1,000 square feet of 16-16-8 fertilizer.
7. 2,000 pounds per acre mulch.

Seed: Furnish grass seed that is fresh, clean, and new crop composed of the varieties shown above and tested to have minimum of 90-percent purity and minimum of 80-percent germination. Do not use wet, moldy or otherwise damaged seed.

Fertilizer: Recommended for grass, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil to the following proportions: Nitrogen 16 percent, phosphoric acid 16 percent, soluble potash 8 percent.

Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass.

Mulch Material: Wood or wood cellulose fiber free of growth or germination inhibiting ingredients.

Grading: Till soil to a depth of 2-inches and remove rocks and debris over 2-inches in diameter and any vegetation and weeds. Fine grade entire site to a smooth, loose, and uniform surface. When subgrade has been established, roll areas to remove ridges and depressions so surface is parallel with finished grade. Limit weight of rolling equipment to 110-pounds minimum or 250-pounds maximum per square foot.

Site tolerances: Total topsoil depth – minimum of 5-inches. Elevation of topsoil relative to walks, hard surfaces or edges – 2-inches below. Make sure sloped is as specified.

One step hydro seeding: Unless indicated otherwise, apply seed at the rate of 5-pounds per 1,000 square feet of area. Mix the seed and fertilizer with the specially prepared dyed wood cellulose fiber and water to form a slurry. Mix the slurry in tanks having continuous agitation so that a homogenous mixture is discharged hydraulically on the area being seeded. Apply evenly.

Sub-section B. Sodding:

Sod shall be well-rooted, 2 year old stock, containing a blend approved by the Owner. The sod shall be top quality certified sod, free of weeds, undesirable native grasses, insects, and diseases. The sod shall be machine cut and vigorously growing (not dormant). Maximum time from stripping to planting shall be 24-hours.

Provide sod of uniform pad sizes with maximum 5 percent deviation in either length or width. Broken pads or pads with uneven ends will not be acceptable. Sod pads incapable of supporting their own weight when suspended vertically with a firm grasp on upper 10 percent of pad will be rejected. For very large turf areas and all athletic fields, large roles of sod shall be used. Sod roles shall be cut, loaded, hauled, unloaded and placed using equipment specifically designed to lay large sod roles

Areas to be sodded shall be raked to a smooth surface free of all clods, roots or stones $\frac{3}{4}$ " or larger. Planting sod shall be done as specified herein and in strict accordance with standard horticultural practices. Lay sod within 24 hours from time of stripping. Do not plant dormant sod or if ground is frozen. Do not plant any sod that has dried out.

Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod strips; do not overlap. The first row of sod shall be laid in a straight line with subsequent rows placed parallel to each other. Lateral joints shall be staggered to promote more uniform growth and strength. Sod is not to be stretched or overlapped. Fill all holes greater than 2 square inches with sod plugs.

In sloping areas sod shall be laid with the long edges parallel to the contours and with joints staggered. In all drainage swales, regardless of degree of slope, the sod shall be laid with the long edges parallel to the contour lines and with staggered joints.

As sodding is completed in any one section, the entire area shall be rolled or tamped. Sod shall be watered immediately after placement until the underside of the new sod pad and soil surface below are thoroughly moistened. Do not allow sod to dry out. Hand water if necessary. Fertilize with 16-16-8 at a rate of 8 lbs. per 1,000 square feet. Place one half of the fertilizer (4 lbs, per 1,000 sq. ft.) in one direction and one half of the fertilizer in the opposite direction.

Sod shall be watered several times a day during the first week and in sufficient quantities to maintain moist soil to a depth of four inches (4"). After the first week sod shall be watered as necessary to maintain adequate moisture, to prevent wilting or browning, and to insure establishment. Begin maintenance immediately after planting. Sod shall be maintained by the Developer/Contractor for 60-days, or longer if necessary to provide a healthy stable turf, firmly knitted to the soil and free of any areas of erosion or washout damage. First mowing should not be attempted until sod is firmly rooted. Mow at 2-1/2-inches.

Sub-section C. Maintenance:

The following maintenance requirements shall be followed by the Developer until a homeowner, in the case of private detention basins, can take over the maintenance responsibilities. In public detention basins the Developer shall maintain it until accepted by the City, but no less than the time shown below:

1. General: Maintain surfaces until Work is accepted and maintenance responsibilities are taken over by others, but in any event for a period of not less than 60-days after planting. Supply additional topsoil where necessary, including areas affected by erosion or settlement.
2. Watering: Water to ensure uniform seed germination and to keep surface of soil damp. Apply water slowly so soil will not puddle and crust. Unless indicated otherwise, the Developer shall pay the cost of water supplied.
3. Fertilizing: Fertilize during seeding and 2 weeks after seeding and sodding.
4. Mowing: Cut grass first time when it reaches a height of 2-1/2-inches and maintain to minimum height of 2-inches. Do not cut more than 1/3 of blade at any one mowing. Remove clippings. After first mowing, water to moisten soil from 3-inches to 5-inches deep. Allow a minimum of 5-days between mowings.
5. Grading: Roll when required to remove minor depressions or irregularities.
6. Control Growth of Weeds: When using herbicides, apply in accordance with manufacture's recommendations. Remedy damage from improper use.
7. Protection: Protect planted areas with warning signs during maintenance period. Erect when necessary, temporary fences, or barriers, to control pedestrians.

Section 20.07 TREES

This section contains identifies trees whose use is allowed or restricted for streetscape in Santaquin.

Sub-section A. Approved Tree Species List:

Table 20-1 contains approved trees, tree characteristics, and indications as to their use in Santaquin:

TABLE 20-1 Approved Tree Species List

Botanical Name	Common Name	Characteristics	Size	Height x	Park	Strip	Positive	Negative
				Width/Size	Strip	Width		
Abies balsamea	Balsam Fir		L	50 X 6		8'		Winged Seed Litter
Abies Concolor	White Fir		L	80 X 7		8'		Non-Parasite resistant
Abies Fraseri	Fraser Fir		M	40 x 3		8'	Soft curved needles.	Has difficult growing in our area
Acer Campestre	Hedge Maple		S-M	25 x 20-25	Y	6'	Easy to transplant; good street tree.	Slow growing. Has difficulty growing in our area.
Acer freemanii 'Jeffersred'	Autumn Blaze Maple	Red Leaves	M	45 x 30		6'	Some drought Tolerance	
Acer ginnala	Amur Maple	White flowers Red leaves	S	15 x 10		6'	Engaging fall colors.	Susceptible to iron chlorosis due to low iron in soils. Keep away from planting on west side.
Acer glabrum	Rocky Mountain Maple	Red/ Orange Leaves	S	20 x 15	N		Tolerant to high soil pH. Plant in moist protected areas or in the shade of other trees, especially in w arm valley sites.	
Acer Grandidentatum	Bigtooth Maple	Yellow flower	M	40 x 30	N	6'	Native	
Acer griseum	Paperbark Maple		S	20 x 10		6'	Sun to partial shade. Water deep and infrequent.	
Acer palmatum	Japanese Maple		S			6'		Compact Root System
Acer palmatum atropurpurea 'Bloodgood'	Bloodgood Japanese Maple		S				Beautiful maple, locate carefully.	
Acer platanoides	Norway Maple	"Emerald Queen"	L	60 x 40	Y	8'-20'		
Acer Platanoides Columnare'	Columnar Norway Maple	Yellow Leaves	L	50 x 15			Great for street use, narrow and upright maple narrow dense-dark green foliage. It is also for the most part free of pests and diseases, and is wind resilient.	Planted too often.
Acer rubrum	October Glory Maple	oval-rounded form	L	40 x 30		8'	This cultivar is improved as it holds leaves longer in fall.	
Acer saccharum	Sugar Maple	Bright red/orange leaves	L	80 x 30		8'	Good Color	Grows in East
Acer tataricum	Tartarian Maple	Yellow /red leaves	S	20 x 15		6'	Good in dry areas	
Acer buergerianum	Trident Maple	Orange Leaves	S	25 x 20		6'	Drought Tolerant	
Acer truncatum Keithsform'	Norwegian Sunset Maple	Yellow /orange leaves	M	35 x 25		6'	Heat Tolerant	Restricted roots
Acer x freemanii	Autumn Blaze Maple	Bright red leaves	M	30 x 25			Great red fall leaf color. Disease resistant	
Acer x pseudoplatanus	Sycamore Maple		L	50 x 40	Y	8'-20'	Alkaline tolerant.	Bark flakes, non-spectacular color.
Aesculus x carnea	Red Horsechestnut	Red or Common	M			6'		
Aesculus glabra	Ohio Buckeye	Orange Leaves	L	50 x 40		6'		
Aesculus hippocastanum	Common Horsechestnut	White flower	L	60 x 40		6'-8'		Litter, leaf scorch
Aesculus pavia	Ruby Red Horsechestnut	Red flowers Red leaves	S	20 x 15	Y			Slow growing

TABLE 20-1 Approved Tree Species List (continued)

Botanical Name	Common Name	Characteristics	Size	Height x Width/Size	Park Strip	Strip Width	Positive	Negative
Albizia julibrissin	Mimosa, (silk tree)	Pink flowers	S	20 x 10		8'	Moderate maintenance	Invasive
Alnus cordata	Italian Alder		L	55 x 29	Y	6'		Tolerates pollution
Alnus glutinosa	Black or European Alder		L	60 x 15	Y	6'		
Alnus incana	Grey Alder		M	30 x 15	Y	6'		
Alnus rhombifolia	White Alder		M	30 x 20		8'		Drought intolerant
Alnus rubra	Red Alder	Yellow leaves Yellow flowers	L	80 x 30	Y	6'		Needs 180 frost free days
Alnus rugosa	Speckled Alder		M	30 x 15	Y	6'		
Amelanchier alnifolia	Alderberry Serviceberry		S	8 x 6		6'		Needs partial shade
Amelanchier canadensis	Shadblow Serviceberry		S	15 x 8		6'		
Amelanchier grandifolia Autumn Brilliance'	Autumn Brilliance Serviceberry		S	20 x 15			White spring flower, Bright red fall leaf.	
Betula nigra	River Birch		M	40 x 30	N		Great at edges of ponds and streams or in low areas. Colorful and dynamic peeling of bark for winter appeal.	
Betula occidentalis	Western Water Birch		S	20 x 10	N		Best along the edges of streams. Roots are tolerant to flooding. Smooth, shiny, dark red-brown bark with thin horizontal lines. Seeds streams. Roots are tolerant to flooding. Smooth, shiny, dark red-brown bark with thin horizontal lines. Seeds are an important source of bird food.	
Betula papyrifera	Paper or canoe Birch	Yellow flower	M	40 x 30		6'		
Betula pendula	European White Birch		L	50 x 30		6'		
Calocedrus decurrens	California Incense Cedar		L	80 x 10		8'		
Carpinus betulus	European Hornbeam		L	50 x 50		6'	Tall skinny tree	
Carpinus betulus Columnaris'	Columnar Hornbeam		M	40 x 30	N	6'	Tall skinny tree	Lime needed to establish root system making difficult to transplant. Plant using 8 to 10 ft. trees in spring having balled and burlapped roots.
Catalpa speciosa	Northern Catalpa	Creamy flowers	L	50 x 25		8'		
Catalpa bignonioides	Southern Catalpa	White flowers	L	45 x 20		8'		
Catalpa bignonioides 'Nana'	Umbrella Catalpa	Yellow leaves	S	16 x 16		6'		
Catalpa speciosa	Western Catalpa		L	50 x 25				
Cedrus atlantica glauca	Atlantic Cedar		L	50 x 35			Ornamental blue evergreen.	
Celtis occidentalis	Common Hackberry		L	50 x 40	Y	8'	Fast growing. Tolerant of dry, hot, heavy, wet soil conditions.	Prune while dormant. Might be susceptible to nipple gall.
Celtis reticulata	Netleaf Hackberry		S	25 x 20		6'		
Cercis canadensis	Eastern Redbud		M	25 x 20	Y	6'	Pink spring blooms.	Seedpods, understory tree.
Cercis canadensis forest 'pansy'	Forest Pansy Redbud	Pink flowers Purple leaves	M	25 x 30		6'		
Cercis occidentalis	Western Redbud	Pink flowers Purple leaves	S	15 x 10		6'		

TABLE 20-1 Approved Tree Species List (continued)

Botanical Name	Common Name	Characteristics	Size	Height x Width/Size	Park Strip	Strip Width	Positive	Negative
Chamaecyparis lawsoniana	Port-oxford-cedar falsecypress, Scarab Cypress		S	8 x 6		6'		
Chionanthus virginicus	Fringetree	Feathery white flowers	S	16 x 16		6'		
Cladrastris leutia	Yellow Wood	White flowers	M	30 x 30		6'		
Cornus kousa	Kousa Dogwood	White flow ers	M	25 x 15		6'		
Corylus columa	Turkish Filbert		L	45 x 25		6'		
Corylus sericea avellana	European Filbert					6'		
Cotinus coggygria	Common Smoketree	Yellow /orange leaves	S	12 x 12		6'		
Crataegus crus-galli	Cockspur Haw thorn	"Inermis"	S	20 x 15	Y	6'		
Crataegus crus-gali inermis	Thornless Crus-gali Hawthorne		S	20 x 20			Small fruit, red fall leaf color.	
Crataegus laevigata	English Haw thorn		S	15 x 12	Y			
Crataegus x lavellei	Lavelle Haw thorn		M	20 x 10	Y	6'		
Crataegus oxyacantha	English Haw thorn	Pink flowers	S	20 x 15		6'		Severe disease problems
Crataegus phaenopyrum	Washington Haw thorn		S	10 x 10	N	6'		
Fagus grandifolia	American Beech		L	80 x 40		8'	Shallow root system likes bottom land and upland soil.	
Fagus sylvatica	European Beech	"Tricolor"	L	40 x 40		12'		Slow growing
Fagus sylvatica 'Dawycy'	Columnar Beech	Purple leaves	S	25 x 6			Tall tree with nice leaves.	
Fraxinus americana	White Ash		L	70 x 50	N	8'		
Fraxinus americana	Ash "Autumn Purple"		L	50 x 40	N		Great red/purple fall color	
Fraxinus pennsylvanica	Patmore Ash		L	50 x 25		8'		
Fraxinus pennsylvanica	Green Ash	"Marshal" Seedless	L	50 x 20	N	8'		
Fraxinus quadrangulata	Blue Ash		S	25 x 3		8'		
Gingko biloba	Gingko or Maidenhair Tree	Male	L		N	6'		
Gleditsia triacanthos	Honeylocust	"Imperial" or "Skyline"	L	50 x 30	Y	8'-20'		
Gleditsia triacanthos inermis	Thornless Honeylocust		M	30 x 30			Yellow fall leaf.	
Gymnocladus dioicus	Kentucky Coffee Tree		L		Y	8'-20'		
Juglans nigra	Black Walnut		L	60 x 30		6'		
Juglans regia	Persian or English Walnut		L	60 x 60		6'		
Juniperus virginiana	Eastern Red Cedar		M	30 x 20			Sun; prefers well drained soil but tolerates a wide range of soil types.	
Juniperus virginiana 'Skyrocket'	Skyrocket Juniper		M	30 x 8			Tall and skinny accent tree.	Urban tolerant
Koelreuteria paniculata	Golden Rain Tree		M	40 x 30	Y	6'	Beautiful orange fall leaf.	
Laburnum x watereri	Golden Chain		S	20 x 15	N	6'		
Larix decidua	European Larch		L	90 x 25		8'		
Liquidambar styraciflua	Sweetgum		L	80 x 50		6'	Aromatic, sweet smell.	
Liriodendron tulipifera	Tulip		L	80 x 60	N	8'		
Maackia amurensis	Amur Maackia					6'		
Magnolia acuminata	Chinese Elm	Not Siberian	L	45 x 30				
Magnolia galaxy	Galaxy Magnolia	Red/Purple flowers	M	30 x 22		6'	Adaptable, good for narrow spaces	
Magnolia liliflora	Lily Magnolia	Red/Purple flowers	S	12 x 8		6'		
Magnolia x soulangiana	Saucer Magnolia		S	20 x 20		6'		Shade intolerant.

TABLE 20-1 Approved Tree Species List (continued)

Botanical Name	Common Name	Characteristics	Size	Height x Width/Size	Park Strip	Strip Width	Positive	Negative
Magnolia stellata	Star Magnolia	Pink flowers	S	20 x 20		6'		Bushy, slow growth
Malus	Crabapple	"Prairie Fire"	M	25 x 20	N	8'	Many different varieties.	
Malus 'spring snow'	Spring Snow	White flowers	M	25 x 20		6'		
Malus ioensis	Crabapple	"Bechtel"	M	20 x 20	N			Suckers, pruning needs.
Morus alba	Common Mulberry (white)	Fruitless	M	45 x 30	N	6'		
Nyssa sylvatica	Black or Tupelo Gum	Orange/Red leaves	M	40 x 25		6'		Difficult to transplant
Ostrya virginiana	Ironwood (American Hophornbeam)		M	40 x 30		6'		
Parotia persica	Persian Parotia	Scarlet leaves	S	20 x 20		6'	Show y all year	Zone 5
Phellodendron amurense	Amur corktree		M	30 x 40		6'		Invasive
Picea glauca densata	Black Hills Spruce		M	30 x 12			Slow growing green spruce	
Picea pungens 'Engelm'	Blue Spruce		L	60 x 20			Grows in all soils. Requires normal moisture with moderate tolerance to flooding and drought.	
Picea pungens glauca	Colorado Blue Spruce	Evergreen	L	50 x 25			Make sure to plan for growth Beautiful dwarf spruce	
Picea pungens glauca 'baby blue eyes'	Baby Blue Eyes Blue Spruce		S	10 x 6				
Pinus Agrifolli Wallichiana	Himalayan White Pine		M	25 x 15			Grows in full sun.	
Pinus edulis	Pinyon Pine		M	30 x 15			Native Pine.	
Pinus flexilis	Limber Pine		S	20 x 12			Flexible wood is excellent adaptation for heavy snow pack and ice.	
Pinus flexilis 'Vanderwolfe'	Vanderwolfe Pine		M	30 x 10			Beautiful dwarf pine.	
Pinus leucodermis 'Heldrechil'	Dwarf Austrian Pine		L	50x 15			Beautiful dwarf pine.	
Pinus longaeva	Bristlecone Pine		M	30 x 15			Do well in alkaline soils and are drought tolerant.	Shallow roots.
Pinus nigra	Austrian Pine		M	50 x 25			Pointy, stiff, dark green needles are in bundles of two.	
Pinus pinea	Pinion Pine		M	30 X 15			Nuts are edible.	Must not be overwatered (not good in lawn environment).
Pinus strobus	Eastern White Pine		L	60 x 40		8'		
Pinus sylvestris	Scotch Pine		M	30 X 25		8'	Grows on a wide variety of even poor soils but does best on well-drained clays and loams. It prefers full sun.	
Platanus x acerifolia	London Plane	"Bloodgood"	L	70 X 50		8'	Full sun. Nice peeling bark.	Foliage drop gradual.
Platanus occidentalis	American Sycamore		L	70 x 60		8'		
Prunus cerasifera	Myrobalan Plum	Fragrant white flowers.	S	25 x 30		6'		
Prunus padas	Mayday Tree	Red Leaves	M	30 x 20			Great white spring flowers.	
Prunus serrulata	Oriental Cherry	White flowers	S	20 x 15		6'		
Prunus serrulata	Kwanzan Cherry		S	20 X 20		6'		
Prunus virginiana 'Schubert'	Canadian Red Chokecherry		M	10 X 10	N			

TABLE 20-1 Approved Tree Species List (continued)

Botanical Name	Common Name	Characteristics	Size	Height x Width/Size	Park Strip	Strip Width	Positive	Negative
Prunus virginiana Canada 'Red'	Canada red Chokecherry	Red Leaves	S	25 x 20			Purple leaf, white flower in spring.	
Prunus xyedoensis	Yoshino Cherry	Pink flowers Orange leaves	S	20 x 15		6'		
Pyrus calleryana	Flowering Pear (Aristocrat)	Bright red leaves	M	30 x 15			Great fall color, very durable.	Unpleasant flower smell
Pyrus calleryana	Callery Pear	All varieties	M	30 X 20	Y		Great fall color, very durable.	
Quercus bicolor	Swamp White Oak	Pyramid-oval	L	60 X 70	Y	12'	Silver/brown, peeling bark.	
Quercus gambelii	Gamble Oak		S	25	N	8'	Native.	Locally grown only. (clump)
Quercus imbricaria	Shingle Oak		L	60 x 60		8'		Messy
Quercus laevis	Turkey Oak		S	20 x 20		8'		Unsuitable for Utah
Quercus macrocarpa	Burr Oak	Broad	L	50 X 80	Y	12'	Fall color brown, ornamental acorns.	
Quercus robur	English White Oak		L	75	N	8'		
Quercus robur 'Fastigiata'	Columnar English White Oak		L	50 x 10		8'	Hardy	Non-showy
Quercus rubra	Red Oak	Red Leaves	L	70 x 60		8'		
Quercus shumardii	Shumard Oak	Red/Orange leaves	L	80 x 50		8'		
Rhus typhina	Staghorn Sumac	Red Leaves	S	20 x 15			Great red/orange fall color.	
Sophora japonica	Japanese Pagoda		M	50 X 40	Y	6'		
Sorbus aucuparia	European Mountain Ash		M	30	N	6'	Ornamental berries.	
Sorbus aucuparia 'Korean'	European Mountain Ash		M	30	N	6'		Very slow growing.
Styrax obasias	Fragrant Snow bell	White flowers	M	25 x 20		6'	Fragrant flowers	
Syringa reticulata	Japanese Tree Lilac		S				Full sun. Good ornamental or street tree.	
Taxodium distichum	Bald Cypress	Orange/Brown Leaves	M	30 x 20		12'		
Thuja picata 'Fastigiata'	Western Red Cedar		L	50 x 4		8'		
Tilia americana	Linden, "Basswood"	Silver leaf, American	L	60		12'		
Tilia Americana 'Redmond'	Little Leaf Linden	"Redmond"	M	40 X 25			Redmond is a vigorous tree with a pyramidal growth habit. The current year's branches turn reddish at the onset of colder weather in autumn, providing more winter interest	Sensitive to salt and air pollutants.
Tilia cordata	Little Leaf Linden	"Green Spire"	M	60 X 35	Y	10'	Prefers moist, well-drained, fertile soil and full sun. Pollution tolerant.	
Tilia x euchlora 'redmond'	Crimean linden	White, fragrant flowers	M	40 x 30		8'	Low maintenance	
Tilia tomentosa	Silver Linden	Sterling Silver	M	40 X 30		12'	Dark green glossy foliage with silvery lower surfaces. Tolerates heat and drought. Fall color is yellow.	
Ulmus americana	American Elm	Yellow Leaves	L	60 x 30		12'		
Ulmus 'Frontier'	Frontier Elm	Red Leaves	S	25 x 15		8'	Disease tolerant	
Ulmus parvifolia	Chinese, Lacebark Elm		M	50 x 30		8'	Great peeling bark.	Susceptible to dutch elm disease
Ulmus procera	English Elm		L	70 x 35		12'		
Zelkova serrata	Japanese Zelkova	Vase	L	70	Y	8'	Bronze in fall, durable green.	Susceptible to iron chlorosis.

Sub-section B. Trees that are Prohibited in Park Strips

The following trees are prohibited in park strips:

1. Aspen
2. Poplar
3. American Elm
4. Birch
5. Russian Olive
6. Black Locust
7. Siberian Elm
8. Boxelder
9. Silver Maple
10. Cottonwood
11. Tree of Heaven
12. Honey Locust (Thorned)
13. Willow
14. Pinoak
15. Evergreen
16. Western Catalpa
17. Idaho Locust
18. Fruit and nut bearing trees
19. Horse Chestnut
20. Poplar

Evergreen Trees (pines, fir, spruce, etc.) are also prohibited in park strips, except as noted in Sub-section C.

Sub-section C. Tree Substitutions for Unique Environments

Table 20-2 identifies trees suitable as substitutions for unique environments:

TABLE 20-2 Tree Substitutions for Unique Environments

Botanical Name	Common Name	Use in Unique Environment
<i>Platanus acerifolia</i>	London Plane Tree	Maples in locations with variable parkstrips 8 feet in
<i>Acer glabrum</i>	Rocky Mountain Maple	Planted in Drifts
<i>Acer grandidentatum</i>	Big Tooth Maple	Planted in Drifts
<i>Morus alba</i> fruitless	Fruitless Mulberry	In locations with wider parkstrips
<i>Liquidambar styraciflua</i>	American Sweetgum	
<i>Zelkova serrata</i> 'Village Green'	Japanese Zelkova	

Pine, Fir, Spruce, Cedar are suitable where extra planting width and proper sight distance are available. Accent trees are suitable at key intersections (200-300 ft.) with specie-type approved during site plan review.

Sub-section D. Streetscape Substitutions

Table 20-3 lists acceptable streetscape tree substitutions. Note that the desired effect of individual planting themes in the plan may be seriously affected by substitutions. The substitute trees are listed in descending order of preference.

Substitutions require the approval of the Public Works Director.

TABLE 20-3 Streetscape Substitutions

<p>Bechtel Crab (<i>Malus ioensis</i> 'Klehms Improved')</p> <ol style="list-style-type: none"> 1. <i>Malus ioensis</i> 'Plena' 2. <i>Malus</i> 'Snowcloud' 3. <i>Malus</i> 'Spring Snow' <p>Bradford Pear (<i>Pyrus calleryana</i> 'Bradford')</p> <ol style="list-style-type: none"> 1. <i>Pyrus calleryana</i> 'Aristocrat' <p>Bur Oak (<i>Quercus macrocarpa</i>)</p> <ol style="list-style-type: none"> 1. Red Oak (<i>Quercus rubrum</i>) 2. Ginkgo (<i>Ginkgo biloba</i> 'Autumn Gold') <p>Columnar Norway Maple (<i>Acer platanoides</i> 'Columnare')</p> <ol style="list-style-type: none"> 1. Columnar English Oak (<i>Quercus robur</i> 'Flastigjata') <p>Common Hackberry (<i>Celtis occidentalis</i>)</p> <ol style="list-style-type: none"> 1. Marshall Seedless Ash (<i>Fraxinus pennsylvanica lanceolata</i> "Marshall's Seedless") 2. Modesto Ash (<i>Frasinus veluntina</i> 'Modesto') 3. Kentucky Coffee Tree (<i>Gymnocladus dioica</i>) 4. Chinese Elm (<i>Ulmus parvifolia</i> 'Brea') sometimes called the lace leaf Elm, not to be confused the Siberian Elm which is mistakenly called 'Chinese' Elm. <p>Crimson King Maple (<i>Acer platanoides</i> 'Crimson King')</p> <ol style="list-style-type: none"> 1. <i>Acer platanoides</i> 'Royal Red' <p>Eastern Redbud (<i>Cercis canadensis</i>)</p> <ol style="list-style-type: none"> 1. Amur Maple (<i>Acer ginnala</i>) 2. Washington Hawthorn (<i>Crataegus phaenopyrum</i>) 3. Bechtel Crab (<i>Malus ioensis</i> 'Klehms Improved') <p>Flowering Plum (<i>Prunus cerasifera</i> 'Blireiana')</p> <ol style="list-style-type: none"> 1. Washington Hawthorn (<i>Crataegus phaenopyrum</i>) 2. Bechtel Crab (<i>Malus ioensis</i> 'Klehms Improved') 3. Eastern Redbud (<i>Cercis canadensis</i>) <p>Hedge Maple (<i>Acer campestre</i>)</p> <ol style="list-style-type: none"> 1. Sycamore Maple (<i>Acer pseudoplatanus</i>) 2. Sugar Maple (<i>Acer saccharum</i>) 	<p>Kwanzan Cherry (<i>Prunus serrulata</i> 'Kwanzan')</p> <ol style="list-style-type: none"> 1. Sargent Cherry (<i>Prunus</i> 'Sargentii') 2. Japanese Flowering Cherry (<i>Prunus serrulata</i> 'Shirofugen') <p>Little Leaf Linden (<i>Tilia cordata</i>)</p> <ol style="list-style-type: none"> 1. <i>Tilia cordata</i> 'Greenspire' 2. <i>Tilia cordata</i> 'Rancho' <p>Norway Maple (<i>Acer platanoides</i> 'Cleveland')</p> <ol style="list-style-type: none"> 1. <i>Acer platanoides</i> 'Emerald Queen' 2. <i>Acer platanoides</i> 'Schwedleri' 3. <i>Acer platanoides</i> 'Deborah' (Improved Schwedleri) <p>Red Maple (<i>Acer rubrum</i> 'October Glory')</p> <ol style="list-style-type: none"> 1. Red Maple (<i>Acer rubrum</i> 'Red Sunset') 2. Hedge Maple (<i>Acer campestre</i>) 3. Sycamore Maple (<i>Acer pseudoplatanus</i>) <p>Red Oak (<i>Quercus rubrum</i>)</p> <ol style="list-style-type: none"> 1. Bur Oak (<i>Quercus macrocarpa</i>) 2. Ginkgo (<i>Ginkgo biloba</i> 'Autumn Gold') <p>Sycamore Maple (<i>Acer pseudoplatanus</i>)</p> <ol style="list-style-type: none"> 1. Hedge Maple (<i>Acer campestre</i>) 2. Sugar Maple (<i>Acer saccharum</i>) <p>Thornless Honeylocust (<i>Gleditsia triacanthos inermis</i> 'Imperial')</p> <ol style="list-style-type: none"> 1. Thornless Honeylocust (<i>Gleditsia triacanthos inermis</i> 'Skyline') 2. Thornless Honeylocust (<i>Gleditsia triacanthos inermis</i> 'Sunburst') 3. Japanese Pagoda Tree (<i>Sophora japonica</i>) 4. Kentucky Coffee Tree (<i>Gymnocladus dioica</i>) <p>Washington Hawthorn (<i>Crataegus phaenopyrum</i>)</p> <ol style="list-style-type: none"> 1. Lavalley Hawthorn (<i>Crataegus</i> x <i>Lavallei</i> x carrier) 2. Eastern Redbud (<i>Cercis canadensis</i>) 3. Flowering Plum (<i>Prunus cerasifera</i> 'Blireiana')
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Sub-Section E. Tree and Shrub Installation:

The work to be performed under this section shall consist of furnishing all materials, labor, equipment and plants necessary for the proper planting of all trees and shrubs.

References

1. ANN: American Associations of Nurserymen, Inc.
2. ANSI Z60.1: American Standard for Nursery Stock.
3. FS O-F-241: Fertilizers, Mixed Commercial.

Quality Assurance

1. Perform work in conformity with applicable requirements of AAN.
2. Provide plants that are declared free of disease and insect pests.

Product Delivery, Storage, and Handling

1. Exercise care in digging, transporting, handling, and packing of all plants.
2. Handle plants so roots are protected at all times. If delivery is in open vehicles, cover entire load without causing overheating.
3. Deliver plant material immediately prior to placement. Keep plant material moist.
4. Protect root balls from sun and wind by covering with soil or other suitable material if not planted immediately on delivery.
5. Store fertilizer in a weatherproof location such that its effectiveness will not be impaired.

Acceptance

1. Plants in which the ball of earth surrounding roots (rootball) has been cracked or broken are not acceptable.
2. Plants in which burlap, staves, and ropes required in connection with transplanting are not intact upon delivery are not acceptable.
3. Heeled in stock from cold storage are not acceptable.

Samples

1. Submit samples of the materials listed below to the City for inspection and approval prior to the beginning of work.
2. Begin delivery of materials only after the City approves samples. All materials furnished for the work shall conform in every respect to the approved samples. Any non-conforming materials will be rejected.

General

1. Provide plants of normal growth and uniform height, according to species, with straight canes and well developed leaders, roots, and tops.
2. Provide plants of sizes indicated. The size stated in each case shall be interpreted to mean dimensions of plant as it stands in its mature position in the nursery without straightening of any branches or leaders.
3. Provide legible labels attached to all plants, specimens, bundles, boxes, bales, or other containers indicating botanical genus, species, and size of each.
4. Plants cut back from larger sizes to meet specifications shall be rejected.
5. Balled and burlapped deciduous shrubs may be acceptable in lieu of container growth deciduous shrubs only if there is a demonstrated significant shortage of container grown stock.

Plants

1. All plants shall comply with federal and state laws requiring inspection for plant disease and infestations.

Any inspection certificates required by law shall accompany each delivery of plants and such certificate shall be given to the City. All plants shall be subject to inspection and approval at the place of growth or upon

delivery to the site for their quality, size, species, and variety. Such approval shall not impair the right of inspection and rejection at the site or during progress of work for size and condition of the plants, latent defects, or injuries. Any and all rejected plants shall be removed immediately from the premises by the Contractor. The Contractor shall make all replacements at his expense should he fail to comply in full with any of the specifications. Necessary replacements will be made as soon as weather conditions permit and all such plants replaced shall conform to all specifications herein.

3. Names and Grades:
 - a) Plant names shall conform to the nomenclature of "Standard Plant Names" or "Bailey's Encyclopedia of Horticulture." When a name is not found in either reference, consult the accepted name used in the nursery trade. All plants shall be tagged by the nursery with the proper identification labels to insure the correct varieties of plants.
 - b) Size and grading standards shall conform to those of the American Association of Nurserymen, Inc., as published in "American Standard for Nursery Stock", 1959 Edition, with all current revisions unless otherwise specified.
 - c) The caliper of trees shall be measured six (6) inches above the surface of the ground.
 - d) Measurements on all trees and shrubs shall be taken with the branches in a normal position. Height and spread dimensions specified refer to the main body of the plant and not from branch or root tip to tip. No trees will be accepted which have had their leaders cut or so damaged that cutting is necessary.
4. No substitution of size, grade, variety or any species shall be permitted except by written permission of the City.
5. Plant Size:
 - a) All plants shall conform to the specified size, age, and condition as specified in the plant list. Undersized plant material shall not be approved. The minimum acceptable tree sizes are:
 - i. Deciduous Trees – 2" caliper
 - ii. Evergreen Trees – 6' height
 - b) No additional compensation shall be due the Contractor if larger than specified plant material is provided.
 - c) Due to the large size of the trees and evergreens being specified, only balled and burlapped or container stock shall be accepted. No bare root stock shall be accepted.
 - d) Plants lists indicate minimum size requirements only. Plant materials shall be equal to or greater in size than those specified.
6. All plants shall be fresh and vigorous, of normal habit and growth, and free of disease, insects and insect eggs and insect larvae, weeds and weed seed.

Installation

The following materials, equipment and methods shall be used to install all trees and shrubs (as applicable):

1. Tree Stake and Tie Materials
 - a) Tree stakes shall be two by two (2x2) inch square or two (2) inch diameter round treated wood stakes six (6) feet in length. Steel stakes may be used if approved by the Engineer and reclaimed after one year.
 - b) For all trees larger than 2" caliper, install 3 tree stakes on all trees. Where 3 tree stakes are installed place them equidistant from each other around the circumference of the tree well.
2. Planting Operations

All concrete work, sprinkling systems, and finished grading shall be completed and approved by the Owner/Engineer before any planting of the specified plant materials is begun.

No tree planting shall be initiated until all sprinkling systems are complete, tested and fully functioning. However, tree planting shall precede lawn sod planting.

Each plant will be placed in an individual plant pit. The sharing of pits shall not be allowed.

All trees and shrubs shall be planted in pits as detailed in the standard drawings. Tree and shrub pits shall be circular in outline, with a diameter at least two (2) times the diameter of the rootball of each plant to be installed. They shall be one to two and one half (1 - 2 ½) inches shallower than the

rootball depth. When the plant is properly placed in the plant pit, the root collar shall be approximately one (1) inch above finished grade. The sides of the plant pit shall be roughened, and not smooth or sculpted.

For container grown plants, remove the container and place the plant vertically in the plant pit, directly on undisturbed soil. The root crown or collar shall be at or just above the finished grade.

For balled and burlapped plants, place the plant vertically in the center of the pit, with the rootball resting on undisturbed soil. Cut and remove the wire basket and burlap or other wrapping material from the rootball. This may be done with the rootball in the pit. Any burlap or wire pieces underneath the rootball may be left in place if they cannot be removed. Do not fold the burlap over, but cut away as much as possible without disturbing the rootball. No burlap shall be pulled from under the rootball. Backfill the bottom one third (1/3) of the pit as the wire and burlap are removed. In all cases, maintain the integrity of the rootball.

Specified backfill material shall be carefully and firmly worked and tamped under and around the rootball to fill all voids. When backfilled and compacted to two thirds (2/3) the depth of the pit, thoroughly water with a hose to completely soak the roots and remove any air pockets.

The plant pit shall then be completely backfilled with the specified backfill mix and tamped well. A shallow watering basin or rain cup shall be formed around each plant.

Monitor all plants to insure that no settling occurs. Pits which settle shall be immediately filled with additional soil mixture at no additional expense to the Owner.

After planting, the following operations shall be performed:

- a) Stake and mulch all trees per installation details.
- b) Remove all nursery stakes ties, and tags from all plants. Prune and remove any dead, damaged, or broken branches. Maintain side growth on all trees.

3. Staking

All trees, including evergreen trees, shall be staked.

Staking shall be performed as follows:

- a) Each stake will be located adjacent to the rootball, on opposing sides, to provide maximum support to the trunk. Do not penetrate the rootball with the stake.
- b) The stakes will be driven into the pit bottom after the tree has been placed in the pit, but before backfilling begins so as to avoid damage to the roots.

Stakes and ties shall be removed after one (1) full growing season from the time the tree was installed.

4. Watering

All plants shall be thoroughly watered immediately after planting. This shall mean full and thorough saturation of all backfill in the pits and beds during the same day of planting. Water shall be applied only by open end hose at very low pressure to avoid creating air pockets, causing injury to the plant, or washing away of backfill. When installed, watered, and fully settled, the plants shall be vertical.

The site's irrigation system shall provide subsequent watering. The Contractor shall insure that all plants, especially trees, receive sufficient water to maintain healthy growth and vigor. Avoid overwatering and eliminate prolonged saturation of the soil around the trees by appropriately controlling the irrigation circuit which provides water to that area.

Section 20.08 Bonding

The requirement for the installation of landscaping requirement may be deferred if the landscaping were to be installed between the dates of October 15th and April 15th and a cash bond is submitted. The value of the bond must be determined by the Public Works Representative/City Engineer.

Chapter 5

Standard Drawings

CHAPTER 5

STANDARD DRAWINGS

SIDEWALK, CURB, & GUTTER DETAILS

- CG1 CURB RAMP AT INTERSECTION WITHOUT PARK STRIP
- CG2A MAIN STREET AND MAJOR STREET CURB RAMP AT INTERSECTION
- CG2B RESIDENTIAL CURB RAMP AT INTERSECTION
- CG3 DRIVEWAY APPROACH WITH PARK STRIP
- CG4 CURB & GUTTER AND CROSS GUTTER DETAILS
- CG5 SIDEWALK DETAILS
- CG6 DRIVEWAY APPROACH W/O PARK STRIP

STREET LIGHT DETAILS

- L1 LOCAL & COLLECTOR STREET LIGHTING DETAILS
- L2 MAIN STREET LIGHTING DETAILS
- L3 ARTERIAL STREET LIGHTING DETAILS
- L4 ANCHOR BASE & BREAK COUPLING DETAILS

LANDSCAPE INSTALLATION DETAILS

- LA1 TREE PLANTING & STAKING DETAIL
- LA2 CONIFER PLANTING & STAKING DETAIL
- LA3 SHRUB PLANTING DETAIL

PRESSURE IRRIGATION DETAILS

- PI1 PRESSURE IRRIGATION SERVICE LATERAL
- PI2 PRESSURE IRRIGATION METER BOX
- PI3 PRESSURE IRRIGATION SYSTEM DRAINS
- PI4 FLUSHING, AIR INLET & REMOVAL FACILITY FOR PRESSURE IRRIGATION
- PI5 PRESSURE IRRIGATION WATER VALVE

SEWER DETAILS

- S1 TYPICAL SEWER MANHOLE
- S2 TYPICAL SEWER LATERAL
- S3 CAST IN PLACE SEWER MANHOLE & MANHOLE RING & COVER
- S4 DROP SEWER MANHOLE
- S5 TYPICAL GREASE INTERCEPTOR

STORM DRAIN DETAILS

- SD1 CURB INLET BOX ASSEMBLY
- SD2 TYPICAL STORM DRAIN MANHOLE & MANHOLE RING & COVER



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REVISION			
NO.	DESCRIPTION	BY	DATE
1	ALPHABETIZED STANDARD DRAWINGS, UPDATED SHEET NAMES & SHEET CDS ADDED	NEB	MLC 11/2011



STANDARD DRAWINGS
 INDEX SHEET #1

SANTAQUIN CITY
 275 WEST MAIN STREET

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PLOT SCALE:	1:000
DRAWN BY:	BTW
DESIGN BY:	NEB
CHECKED BY:	MLC
ADOPTED DATE:	20 JUN 12

STREETS & RIGHTS OF WAY DETAILS

- ST1 STANDARD STREET CROSS SECTIONS
62' MAJOR LOCAL ROAD RIGHT-OF-WAY
60' COLLECTOR ROAD RIGHT-OF-WAY
24' RURAL PRIVATE LANE CROSS SECTION
- ST2 STANDARD STREET CROSS SECTIONS
55' RURAL LOCAL ROAD RIGHT-OF-WAY
90' ARTERIAL ROAD RIGHT-OF-WAY
24' PRIVATE STREET CROSS SECTION
- ST3 STANDARD STREET CROSS SECTIONS
55' ROAD RIGHT-OF-WAY
HAMMER HEAD TURNAROUND
- ST4 HIGHLAND DRIVE CROSS SECTION
- ST5 CENTER STREET CROSS SECTION
- ST6 MAIN STREET CROSS SECTION
- ST7 LOCAL STREET/STOP SIGN DETAILS
- ST8 ARTERIAL & COLLECTOR STREET/STOP SIGN DETAILS
- ST9 TYPICAL STREET SIGN DETAIL (NO STOP SIGN)
- ST10 TYPICAL SPEED LIMIT SIGN DETAIL

TRAIL & PATH WAY DETAILS

- T1 SINGLE PATH TRAIL CROSS SECTIONS
- T2 DUAL PATH TRAIL & NEIGHBORHOOD
PATH TRAIL CROSS SECTIONS
- T3 LOW IMPACT NON-URBAN & 20' TRAIL ADJACENT
TO STREET CROSS SECTIONS

UTILITY LOCATION DETAILS

- UT1 STREET UTILITY LOCATIONS PLAN VIEW
- UT2 STREET UTILITY LOCATIONS SECTIONS
- UT3 TYPICAL TRENCH SECTION
- UT4 THRUST BLOCK DETAILS

WATER DETAILS

- W1 CULINARY WATER SERVICE CONNECTION
- W2 FIRE HYDRANT & WATER VALVE DETAIL
- W3 4" WATER SERVICE CONNECTION
- W4 PRESSURE REDUCING VALVE DETAILS
- W5 MEGALUG RESTRAINING SYSTEM DETAILS
- W6 MEGALUG RESTRAINING SYSTEM DETAILS
- W7 MEGALUG RESTRAINING SYSTEM DETAILS &
ECLIPSE HYDRANT BLOW-OFF ASSEMBLY



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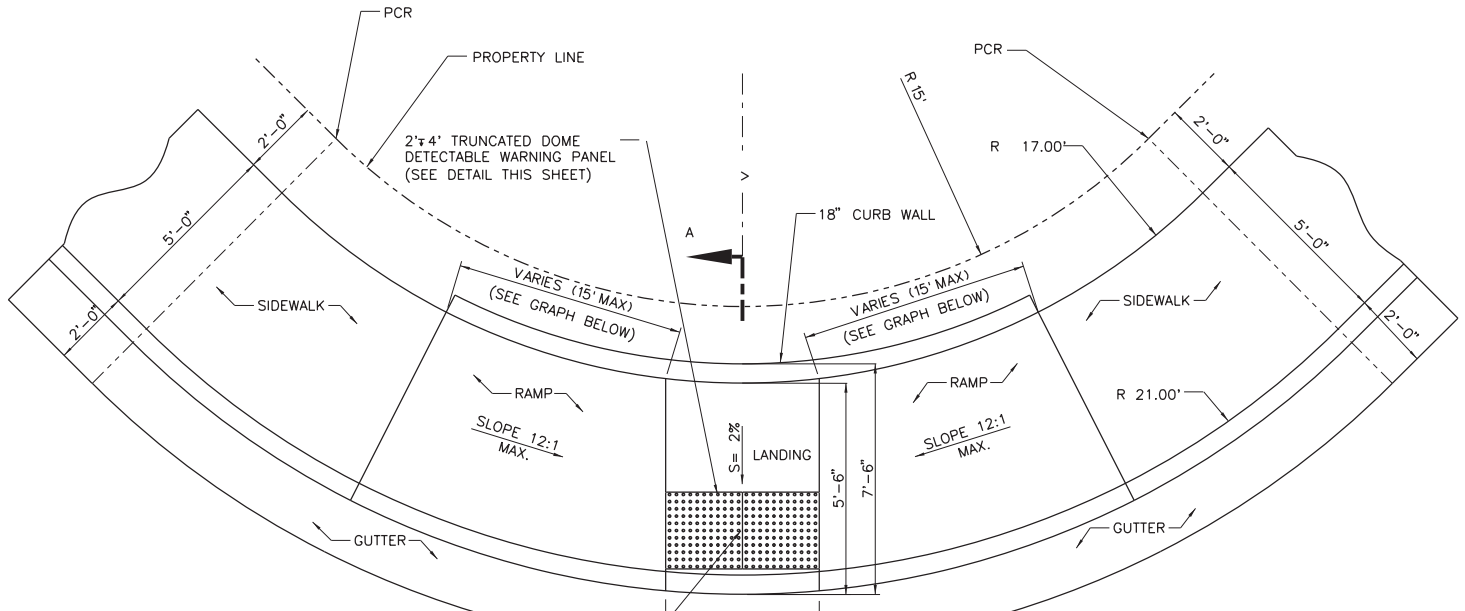


**STANDARD DRAWINGS
INDEX SHEET #2**

SANTAQUIN CITY
275 WEST MAIN STREET

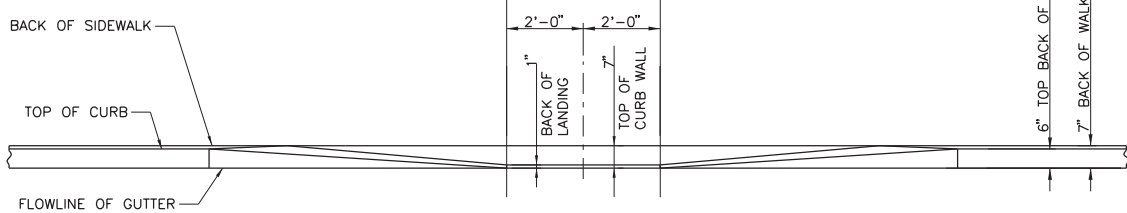
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DESIGN BY:	NEB
CHECKED BY:	MLC
ADOPTED DATE:	20 JUN 12

REVISION			
NO.	DESCRIPTION	BY	DATE
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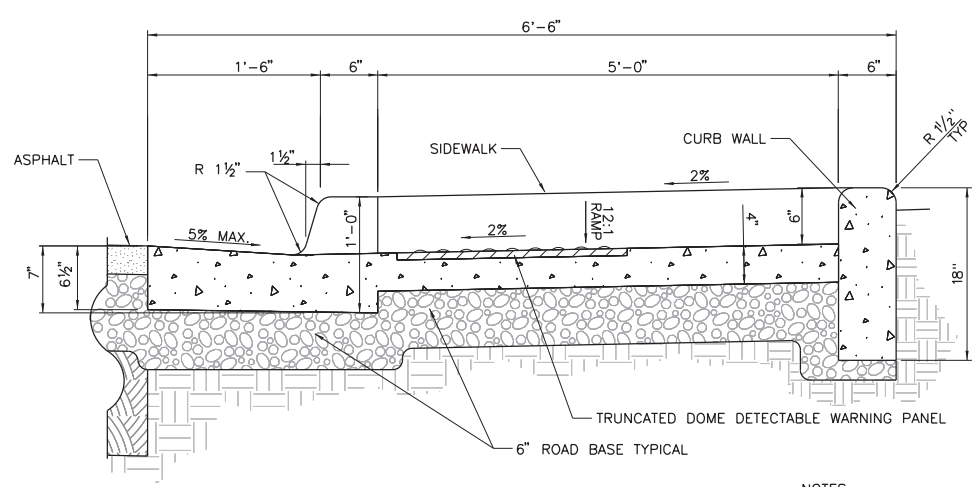


PLACE TRUNCATED DOMES
6" TO 8" BEHIND GUTTER
FLOWLINE

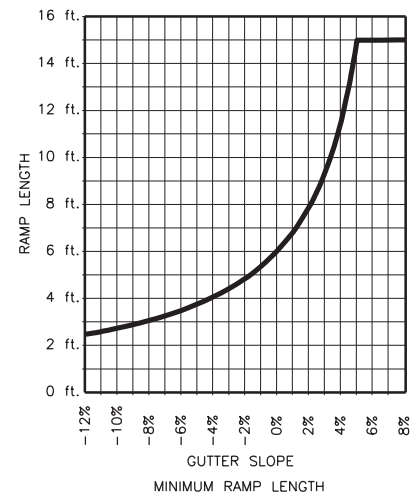
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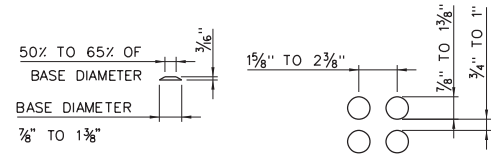
ELEVATION



SECTION A-A
ENLARGED: N.T.S.



GUTTER SLOPE
MINIMUM RAMP LENGTH



TRUNCATED DOMES
ENLARGED SCALE 1" = 1"

NOTES:

1. LANDING SHALL NOT EXCEED 2% IN ANY DIRECTION.
2. TRUNCATED DOME DETECTABLE WARNING PANEL SHALL BE YELLOW POLYMER COMPOSITE/FIBERGLASS.
3. MID-BLOCK CROSSINGS SHALL USE THE SAME RAMP CONFIGURATION, EXCEPT THAT THERE WOULD BE A DIFFERENT RADIUS CURVE OR NO CURVE AT ALL.
4. CURB RETURNS BETWEEN SIDEWALKS OR TRAILS NOT 4' WIDE, BUT WHERE THE WIDTH IS THE SAME ON BOTH ENDS OF THE CURB RETURN HAVE THE SAME GENERAL CONFIGURATION AS THE DETAIL SHOWN ON THIS SHEET.



STATEMENT OF USE

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REVISION

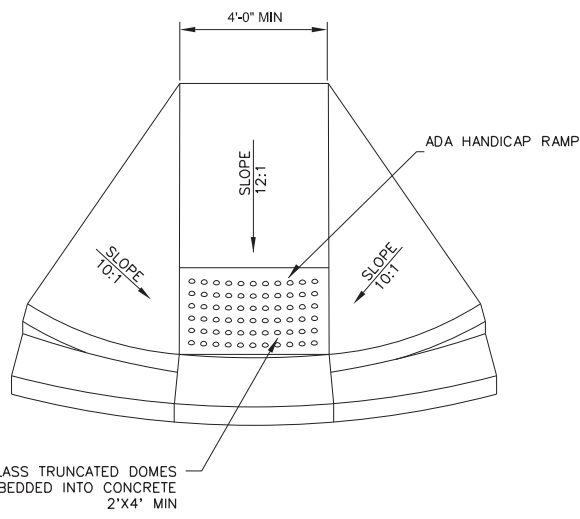
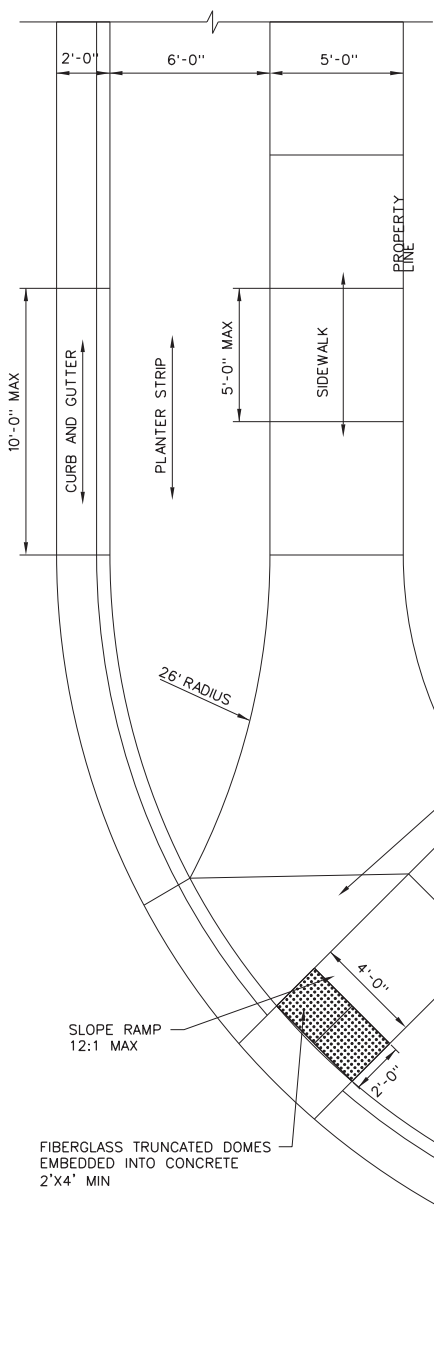
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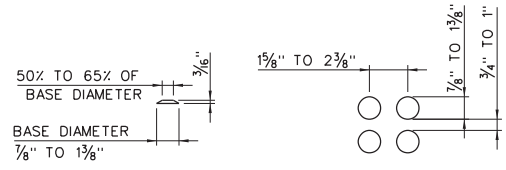
CURB RAMP AT INTERSECTION WITHOUT PARK STRIP

SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	CG1
CAD DWG.dwg_6-12.dwg	
PLOT SCALE:	1:000
DRAWN BY:	DSF
DESIGN BY:	DSF
CHECKED BY:	DCT
ADOPTED DATE:	20 JUN 12



ISOMETRIC VIEW



TRUNCATED DOMES
ENLARGED SCALE 1"=1'

- NOTES:
1. COUNTER SLOPES OF ADJOINING GUTTERS AND ROAD SURFACES IMMEDIATELY ADJACENT TO THE CURB RAMP SHALL NOT BE STEEPER THAN 1:20. THE ADJACENT SURFACES AT TRANSITIONS AT CURB RAMPS TO WALKS, GUTTERS, AND STREETS SHALL BE AT THE SAME LEVEL.
 2. LANDING SHALL NOT EXCEED 2% SLOPE IN ANY DIRECTION.
 3. TRUNCATED DOME DETECTABLE WARNING PANEL SHALL BE YELLOW POLYMER COMPOSITE/FIBERGLASS.
 4. MID-BLOCK CROSSINGS MAY BE CONSTRUCTED SIMILARLY.

ELEVATION VIEW
NOT TO SCALE



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REVISION

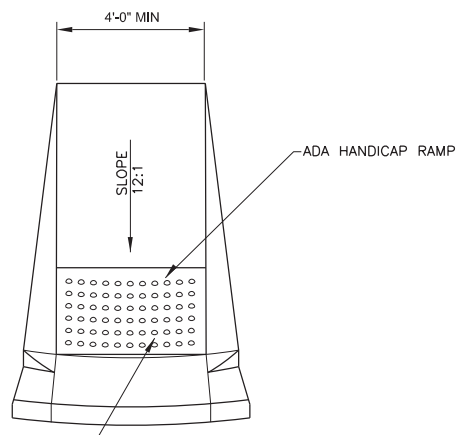
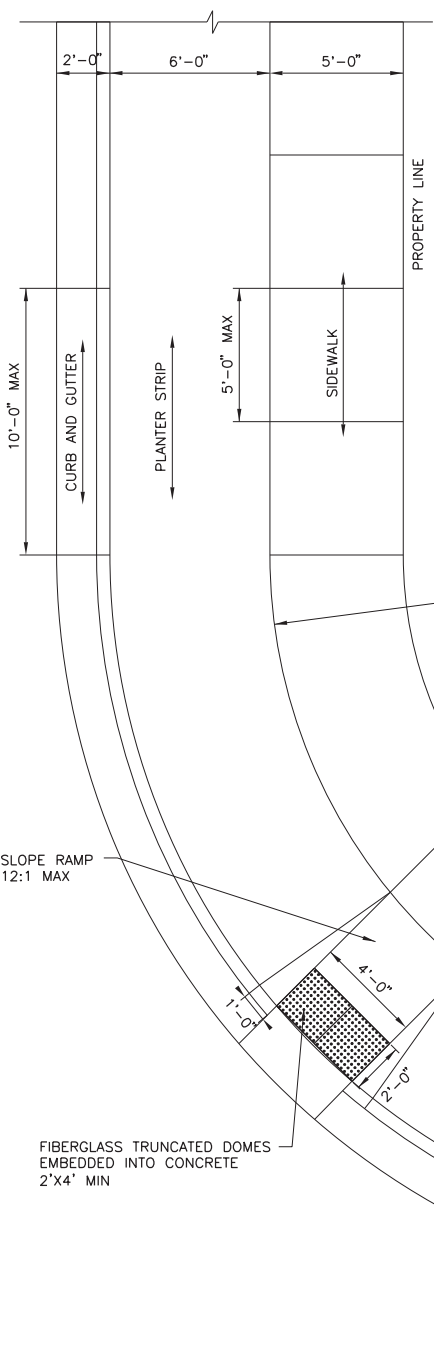
NO.	DESCRIPTION	BY	APR.	DATE



**RESIDENTIAL CURB RAMP
AT INTERSECTION**

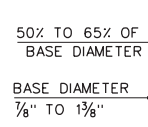
SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	CG2A
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PLOT SCALE:	1,000
DRAWN BY:	NEB
DESIGN BY:	NEB
CHECKED BY:	MJC
ADOPTED DATE:	20 JUN 12



FIBERGLASS TRUNCATED DOMES
EMBEDDED INTO CONCRETE
2'X4' MIN

ISOMETRIC VIEW



TRUNCATED DOMES
ENLARGED SCALE 1"=1'

- NOTES:
- COUNTER SLOPES OF ADJOINING GUTTERS AND ROAD SURFACES IMMEDIATELY ADJACENT TO THE CURB RAMP SHALL NOT BE STEEPER THAN 1:20. THE ADJACENT SURFACES AT TRANSITIONS AT CURB RAMPS TO WALKS, GUTTERS, AND STREETS SHALL BE AT THE SAME LEVEL.
 - LANDING SHALL NOT EXCEED 2% SLOPE IN ANY DIRECTION.
 - TRUNCATED DOME DETECTABLE WARNING PANEL SHALL BE YELLOW POLYMER COMPOSITE/FIBERGLASS.
 - MID-BLOCK CROSSINGS MAY BE CONSTRUCTED SIMILARLY.

ELEVATION VIEW
NOT TO SCALE



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REVISION

NO.	DESCRIPTION	BY	APR.	DATE

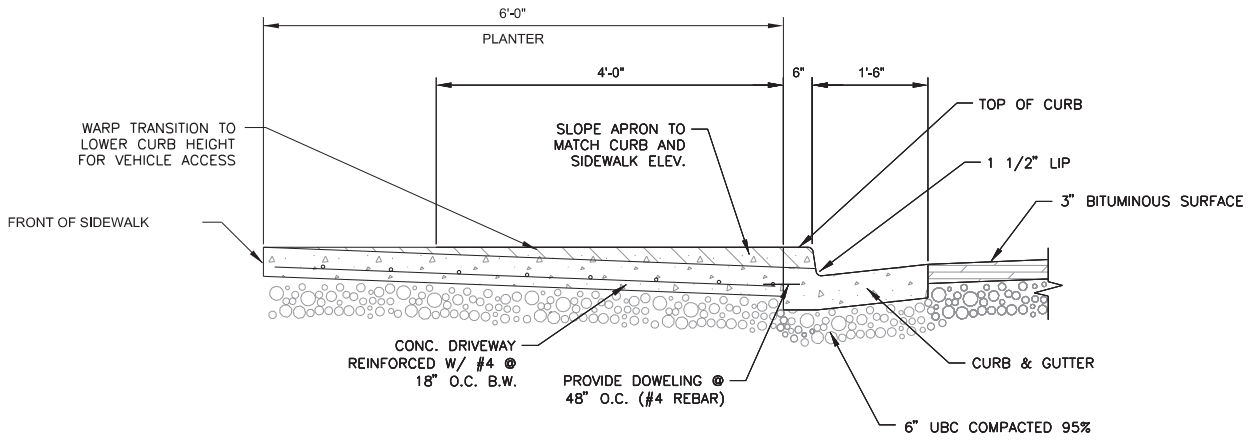


**RESIDENTIAL CURB RAMP
AT INTERSECTION**

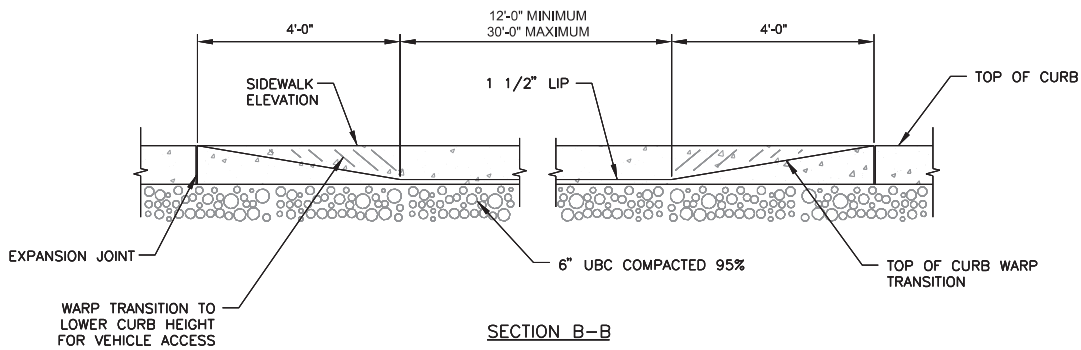
SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER: **CG2B**

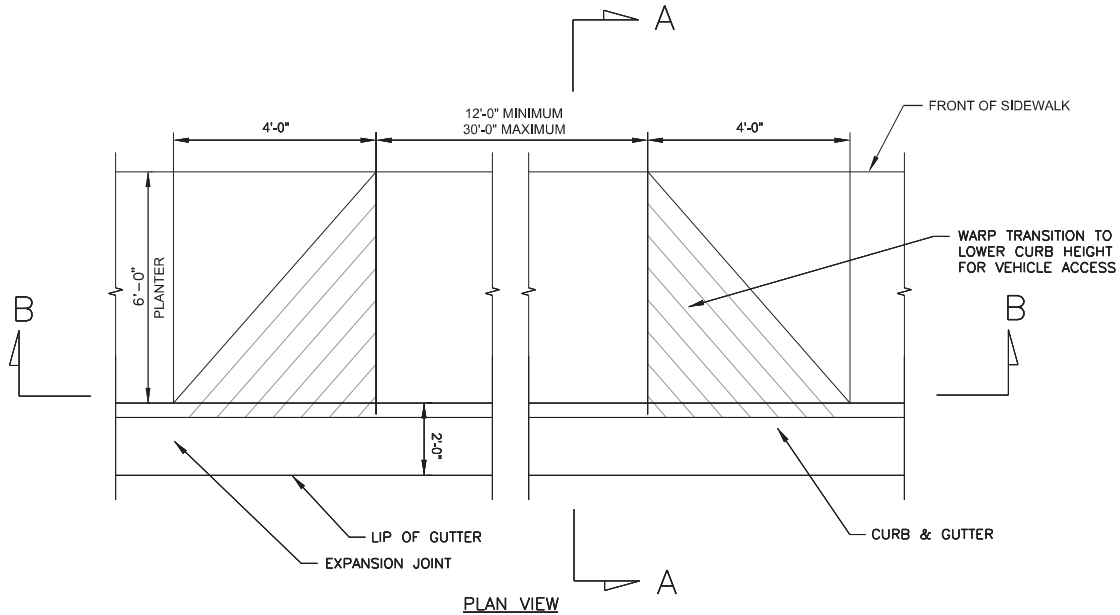
CAD DWG: dws_6-12.dwg
PLOT SCALE: 1:500
DRAWN BY: NEB
DESIGN BY: NEB
CHECKED BY: MLC
ADOPTED DATE: 20 JUN 12



SECTION A-A



SECTION B-B



PLAN VIEW

DRIVEWAY APPROACH WITH PARK STRIP
NOT TO SCALE



STATEMENT OF USE

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REVISION

NO.	DESCRIPTION	BY	APR.	DATE
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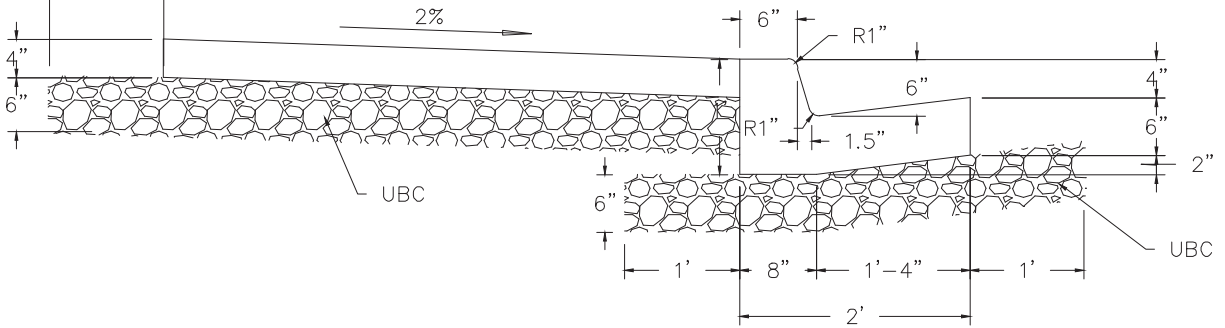


DRIVEWAY APPROACH WITH PARK STRIP

SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	CG3
CAD DWG.dwg_6-12.dwg	
PLOT SCALE:	1:000
DRAWN BY:	DSF
DESIGN BY:	NEB
CHECKED BY:	MLC
ADOPTED DATE:	20 JUN 12

COMPACT UBC 12"
BEYOND SIDEWALK

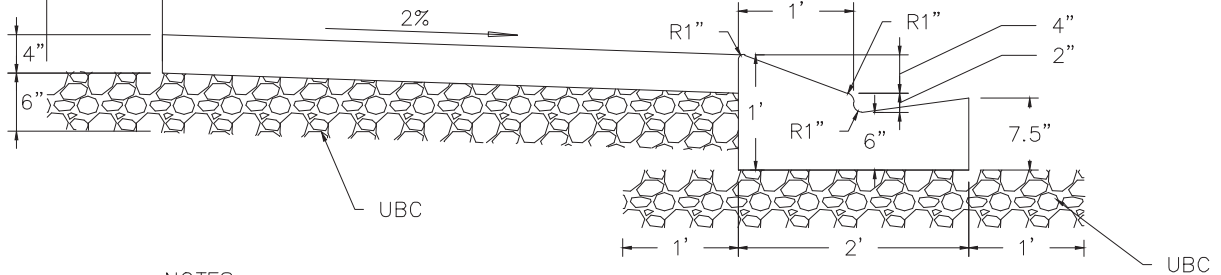


NOTES:

1. PROVIDE A TOOLED JOINT EVERY 10' IN CURB & GUTTER, & EVERY 5' IN SIDEWALK.
2. PROVIDE AN EXPANSION JOINT EVERY 30' IN SIDEWALK.

TYPICAL HIGH BACK CURB AND GUTTER

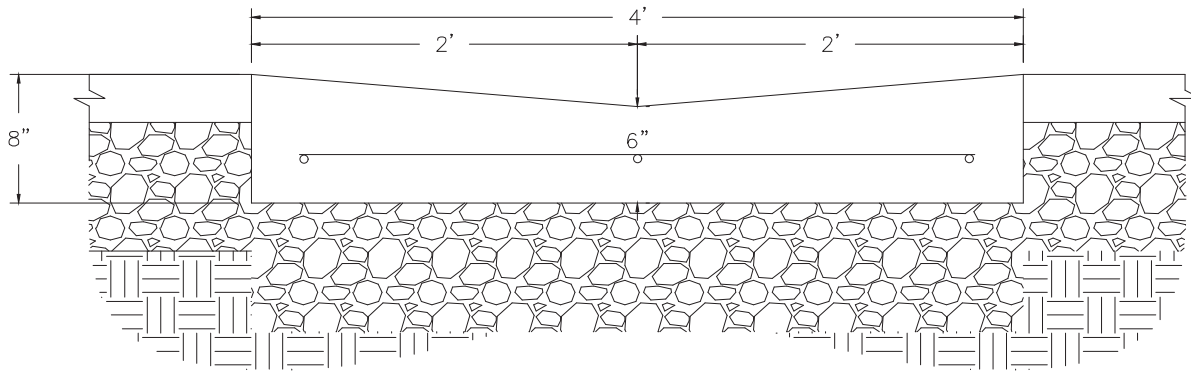
COMPACT UBC 12"
BEYOND SIDEWALK



NOTES:

1. 24" MOUNTABLE CURB IS APPROVED ONLY ON A CASE BY CASE BASIS. (FACTORS FOR APPROVAL INCLUDE SUBDIVISION SIZE, STORM WATER DRAINAGE ISSUES, STREET WIDTH, AND SURROUNDING SUBDIVISIONS)
2. TRANSITIONS TO HIGH BACK CURB SHALL BE ACCOMPLISHED IN A MINIMUM OF 6'. (FOR CURB INLET BOXES, ETC.)

MODIFIED CURB AND GUTTER



CROSS GUTTER

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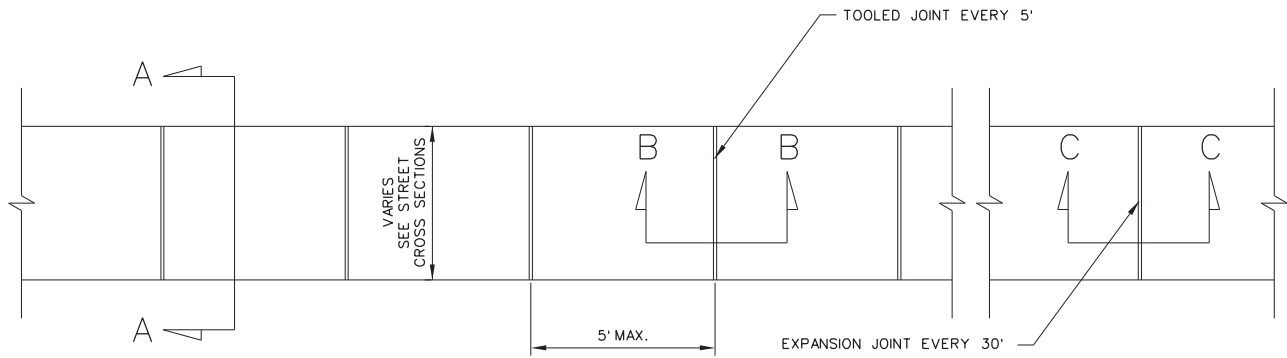
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NO.	BY	APR	DATE



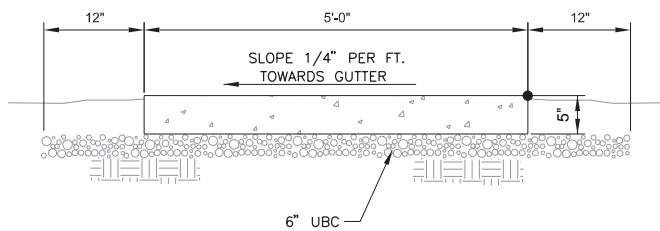
**CURB & GUTTER
AND CROSS GUTTER DETAILS**
SANTAQUIN CITY
275 WEST MAIN STREET

CG4

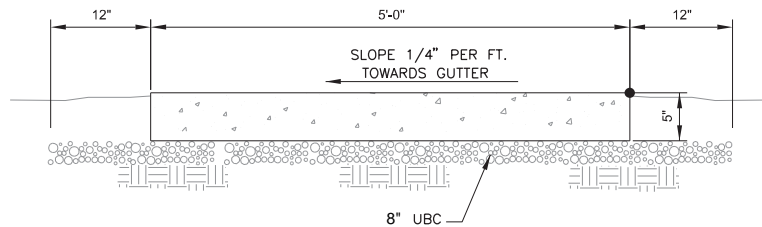
ADOPTED DATE:
19 - OCT - 16



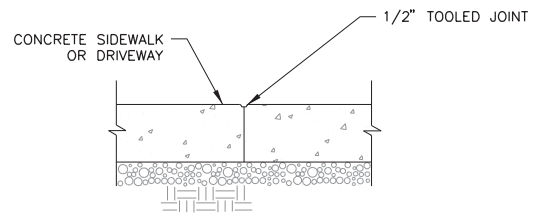
PLAN VIEW



RESIDENTIAL SIDEWALK SECTION A-A

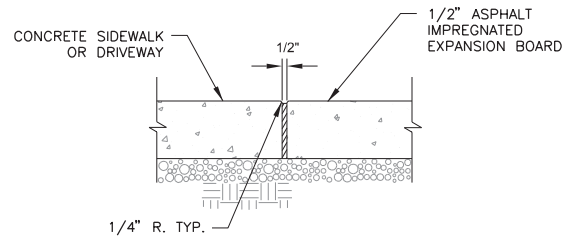


COMMERCIAL SIDEWALK SECTION A-A



SECTION B-B

NOTE:
TOOLED JOINT IS TYPICAL FOR CURB, GUTTER, SIDEWALK, AND BLOCKOUTS



SECTION C-C

NOTE:
EXPANSION JOINT IS TYPICAL FOR CURB, GUTTER, SIDEWALK, AND BLOCKOUTS

- NOTES:
1. PROVIDE A TOOLED JOINT EVERY 10'-0" IN CURB & GUTTER, & EVERY 5'-0" IN SIDEWALK.
 2. PROVIDE AN EXPANSION JOINT EVERY 30'-0" IN SIDEWALK.
 3. PLACE UBC UNDER CONCRETE SIDEWALK, AND 12" BEYOND FRONT AND BACK OF WALK

SIDEWALK DETAILS

NOT TO SCALE



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REVISION

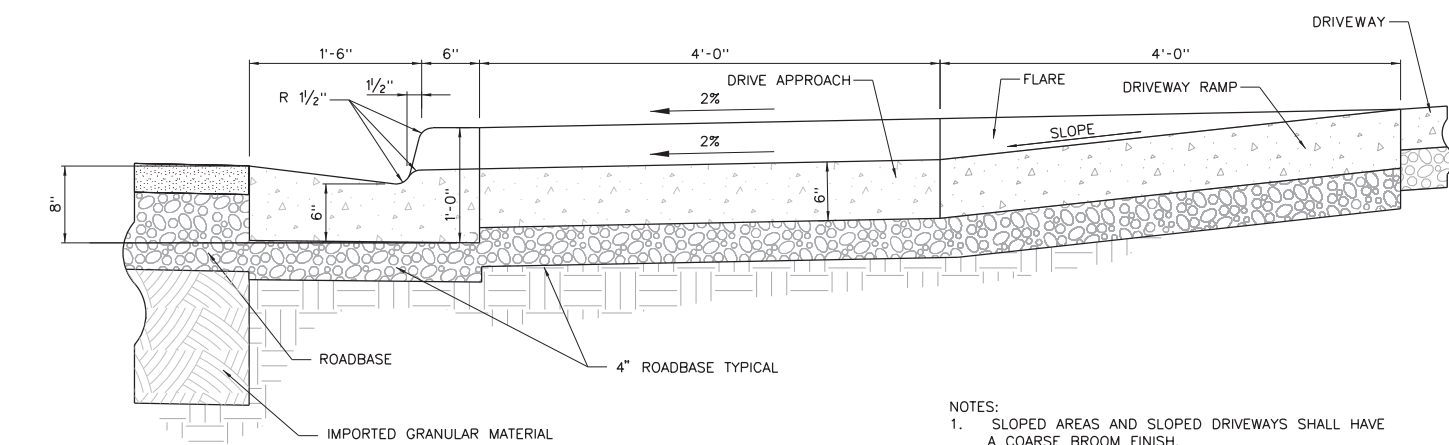
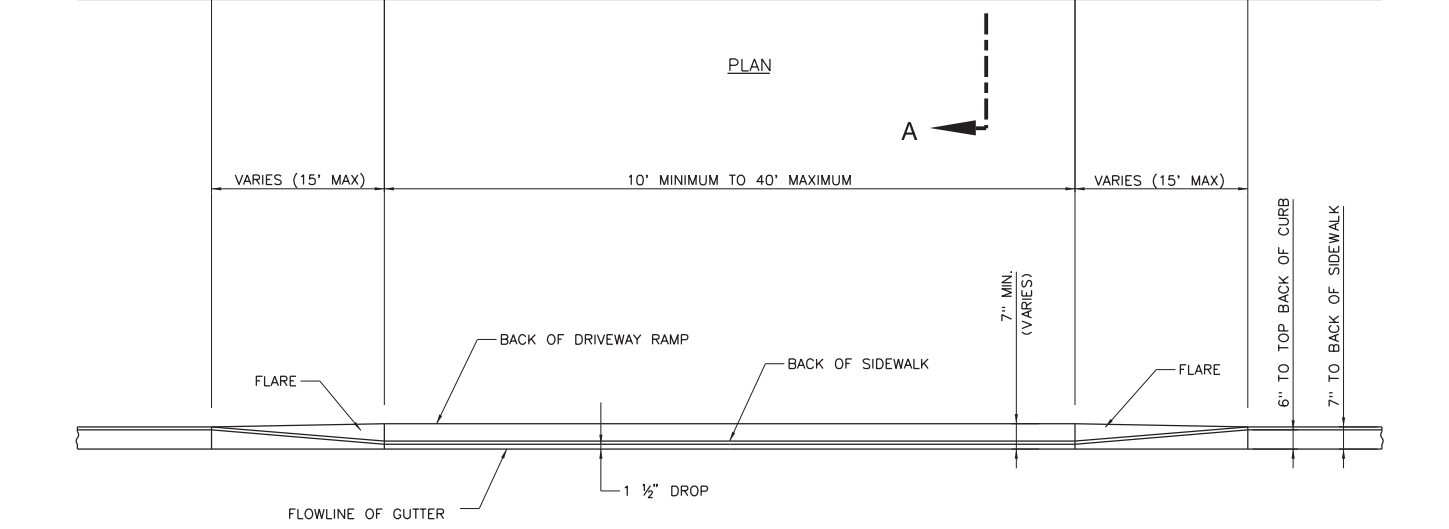
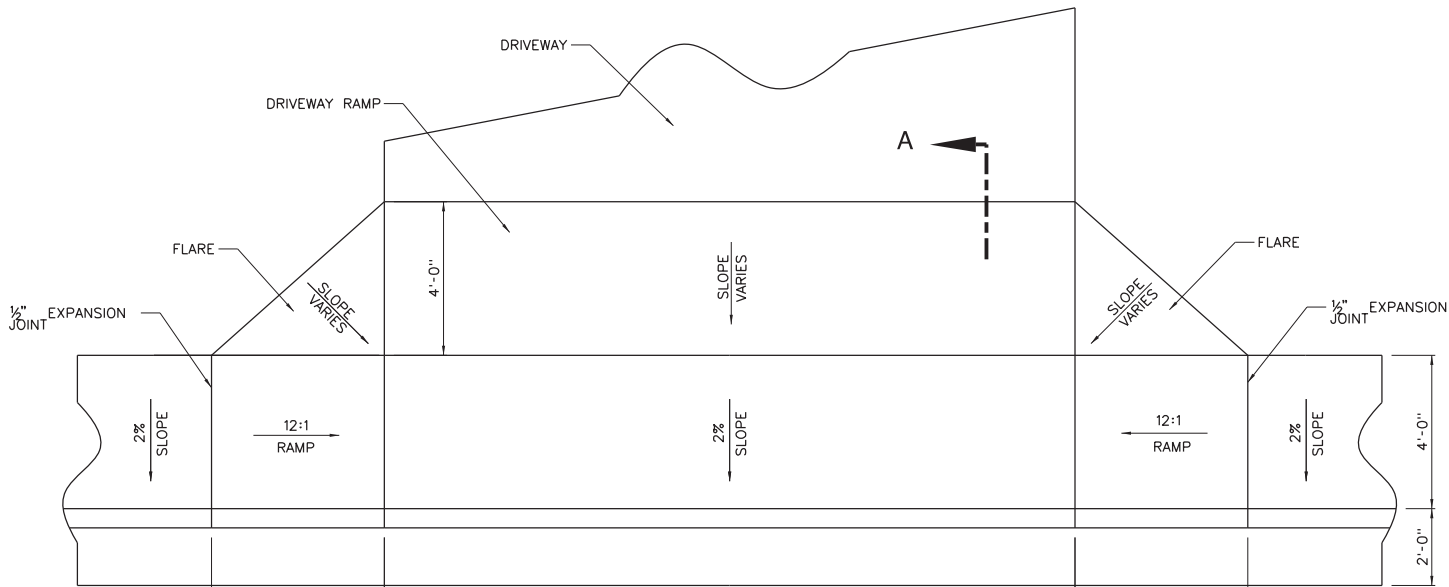
NO.	DESCRIPTION	BY	APR.	DATE
1	CHANGED EXPANSION JOINT SPACING TO 30 FEET	NEB	MLC	31/2011



SIDEWALK DETAILS

SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	CG5
CAD DWG.dwg_6-12.dwg	
PLOT SCALE:	1:000
DRAWN BY:	BTW
DESIGN BY:	NEB
CHECKED BY:	MLC
ADOPTED DATE:	20 JUN 12



SECTION A-A
N.T.S.

- NOTES:
1. SLOPED AREAS AND SLOPED DRIVEWAYS SHALL HAVE A COARSE BROOM FINISH.
 2. THE DRIVEWAY, AT A POINT 4' BEHIND THE SIDEWALK, SHALL BE AT LEAST 7" HIGHER THAN THE FLOWLINE OF THE GUTTER.
 3. RAMPS AND FLARES ARE TO BE 6" THICK CONCRETE.



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REVISION			
NO.	DESCRIPTION	BY	DATE
1	SHEET ADDED TO ADDRESS DRIVE APPROACH W/O PARK STRIP	NEB	MLC 11/20/11

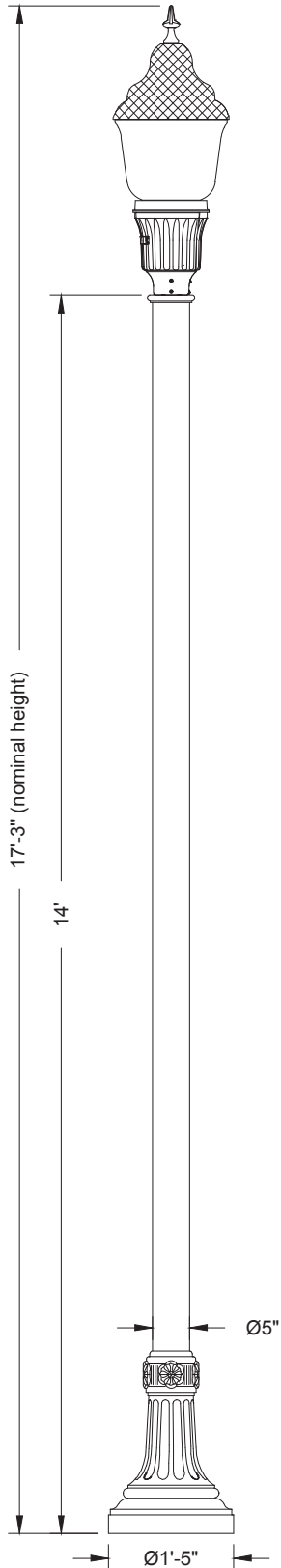


DRIVEWAY APPROACH
W/O PARK STRIP

SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	CG6
CAD DWG.dwg_6-12.dwg	
PLOT SCALE:	1:000
DRAWN BY:	BTW
DESIGN BY:	NEB
CHECKED BY:	MLC
ADOPTED DATE:	20 JUN 12

Specifications



POST DESCRIPTION

The lighting post shall be all aluminum, one-piece construction, with a classic tapered and fluted base design. The shaft shall be Ø5" smooth.

MATERIALS

The base shall be heavy wall, cast aluminum produced from certified ASTM 356.1 ingot per ASTM B-179-95a or ASTM B26-95. The straight shafts shall be extruded from aluminum, ASTM 6061 alloy. All hardware shall be tamper resistant stainless steel. Anchor bolts to be completely hot dip galvanized.

CONSTRUCTION

The shaft shall be double welded to the base casting and shipped as one piece for maximum structural integrity. The shaft shall be circumferentially welded inside the base casting at the top of the access door, and externally where the shaft exits the base. All exposed welds below 8' shall be ground smooth. All welding shall be per ANSI/AWS D1.2-90. All welders shall be certified per Section 5 of ANSI/AWS D1.2-90.

DIMENSIONS

The post shall be 14'-0" in height with a 17" diameter base. The shaft diameter shall be 5". At the top of the post, a Ø3" x 3" tall tenon with a transitional donut shall be provided for luminaire mounting.

INSTALLATION

The post shall install with four, stainless steel L-type anchor bolts to be installed on a 12" diameter bolt circle. A door shall be provided in the base for anchorage and wiring access. A grounding screw shall be provided inside the base opposite the door.

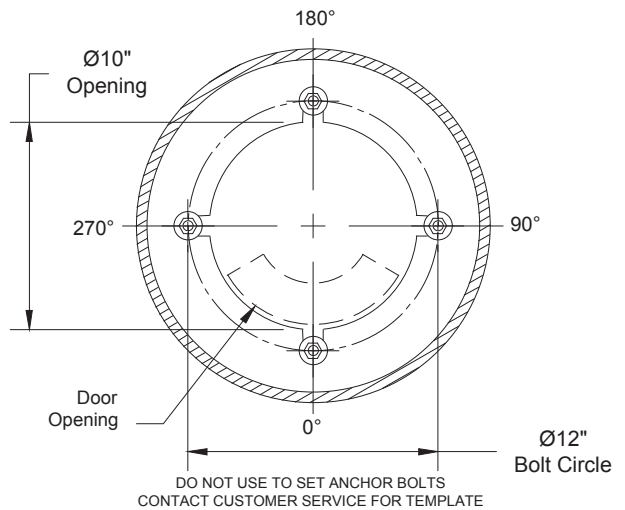
FINISH

The entire assembly shall have a standard Holophane 'black' finish.

LUMINAIRE DESCRIPTION

- Granville Premier II LED
 - 40W 215mA Driver, 4k CCT
 - Auto-Sensing 120-277V
 - Symmetric Type V, No Trim, Spike Finial, Full Cover
 - NEMA Twistlock Photocontrol Receptacle
 - DTL Twistlock Photocontrol For Solid-State Lighting 120-277V
 - 25ft Prewired Leads
- For complete specifications see LUM_GPD.

Anchorage Detail



Catalog #'s:

GPD404KASMB5NSBFCVRBHPCL25 - NYA14S5J17P07ABGBK

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REVISION

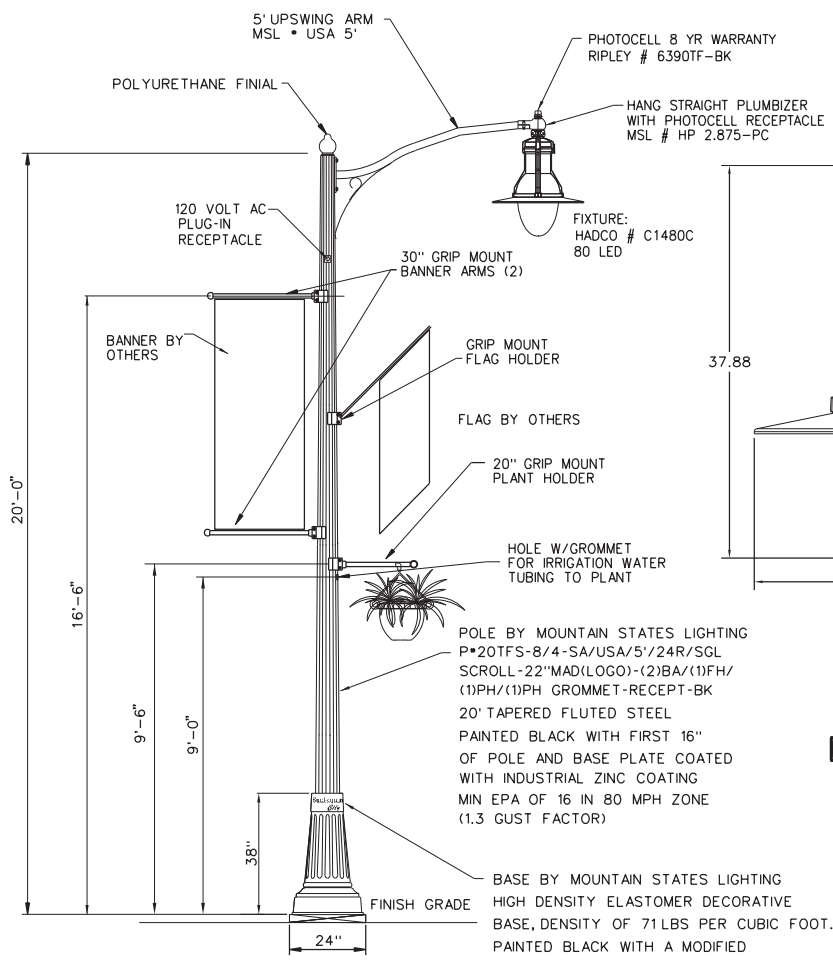
NO.	BY	APR	DATE



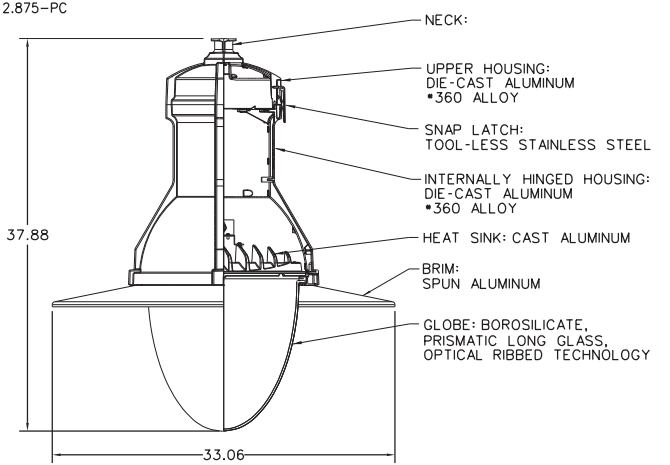
**LOCAL AND COLLECTOR STREET
LIGHTING DETAILS**
SANTAQUIN CITY
275 WEST MAIN STREET

L1

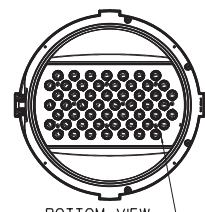
ADOPTED DATE:
19 - OCT - 16



ALL POLES PROVIDED TO THE CITY TO HAVE PROVISIONS FOR ACCESSORIES AS SHOWN. ACCESSORIES ORDERED SEPERATELY.

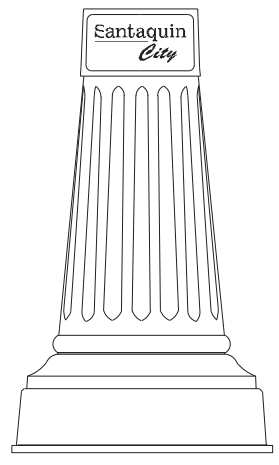
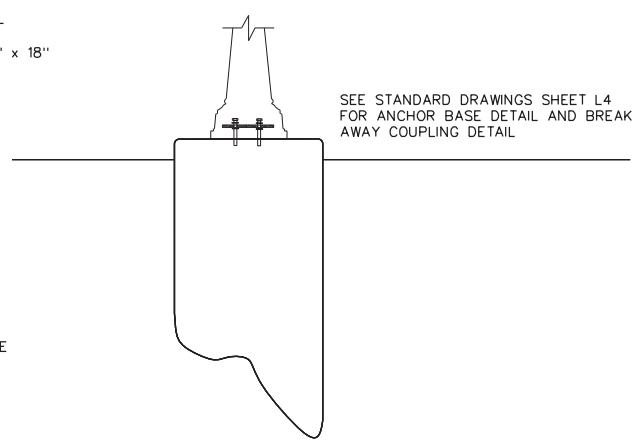
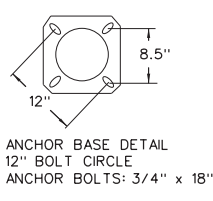


LUMINAIRE DETAIL



- PHILLIPS LEDgine SPECIFICATIONS:
- 80, 4000K PHILLIP LUMILEDS REBEL LEDs 70 COLOR RENDERING INDEX (CRI) NOMINAL W/INJECTION MOLDED ACRYLIC OPTICAL PLATES
 - TYPE III LIGHT DISTRIBUTION
 - PHILLIPS ADVANCED Titanium LED DRIVER, CLASS 1, OUTDOOR RATED (IP66).
 - DRIVER OPERATES 120-277 VAC, 50-60 Hz, 530mA, <3kV SUGER SUPPRESSION BUILT IN, >90 POWER FACTOR, <20 % THD.
 - OPERATING TEMPERATURE RANGE IS -40° C to +40° C.
 - L70 @ 80,000 hrs. @ 25C (DRIVER 100,000 hrs.).
 - MANUFACTURED TO ISO 9001:2000 STANDARDS, RoHS, VIBRATION TESTED TO ANSIC136.31 FOR BRIDGE APPLICATIONS, ETL/CETL LISTED TO UL 1598 & UL8750 STANDARDS.

LED'S: 80 INDIVIDUAL, INJECTION MOLDED CLEAR LENS PRISMS



NOTES:

LIGHTS ARE TO BE PLACED ON MAIN STREET AT INTERSECTIONS AND BETWEEN INTERSECTIONS AS NEEDED SO SPACING DOES NOT EXCEED 200 FEET.

WIRE IS #6 RHH WITH BARE GROUND

FOR MORE INFORMATION ON CONNECTION TO THE POWER SOURCE SEE ROCKY MOUNTAIN POWER STREET LIGHT POINT-OF-CONNECTION DIAGRAM.

ALL STREET LIGHTS SHALL BE BONDED TO GROUND ROD IN JUNCTION BOX AND UFER GROUND IN CONCRETE BASE.

SEE SHEET L4 FOR IRRIGATION TO HANGING PLANTER.

MAIN STREET LIGHTING DETAILS

NOT TO SCALE



PART# 20TFS-8/4-SA/USA/5'/24R/SGL SCROLL-22" MAD(LOCO)-(2)BA/(1)FH/(1)PH/(1)PH GROMMET-RECEPT-BK

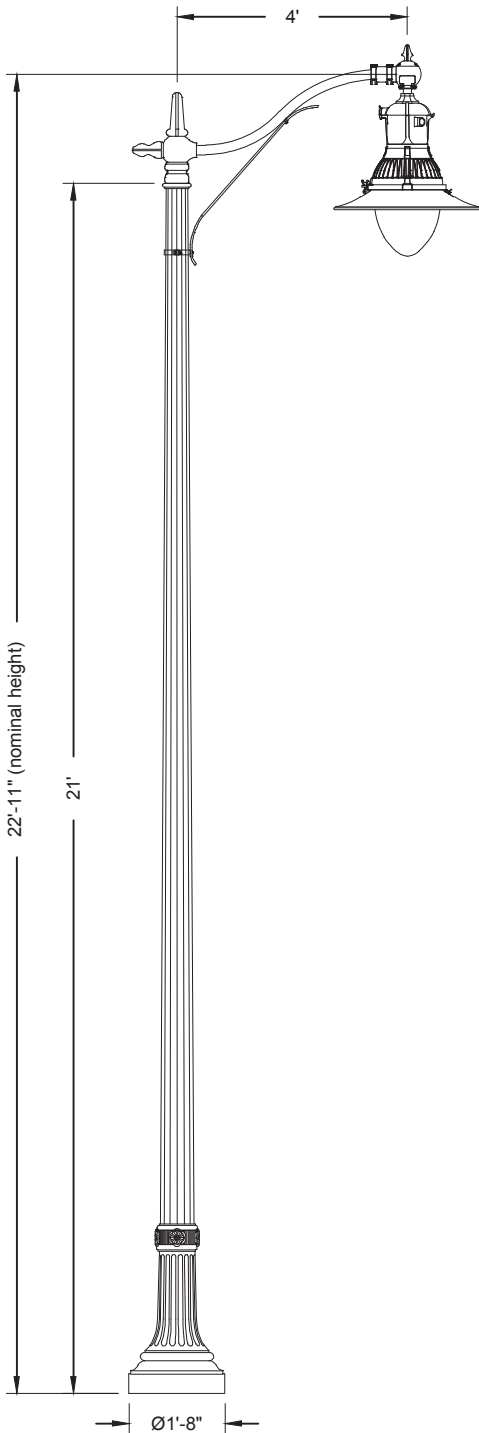
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REVISION			
NO.	DESCRIPTION	BY	DATE
1	SHEET CHANGED TO MAIN STREET DETAIL (FORMERLY L3)	NEB	M.C. 11/2011
2	LINE WORK & NOTE CHANGES AS PER SCSO RECOMMENDATIONS	EEA	NEB 05/2012
3	REVISIONS AND BREAK AWAY DETAILS MOVED TO SHEET L4	EEA	NEB 05/2012
4	UPGRADE LIGHTING TO LED MODULE LUMINAIRE, UP DATE NOTES	EEA	NEB 05/2012



MAIN STREET LIGHTING DETAILS

SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	L2
CAD DWG.dwg_6-12.dgn	
PLOT SCALE:	1:000
DRAWN BY:	BTW
DESIGN BY:	NEB
CHECKED BY:	M.C.
ADOPTED DATE:	20 JUN 12



Specifications

POST DESCRIPTION

The lighting post shall be cast iron and steel construction with a tapered fluted cast iron base and 16 flute tapered steel shaft. The post shall be provided with a single 48" BHC series arm.

MATERIALS

The base material shall be heavy-wall cast iron formed true to pattern with complete detail. The shaft shall be steel. Banner arms shall be all aluminum. All hardware shall be tamper resistant, stainless steel. Anchor bolts shall be hot-dip galvanized steel.

DIMENSIONS

The post shall be 21'-0" in height with a $\varnothing 20"$ base. Shaft shall taper from $\varnothing 7"$ to $\varnothing 4\frac{1}{2}"$. The BHC series arms shall have a span of 4'.

INSTALLATION

Post shall use (4) $\frac{3}{4}" \varnothing \times 36"$ hot dip galvanized steel L-type anchor bolts. A door is located in the base to provide anchorage and wiring access.

FINISH

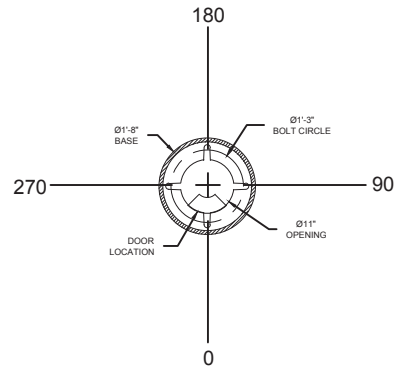
The post assembly shall have a standard Holophane black finish.

LUMINAIRE DESCRIPTION

- Memphis Teardrop LED
- 110W System, 4K CCT
- Auto-Sensing 120-277V
- Teardrop Asymmetric Type IV Optics
- 30Inch Shallow Skirt For Chutoff
- DTL Twistlock Photocontrol For Solid-State Lighting 120-277V
- NEMA Twistlock Photocontrol Receptacle

For complete specifications see LUM_MPL.

ANCHORAGE DETAIL



DO NOT USE TO SET ANCHOR BOLTS
CONTACT CUSTOMER SERVICE FOR TEMPLATE

Catalog #'s:

MPL1104KASSB4SSPCSR - BHDF13200BK - BHC48/1CABKH - NYS21FTB20P08ABGBK

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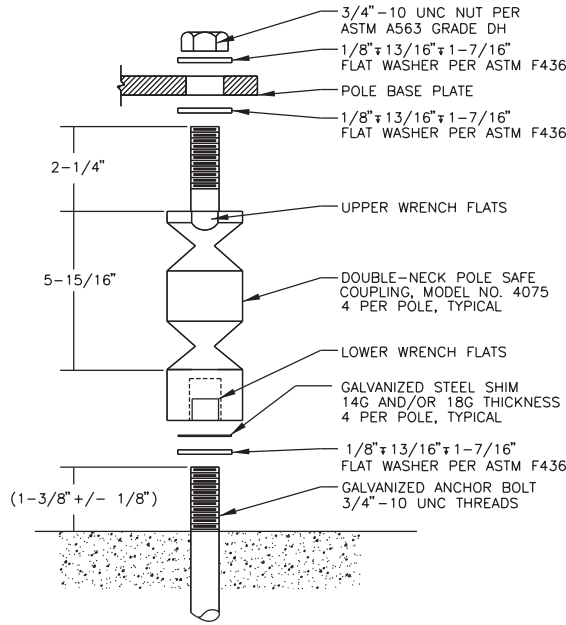
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NO.	BY	APR	DATE



**ARTERIAL STREET
LIGHTING DETAILS**
SANTAQUIN CITY
275 WEST MAIN STREET

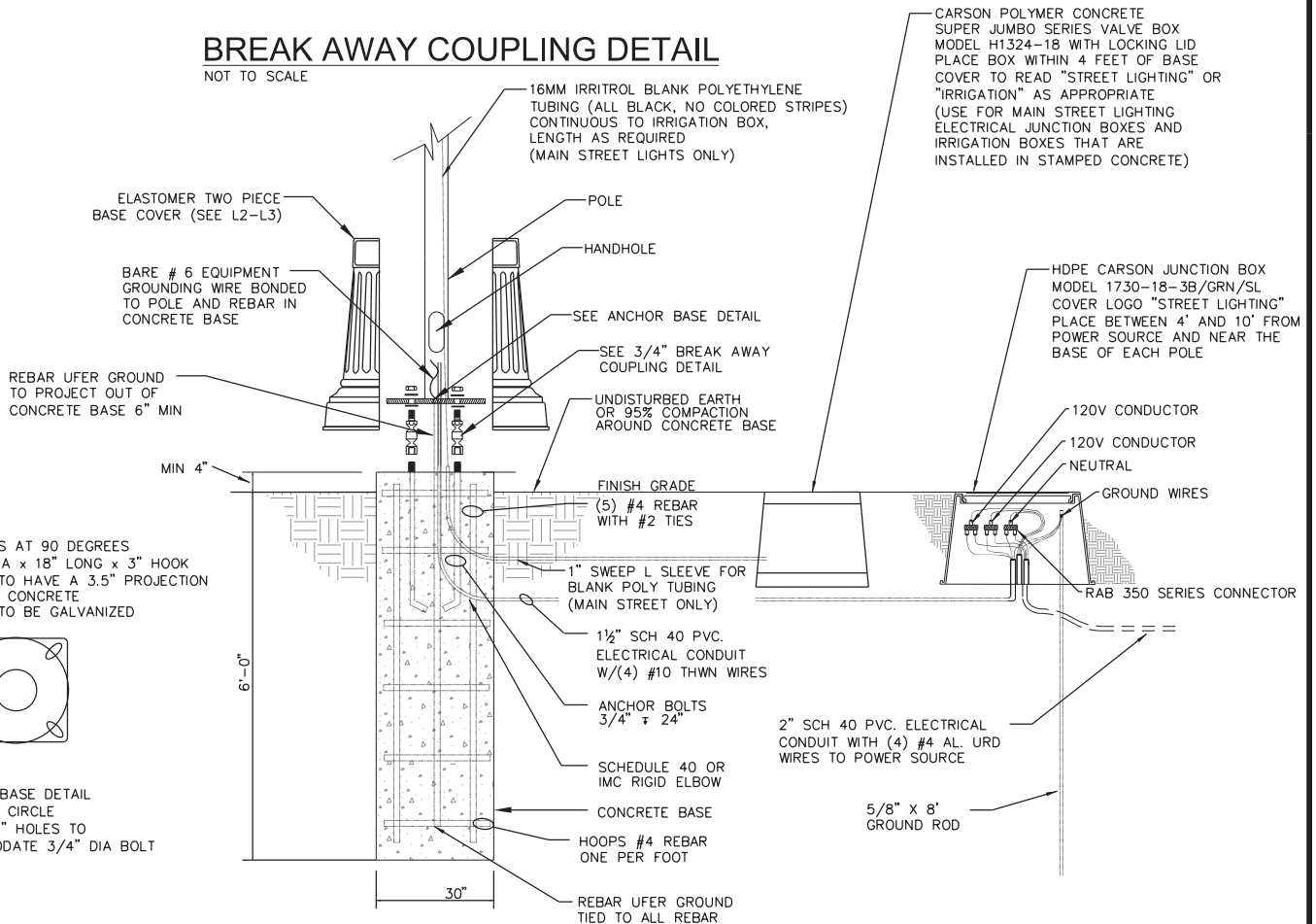
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ADOPTED DATE:
19 - OCT - 16

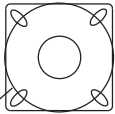


BREAK AWAY COUPLING DETAIL

NOT TO SCALE



4 BOLTS AT 90 DEGREES
 3/4" DIA x 18" LONG x 3" HOOK
 BOLTS TO HAVE A 3.5" PROJECTION
 OUT OF CONCRETE
 BOLTS TO BE GALVANIZED



ANCHOR BASE DETAIL
 12" BOLT CIRCLE
 7/8" x 1" HOLES TO ACCOMMODATE 3/4" DIA BOLT

NOTE:
 IF DEPTH CANNOT BE MET MASS MUST BE EQUIVALENT TO MASS SHOWN

ANCHOR BASE DETAIL

NOT TO SCALE



STATEMENT OF USE

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REVISION

NO.	DESCRIPTION	BY	APR.	DATE
1	SHEET CHANGED FROM ARTERIAL DETAIL TO BASE & BREAK AWAY DETAIL	NEB	MLC	11/20/11
	LINE WORK & NOTE CHANGES AS PER SCSO RECOMMENDATIONS			
	ADDED MAIN STREET LIGHTING IRRIGATION DETAIL			

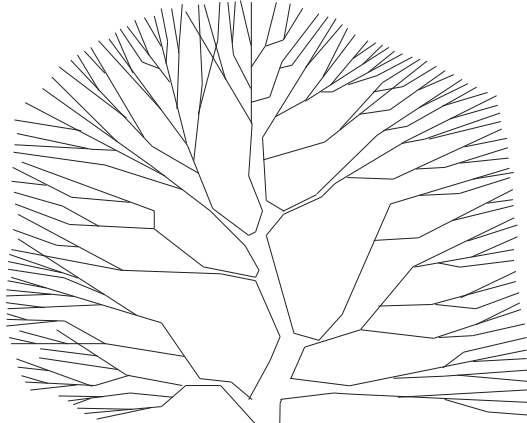


ANCHOR BASE & BREAK AWAY COUPLING

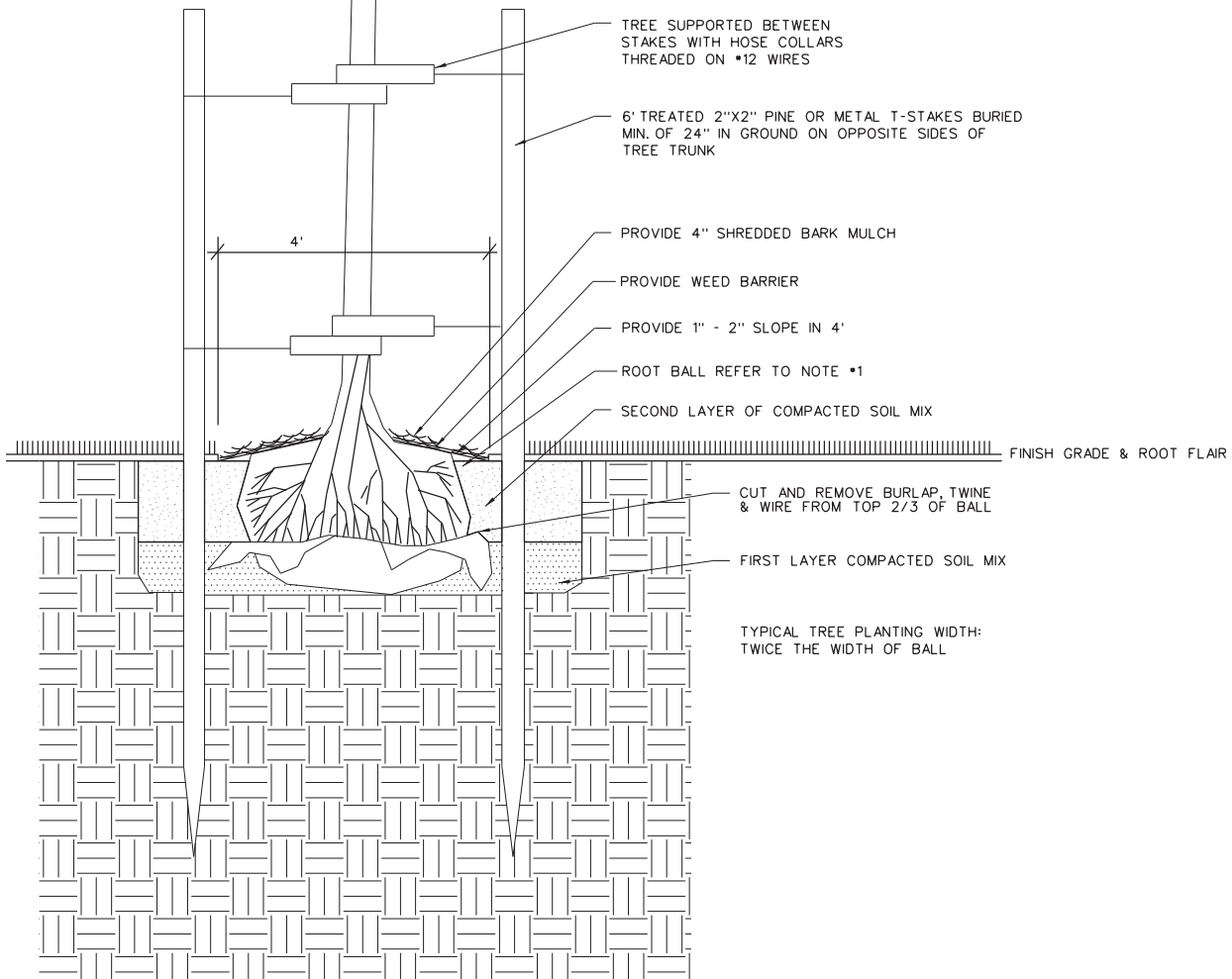
SANTAQUIN CITY
 275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	L4
CAD DWG.dwg_6-12.dwg	
PLOT SCALE:	1:000
DRAWN BY:	BTW
DESIGN BY:	NEB
CHECKED BY:	MLC
ADOPTED DATE:	20 JUN 12

NOTE #1: TREE MUST BE PLANTED SUCH THAT THE TRUNK FLARE IS VISIBLE AT THE TOP OF THE ROOT BALL. TREES WHERE THE TRUNK FLARE IS NOT VISIBLE SHALL BE REJECTED. DO NOT COVER THE TOP OF THE ROOT BALL WITH SOIL
 NOTE #2: REMOVE ALL TREE STAKES AFTER ONE COMPLETE GROWING SEASON OR AS NECESSARY TO PREVENT GIRDLING.



SOIL MIX FOR ALL TREES SHALL BE 30% EXISTING SOIL EXCAVATED FROM PLANT HOLE, 30% IMPORTED LOAMY TOPSOIL, 20% CLEAN COARSE SAND, 20% PEAT MOSS



TREE PLANTING AND STAKING DETAIL

Not to Scale



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REVISION

NO.	DESCRIPTION	BY	APR.	DATE
1	LINE WORK & NOTE CHANGES (BARK FABRIC, STAKING, ETC)	MLC	MLC	11/2/011

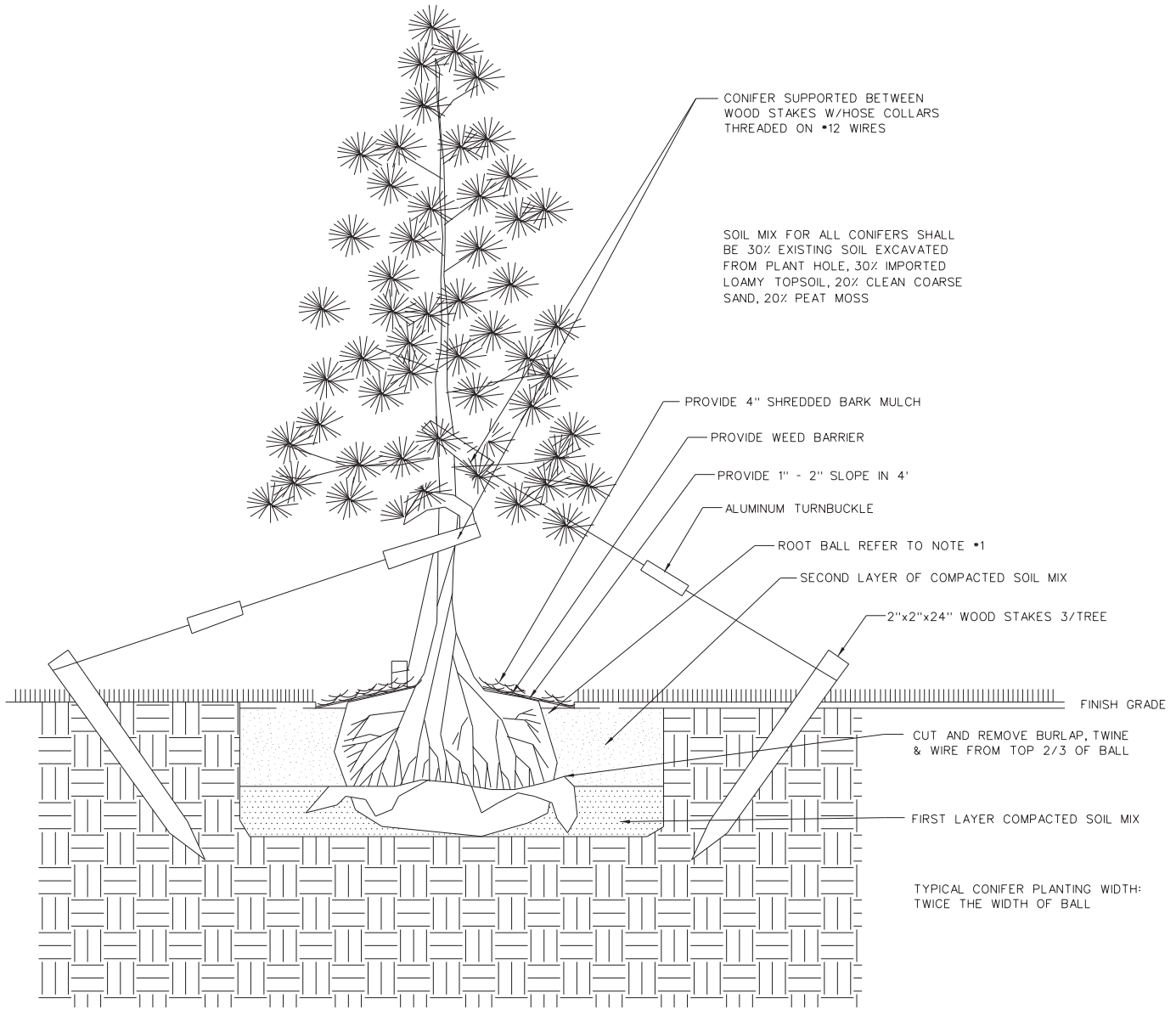


TREE PLANTING & STAKING DETAIL

SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	LA1
CAD DWG.dwg_6-12.dwg	
PLOT SCALE:	1:000
DRAWN BY:	BTW
DESIGN BY:	MLC
CHECKED BY:	MLC
ADOPTED DATE:	20 JUN 12

NOTE #1: CONIFER MUST BE PLANTED SUCH THAT THE TRUNK FLARE IS VISIBLE AT THE TOP OF THE ROOT BALL. CONIFERS WHERE THE TRUNK FLARE IS NOT VISIBLE SHALL BE REJECTED. DO NOT COVER THE TOP OF THE ROOT BALL WITH SOIL
 NOTE #2: REMOVE ALL CONIFER STAKES AFTER ONE COMPLETE GROWING SEASON OR AS NECESSARY TO PREVENT GIRDLING.



CONIFER PLANTING AND STAKING DETAIL

Not to Scale



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REVISION

NO.	DESCRIPTION	BY	APR.	DATE
1	LINE WORK & NOTE CHANGES (BARK FABRIC, STAKING, ETC)	NEH	MLC	11/2/2011

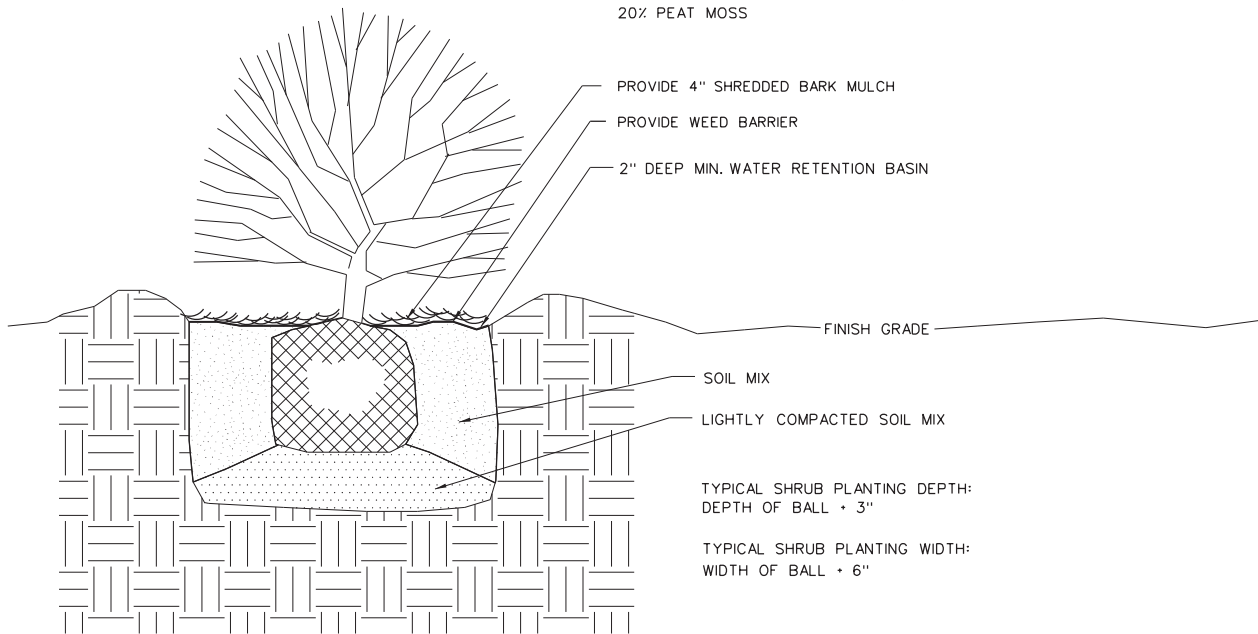


CONIFER PLANTING & STAKING DETAIL

SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	LA2
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PLOT SCALE:	1:000
DRAWN BY:	BTW
DESIGN BY:	NEB
CHECKED BY:	MLC
ADOPTED DATE:	20 JUN 12

SOIL MIX FOR ALL SHRUBS AND
GROUND COVER SHALL BE 30%
EXISTING SOIL EXCAVATED FROM
PLANT HOLE, 30% IMPORTED LOAMY
TOPSOIL, 20% CLEAN COARSE SAND,
20% PEAT MOSS



SHRUB PLANTING DETAIL

Not to Scale



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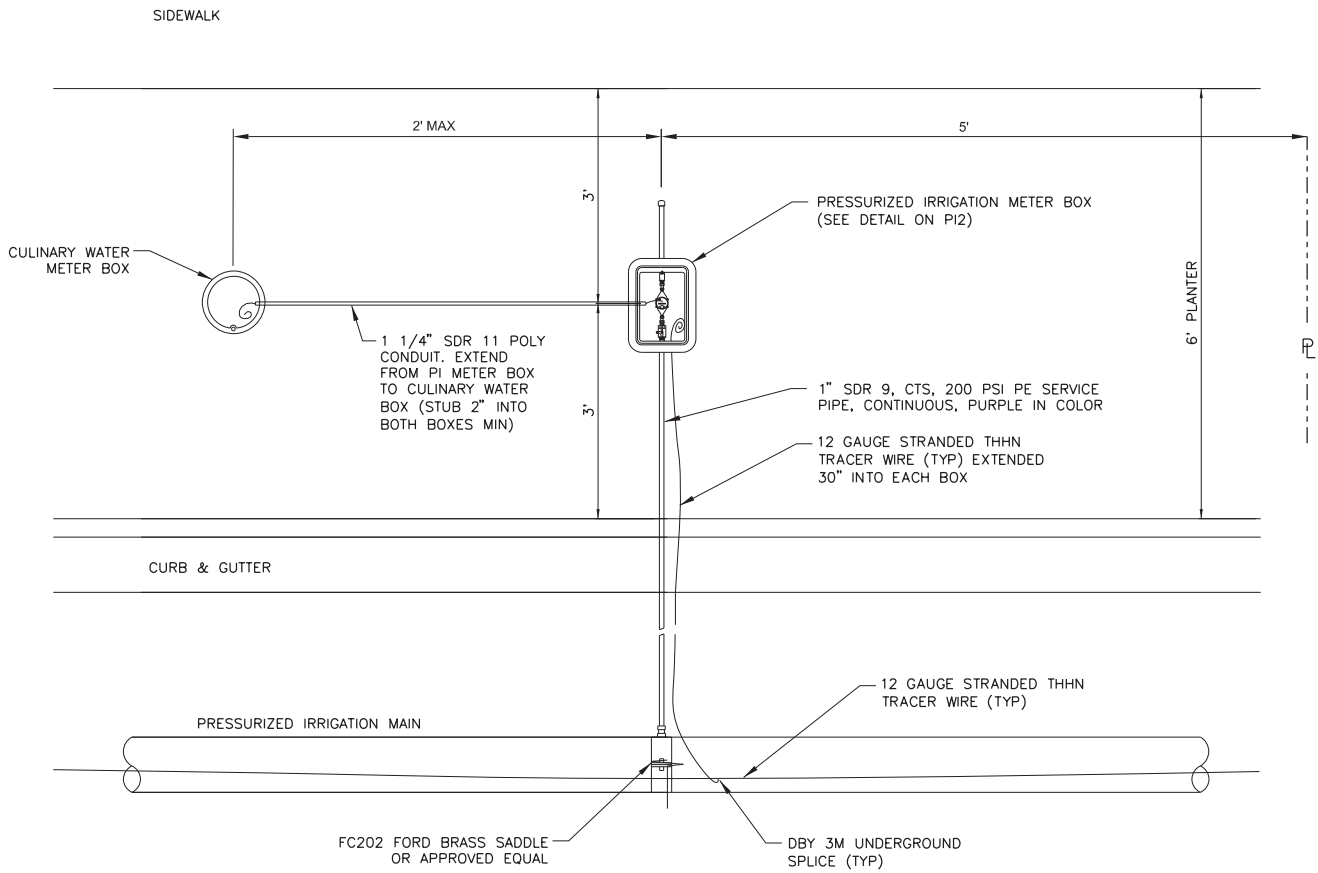
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1	LINE WORK & NOTE CHANGES (BARK, FABRIC, STAKING, ETC.)	NEB	MLC	11/2011



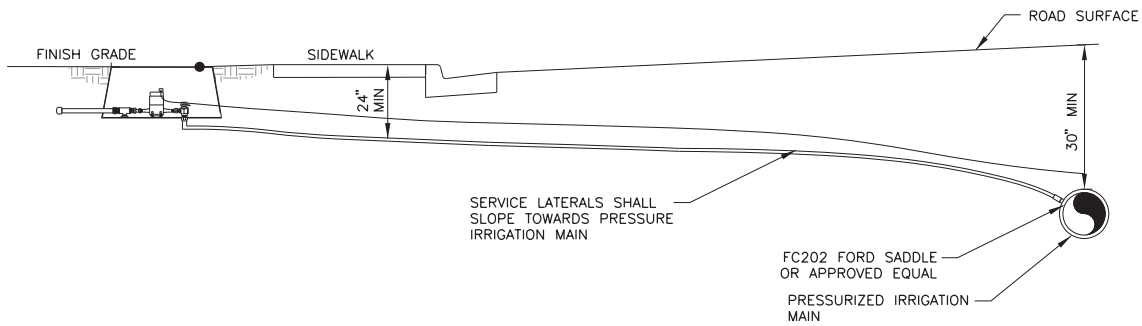
SHRUB PLANTING DETAIL

SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	LA3
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PLOT SCALE:	1:000
DRAWN BY:	BTW
DESIGN BY:	NEB
CHECKED BY:	MLC
ADOPTED DATE:	20 JUN 12



PLAN VIEW



NOTES:

1. STAINLESS STEEL LINER INSERTS WILL BE REQUIRED INSIDE OF TUBING AT COMPRESSION FITTINGS.
2. ALL FITTINGS SHALL BE COMPATIBLE WITH SERVICE SIZE.
3. SEE PI2 FOR PRESSURIZED IRRIGATION SERVICE BOX.
4. SERVICE LATERALS SHALL SLOPE TOWARDS PRESSURIZED IRRIGATION MAIN.
5. SLEEVES SHALL BE REQUIRED WHEN PARK STRIPS ARE PROPOSED FOR THE ROAD SECTION

PRESSURE IRRIGATION SERVICE LATERAL

NOT TO SCALE



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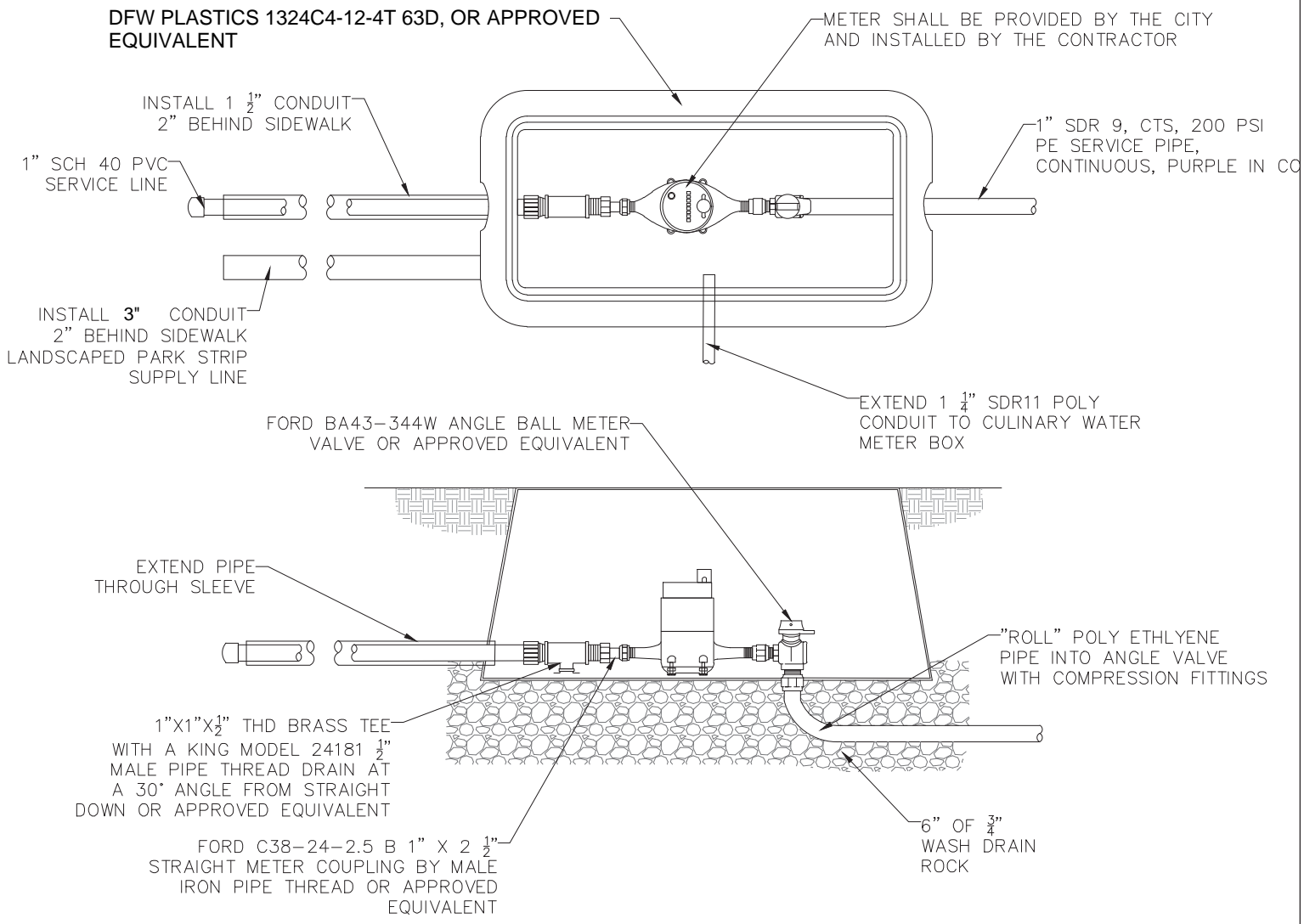
NO.	DESCRIPTION	BY	APR.	DATE
1	CHANGED TO ANGLE VALVE & CHANGED PIPE & FITTINGS ACCORDINGLY	NEB	MLC	11/2011



PRESSURE IRRIGATION SERVICE LATERAL

SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	PI 1
CAD DWG#:	dwgs_6-12.dwg
PLOT SCALE:	1:000
DRAWN BY:	BTW
DESIGN BY:	NEB
CHECKED BY:	MLC
ADOPTED DATE:	20 JUN 12



PRESSURIZED IRRIGATION METER BOX
NOT TO SCALE

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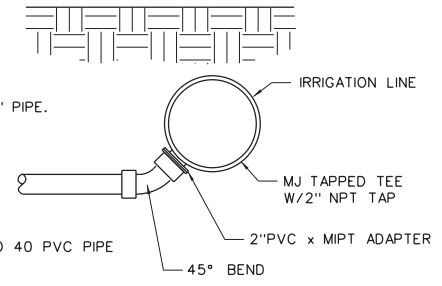
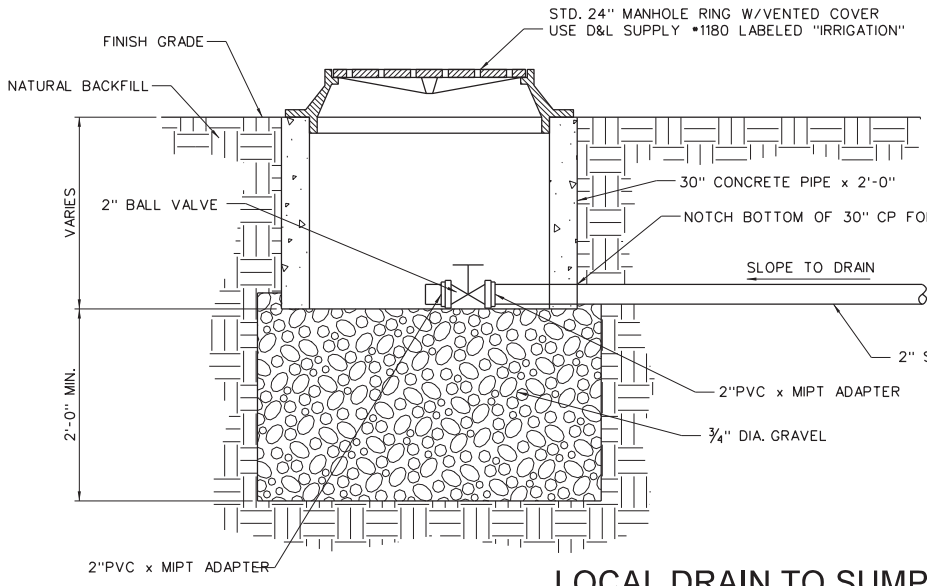
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NO.		BY	DATE



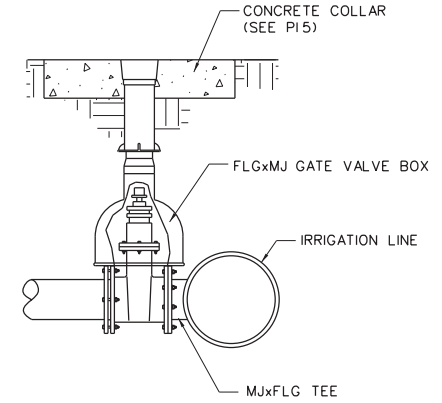
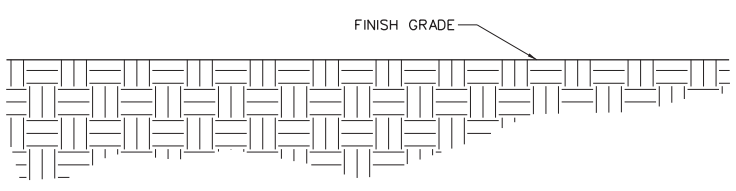
**PRESSURE IRRIGATION
METER BOX**
SANTAQUIN CITY
275 WEST MAIN STREET

PI2

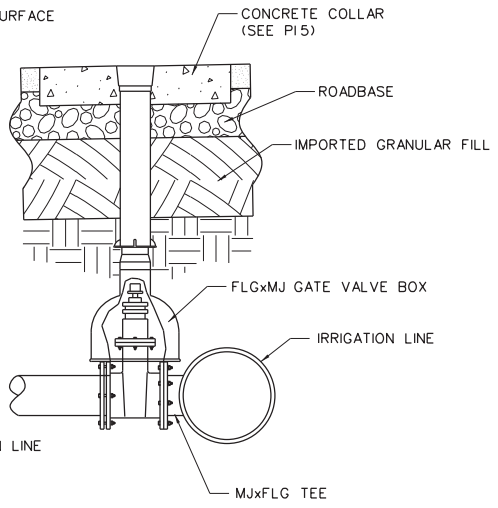
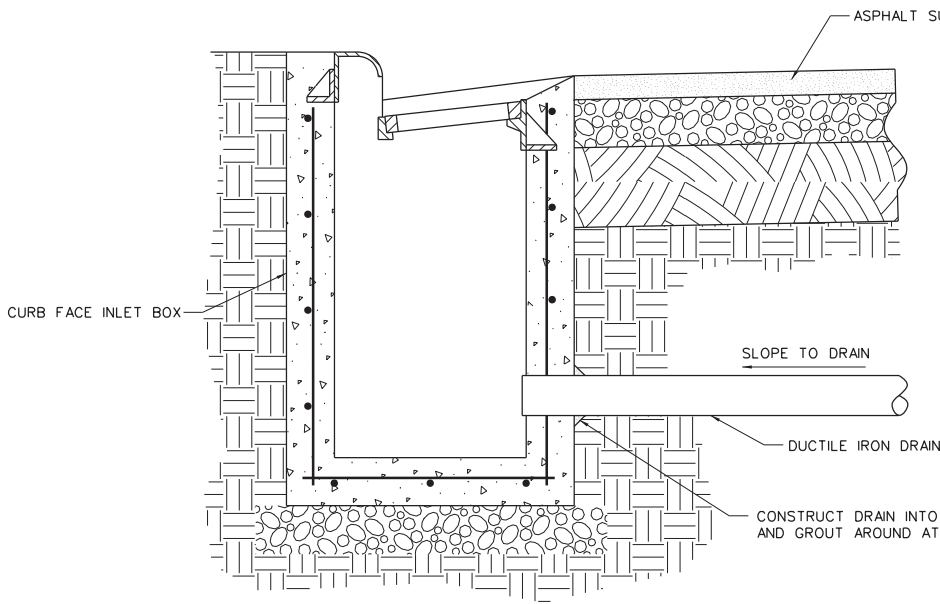
ADOPTED DATE:
19 - OCT - 16



LOCAL DRAIN TO SUMP
NOT TO SCALE



SYSTEM DRAIN TO STORM DRAIN PIPE
NOT TO SCALE



SYSTEM DRAIN TO CURB INLET BOX
NOT TO SCALE



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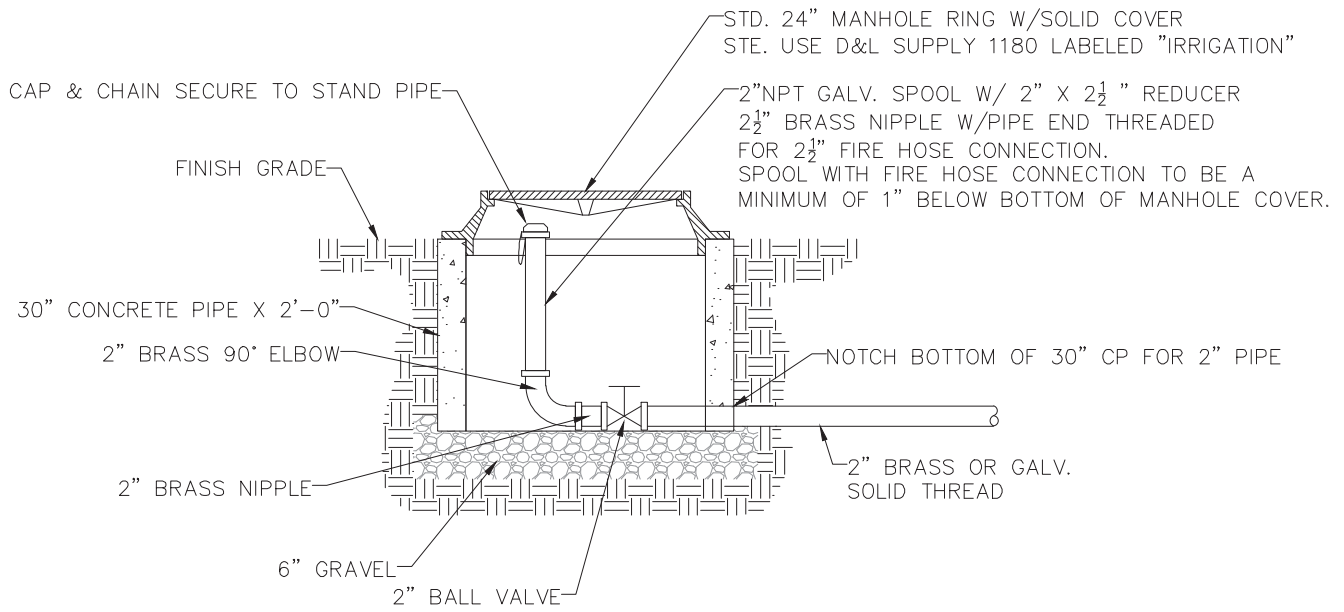
REVISION		NO.	DATE
1	ADDED CONCRETE COLLARS ON VALVE BOXES & WINDOW UPDATES	NEB	M.C. 11/2011



**PRESSURE IRRIGATION
SYSTEM DRAINS**

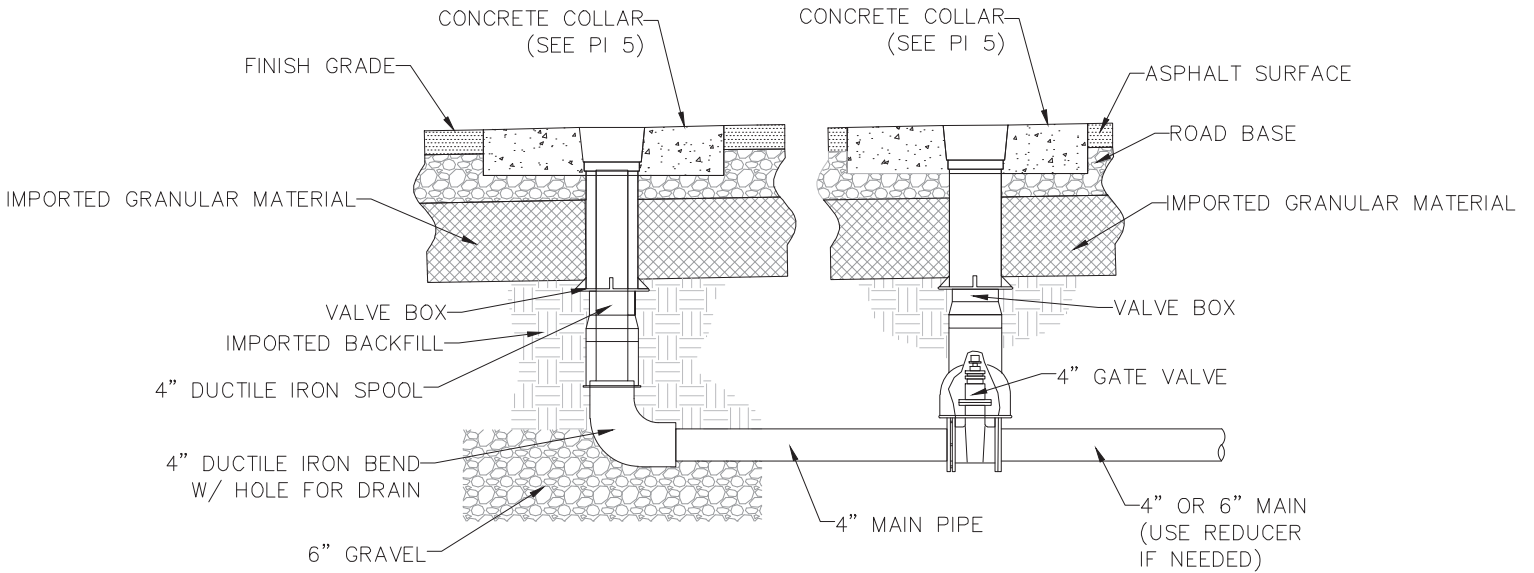
SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	PI 3
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PLOT SCALE:	1:000
DRAWN BY:	BTW
DESIGN BY:	NEB
CHECKED BY:	M.C.
ADOPTED DATE:	20 JUN 12



STANDARD SECTION WHERE NO STREET IMPROVEMENTS EXIST

NOT TO SCALE



STANDARD SECTION WHERE STREET IMPROVEMENTS EXIST

NOT TO SCALE

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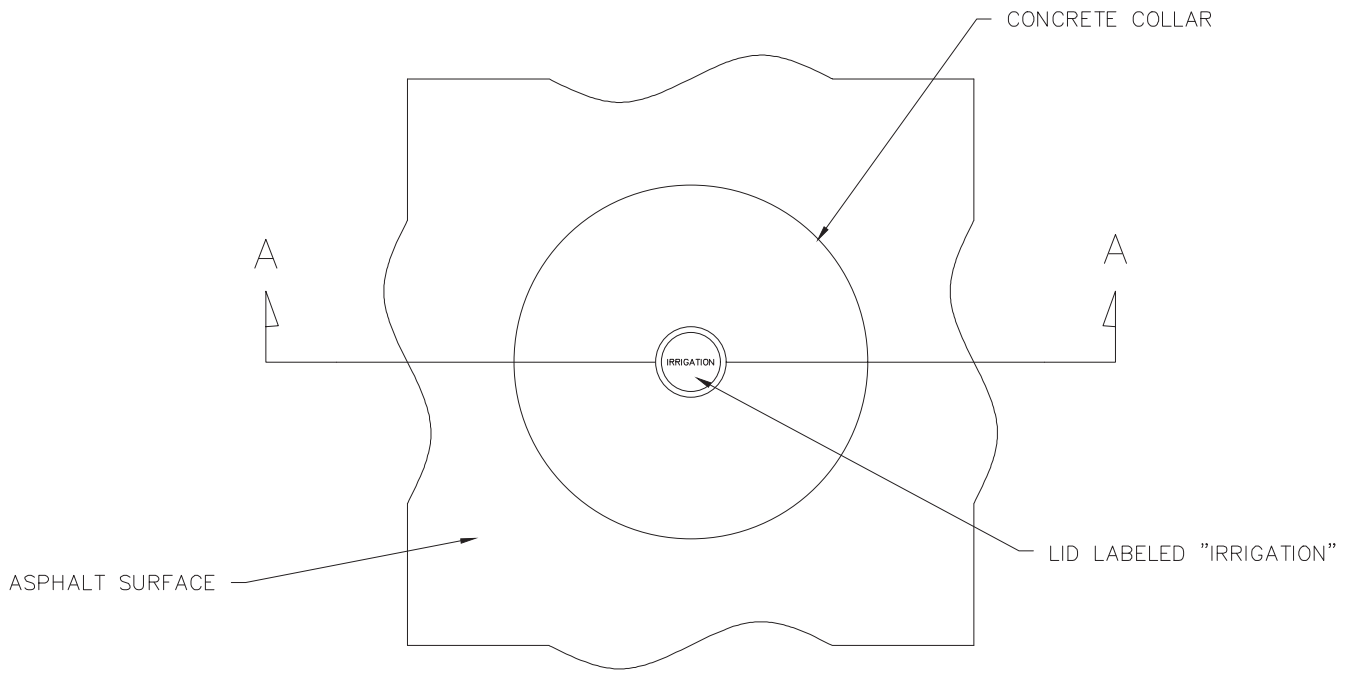
REVISION			
NO.	BY	APR	DATE



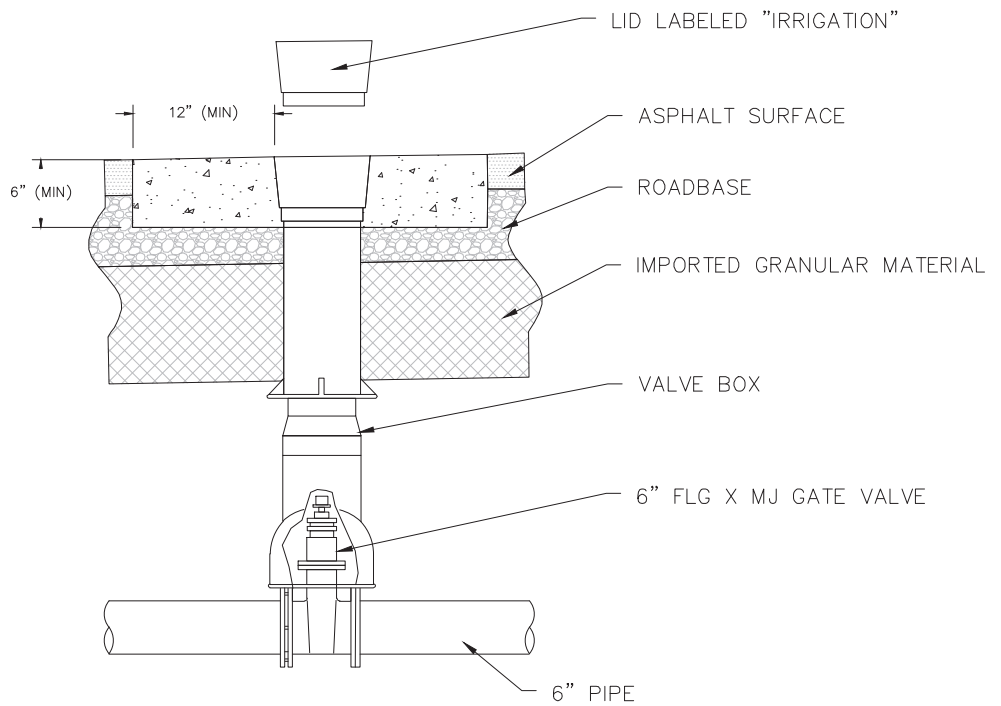
FLUSHING, AIR INLET & REMOVAL FACILITY FOR PRESSURE IRRIGATION
SANTAQUIN CITY
275 WEST MAIN STREET

PI4

ADOPTED DATE:
19 - OCT - 16



PLAN VIEW



SECTION A-A

STATEMENT OF USE:
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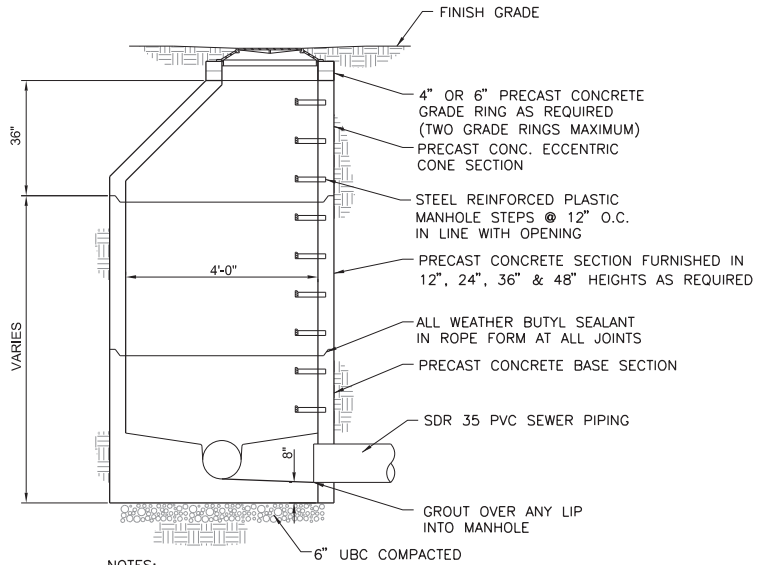
REVISION			
NO.	BY	APR	DATE



**PRESSURE IRRIGATION
 WATER VALVE**
SANTAQUIN CITY
275 WEST MAIN STREET

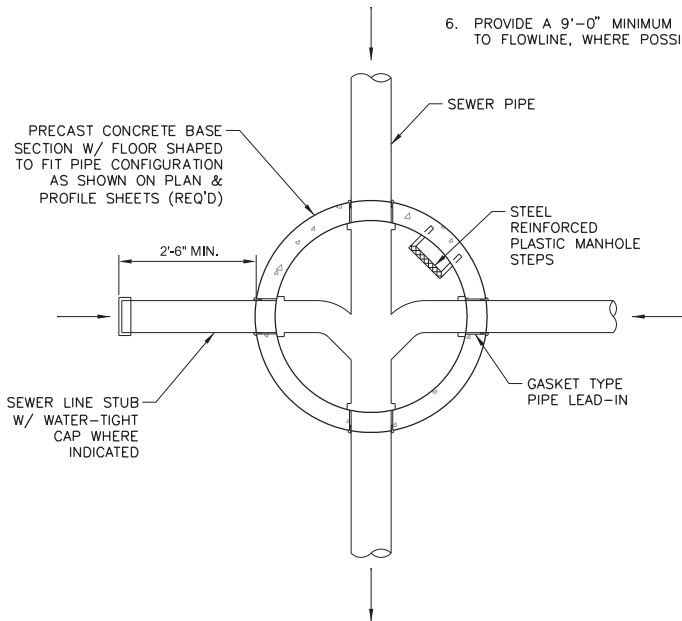
PI5

ADOPTED DATE:
 19 - OCT - 16



NOTES:

1. FLAT LIDS MAY BE USED IN LIEU OF ECCENTRIC CONES WHERE NECESSARY, AND UPON APPROVAL OF THE CITY ENGINEER. FLAT LIDS SHALL BE OF ECCENTRIC DESIGN AND MEET H20 LIVE LOADING.
2. MANHOLES PLACED IN FIELDS SHALL HAVE SOLID LIDS.
3. MANHOLES OUTSIDE OF ROADWAYS SHALL BE PLACED 4 INCHES ABOVE GRADE.
4. PROVIDE A 0.10 FOOT INVERT ELEVATION DROP ACROSS THE MANHOLE (MINIMUM).
5. 60" MANHOLES SHALL BE REQUIRED WHEN THE SUM OF ALL INLET & OUTLET DIAMETERS IS GREATER THAN 24".
6. PROVIDE A 9'-0" MINIMUM DEPTH TO FLOWLINE, WHERE POSSIBLE.



NOTES:

1. VENTED LIDS REQ'D. IN ALL PAVED STREETS.
2. WHERE FIELD CONDITIONS PROHIBIT COMBINATION OF PRECAST CONC. SECTIONS SHOWN, OTHER COMBINATIONS OF PRECAST CONC. SECTIONS MAY BE USED AS PER ENGINEER'S APPROVAL.
3. SEWER MANHOLE BASES SHALL PROVIDE A 0.10 FOOT INVERT ELEVATION DROP ACROSS THE MANHOLE (MINIMUM).
4. NO COLLARS (CONCRETE NOR ASPHALT) ARE TO BE USED ON MANHOLES WITHIN SANTAQUIN CITY ROW. USE D & L SUPPLY MANHOLE ADAPTER RING(S) (RISER(S)) TO SET RING AND COVER TO FINISH GRADE.
5. EXCAVATIONS FOR MANHOLE ADAPTER RING(S) (RISER(S)) SHALL HAVE VERTICAL SIDE WALLS.

TYPICAL SEWER MANHOLE

NOT TO SCALE



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REVISION

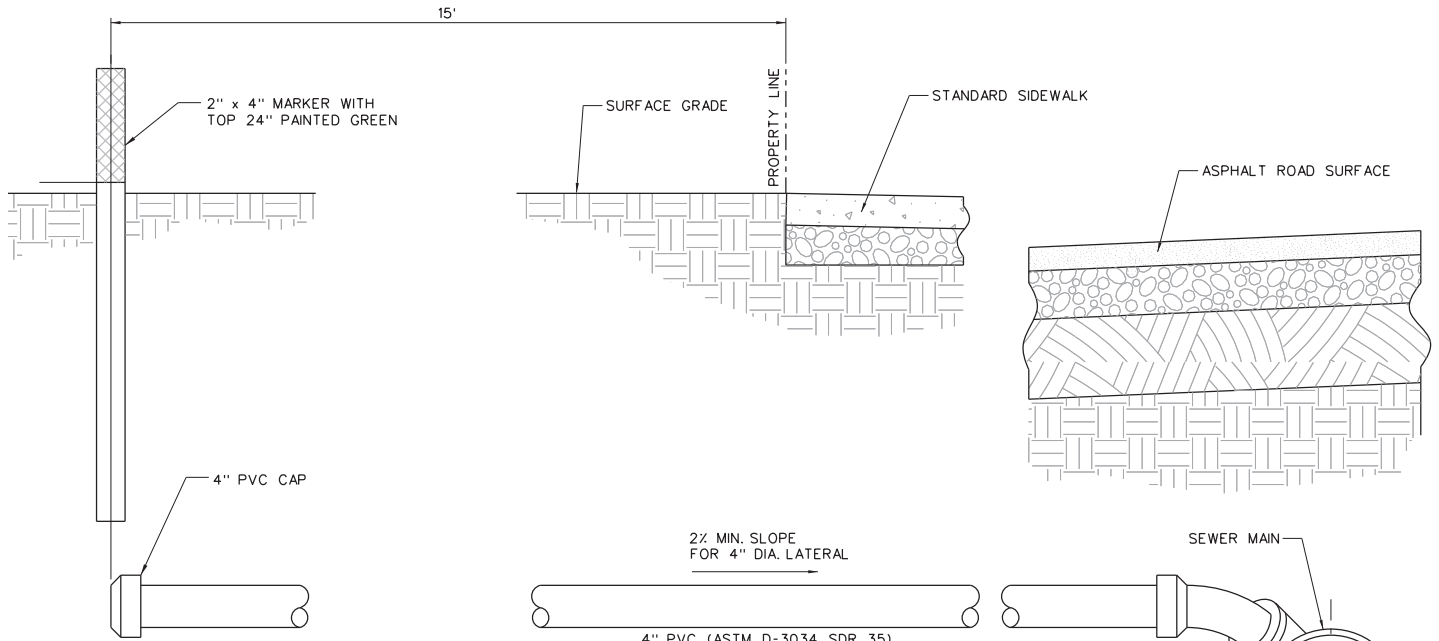
NO.	DESCRIPTION	BY	APR.	DATE
1	ADD "PRECAST CONCRETE MANHOLE SECTION" NOTE	M.C.	M.C.	11/22/08
2	REMOVED CONCRETE COLLAR, ADDED CALL OUT FOR MANHOLE RISERS & MINOR NOTE CHANGES	N.B.	M.C.	11/20/11



TYPICAL SEWER MANHOLE

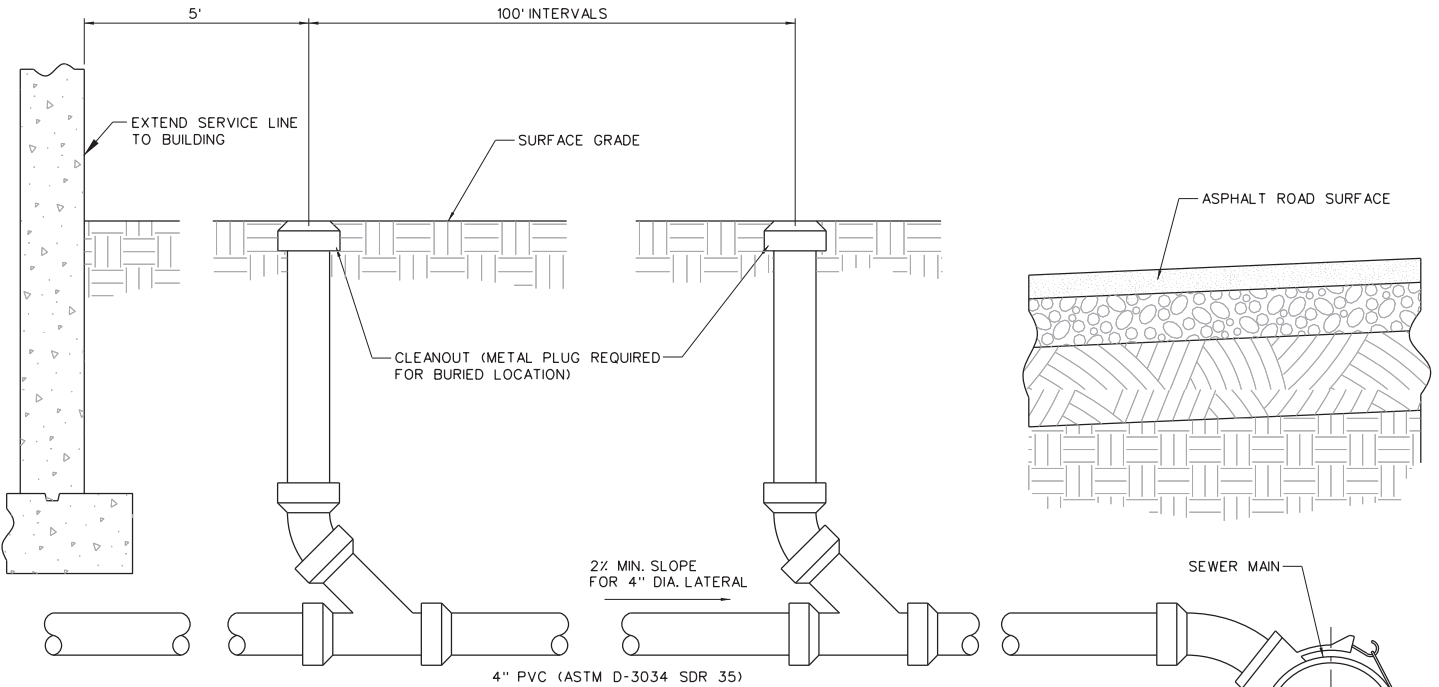
SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	S1
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PLOT SCALE:	1:000
DRAWN BY:	BTW
DESIGN BY:	NEB
CHECKED BY:	M.C.
ADOPTED DATE:	20 JUN 12



STUB FOR NEW CONSTRUCTION
NOT TO SCALE

- NOTES FOR CONNECTING TO NEW SEWER MAIN:
1. CONNECTION TO MAIN SHALL BE BY WYE'S OR TEE'S INSTALLED AS PART OF THE SEWER MAIN CONSTRUCTION.
 2. LOCATION OF STUB TO BE 10' UPHILL OF LOWEST FRONT LOT CORNER.
 3. SHOW CENTERLINE STATION OF THE LATERAL FROM THE NEAREST DOWNSTREAM MANHOLE. USE SAME STATIONING USED FOR SEWER MAIN.



TIE TO EXISTING CONSTRUCTION
NOT TO SCALE

- NOTES FOR CONNECTING TO EXISTING SEWER MAIN:
1. CORE SEWER MAIN WITH MAXIMUM OPENING AROUND LATERAL OF 1".
 2. INSTALL CAST IRON BACKMAN SEWER SADDLE WITH 1" PLUMBERS TAPE STRAP.
 3. GROUT AROUND CONNECTION TO SEWER MAIN.
 4. ENCASE SEWER MAIN AND LATERAL CONNECTION IN CONCRETE.
 5. CONNECTION TO BE MADE IN PRESENCE OF PUBLIC WORKS INSPECTOR.



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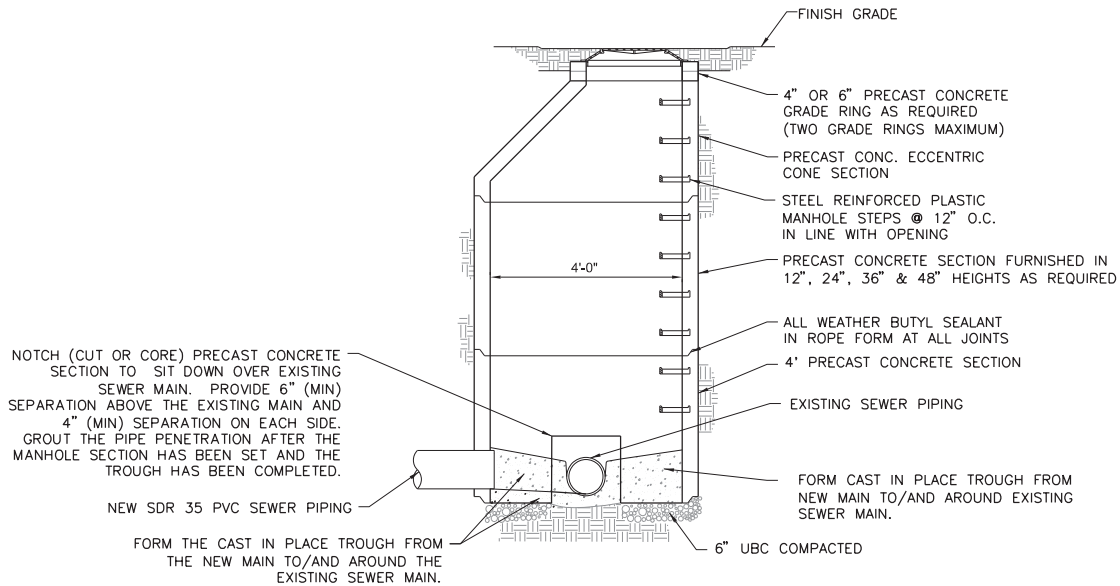
NO.	DESCRIPTION	BY	APR.	DATE



TYPICAL SEWER LATERAL

SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER: **S2**
CAD: DW61d.dwg_6-12.dgn
PLOT SCALE: 1:1000
DRAWN BY: EEA/CJC
DESIGN BY: DCT
CHECKED BY: DCT
ADOPTED DATE: 20 JUN 12



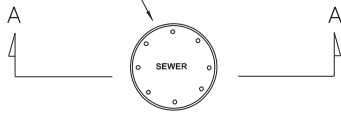
NOTE

1. CAST IN PLACE MANHOLE SECTIONS SHALL ONLY BE USED WHEN A NEW SEWER MAIN IS BEING CONNECTED INTO AN EXISTING SEWER MAIN.
2. PROVIDE .20 FOOT DROP FROM THE NEW SEWER MAIN TO THE EXISTING SEWER MAIN.
3. CONSTRUCT THE CAST IN PLACE TROUGH W/ A SWOOPING RADIUS AS SHOWN ON DRAWING S1.
4. CUT OUT THE TOP HALF OF THE EXISTING PIPE AFTER THE CAST IN PLACE TROUGH HAS HAD AT LEAST 48 HOURS OF CURING TIME.
5. GROUT/GRIND ANY RIDGES OR BELLIES THAT MAY HAVE BEEN CREATED IN THE TROUGH OR AT THE MAIN TIE-IN CONNECTION TO PROVIDE A SMOOTH FLOW LINE.
6. 60" MANHOLES SHALL BE REQUIRED WHEN THE SUM OF ALL INLET & OUTLET DIAMETERS IS GREATER THAN 24".

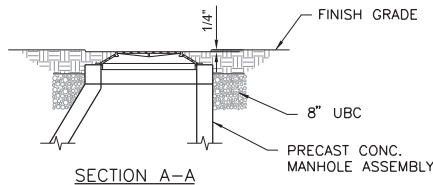
CAST IN PLACE SEWER MANHOLE

NOT TO SCALE

D&L SUPPLY #1180 OR EQUIVALENT MANHOLE FRAME AND LID LABELED "SEWER"



PLAN VIEW



SECTION A-A

NOTE:

1. EXCAVATIONS FOR MANHOLE ADAPTER RING(S) (RISER(S)) SHALL HAVE VERTICAL SIDE WALLS.
2. FINISH RING AND COVER 1/4" BELOW THE FINISH GRADE OF THE ROADWAY.

MANHOLE RING & COVER

NOT TO SCALE



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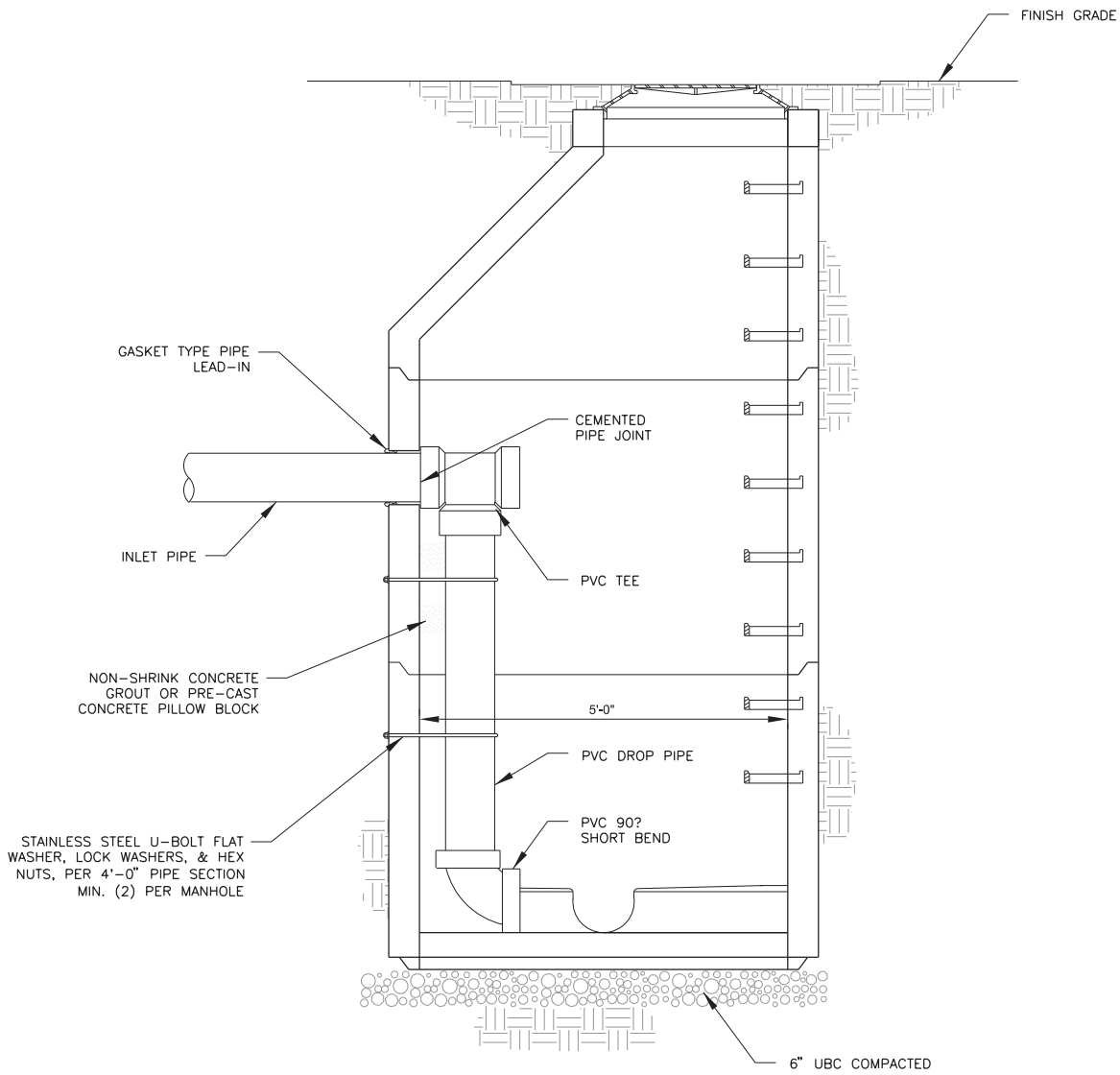
NO.	DESCRIPTION	BY	APR.	DATE
1	REMOVED CONCRETE COLLAR, ADDED CALL OUT FOR MANHOLE RISERS & MINOR NOTE CHANGES	N.B.	M.C.	11/2011



CAST IN PLACE SEWER MANHOLE MANHOLE RING & COVER

SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	S3
CAD DWG.dwg_6-12.dgn	
PLOT SCALE:	1:000
DRAWN BY:	BTW
DESIGN BY:	NEB
CHECKED BY:	M.C.
ADOPTED DATE:	20 JUN 12



NOTES:

1. FOR DROP DISTANCES LESS THAN 18" NO DROP MANHOLE SHALL BE USED. THE CONTRACTOR SHALL SLOPE THE TROUGHS IN THE BASE SECTION OF THE MANHOLE TO ACCOMMODATE THE DROP DISTANCES.
2. SEWER MAINS LARGER THAN 10" SHALL USE OUTSIDE DROPS, SIMILARLY CONFIGURED, BUT WITH THE DROP PIPE OUTSIDE THE MANHOLE WITH SHORT LENGTHS OF PIPE EXTENDING INTO THE MANHOLE.

DROP SEWER MANHOLE

NOT TO SCALE



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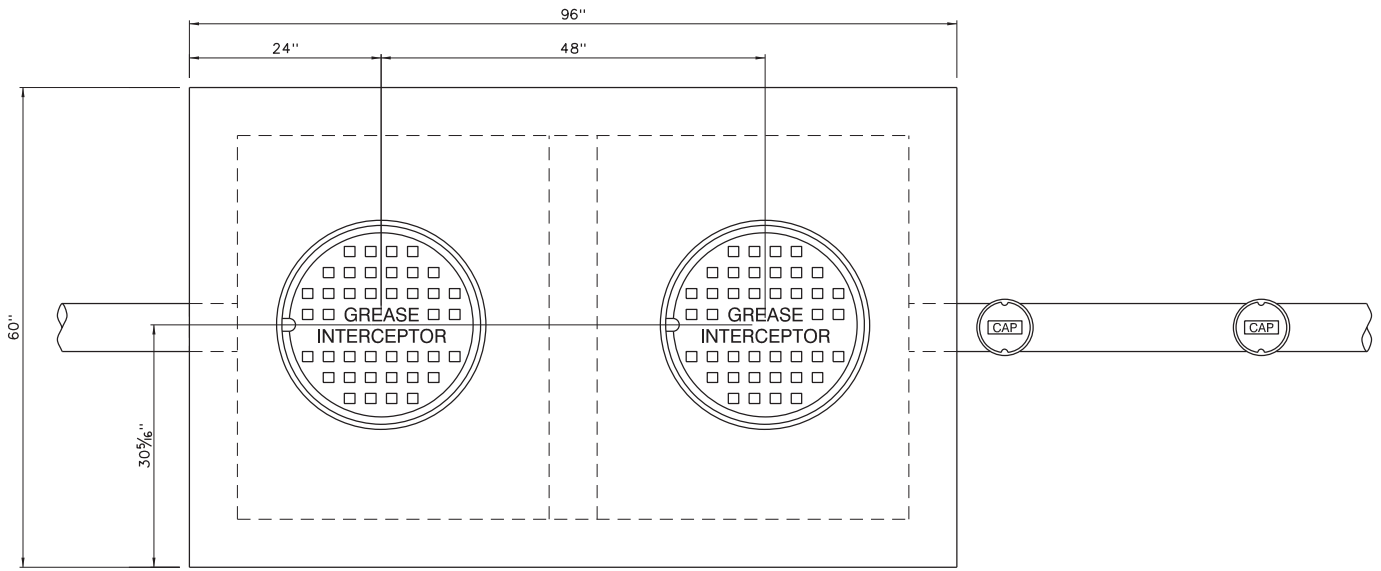
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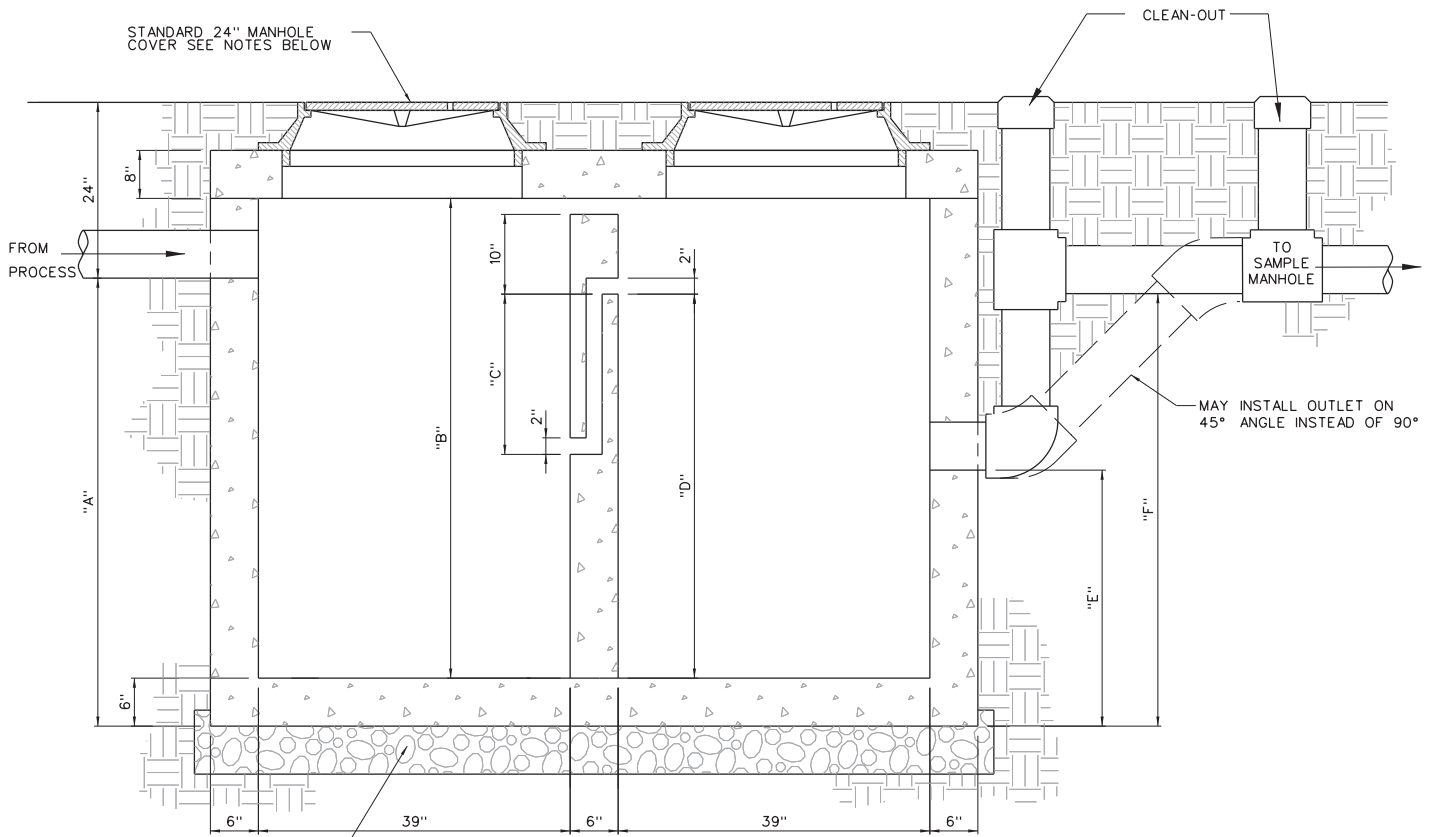
DROP SEWER MANHOLE

SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	S4
CAD DWG.dwg_6-12.dwg	
PLOT SCALE:	1:000
DRAWN BY:	BTW
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CHECKED BY:	M.C.
ADOPTED DATE:	20 JUN 12



LID DIMENSIONS



INSIDE AND PLUMBING

3/4" GRAVEL FOUNDATION OUTSIDE SHAPE MAY BE IRREGULAR. MAXIMUM THICKNESS WILL DEPEND ON SPECIFIC SITE CONDITIONS.

GREASE TRAP DIMENSIONS PER CAPACITY						
CAPACITY	DIMENSION "A"	DIMENSION "B"	DIMENSION "C"	DIMENSION "D"	DIMENSION "E"	DIMENSION "F"
1000 GAL	68"	72"	24"	61"	43"	65"
1200 GAL	74"	78"	24"	67"	49"	71"

- NOTE:
1. MINIMUM CAPACITY ALLOWED IS 1,000 GALLONS.
 2. PRECAST MANUFACTURERS DIMENSIONS MAY VARY FROM THOSE SHOWN BUT MUST MEET REQUIRED CAPACITY.
 3. MANHOLE COVER TO BE A SOLID LID CONTAINING ONE CLOSED PICK HOLE AND MACHINED GROOVE WITH "O" RING. SEE SPECIFICATION DIVISION 5 FOR COVER LABEL. D&L SUPPLY P/N A-1180-10 (OR EQUAL).
 4. STEEL REINFORCING TO BE APPROVED BY A LICENSED PROFESSIONAL ENGINEER.



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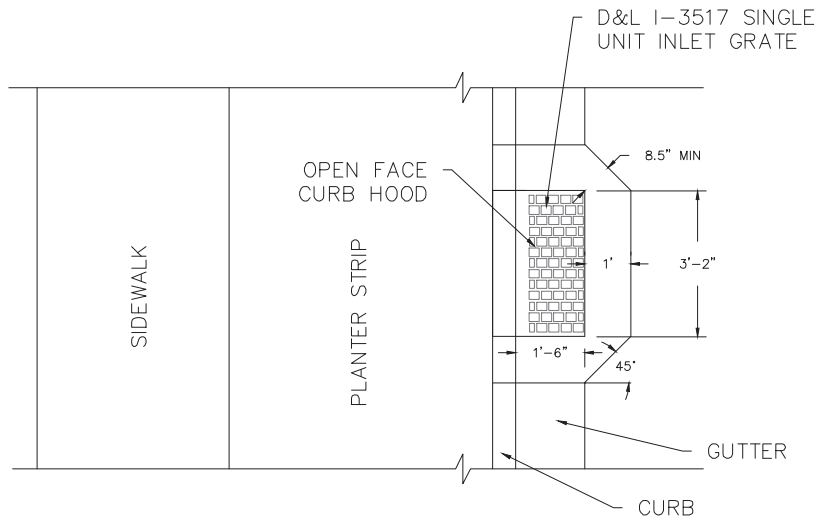
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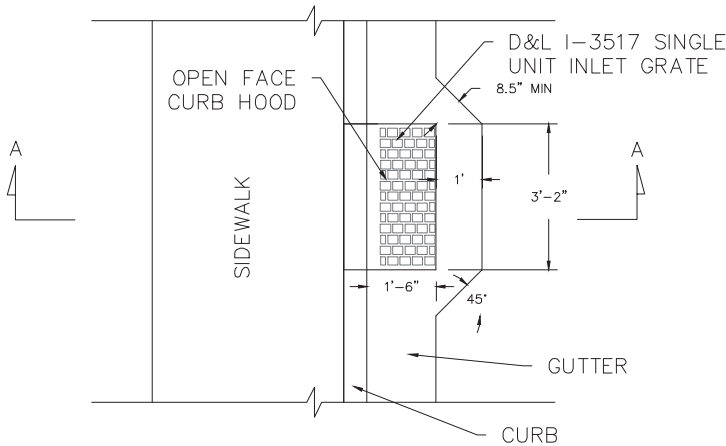
TYPICAL GREASE INTERCEPTOR

SANTAQUIN CITY
275 WEST MAIN STREET

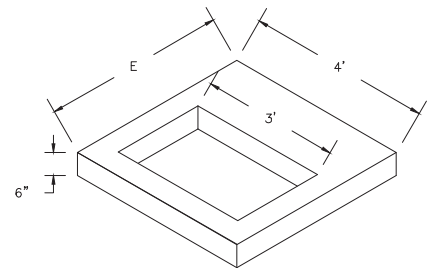
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PLOT SCALE:	1:000
DRAWN BY:	DSF
DESIGN BY:	DSF
CHECKED BY:	DCT
ADOPTED DATE:	20 JUN 12



PLAN - CURB/PLANTER STRIP/SIDEWALK



PLAN - COMBINATION CURB & SIDEWALK



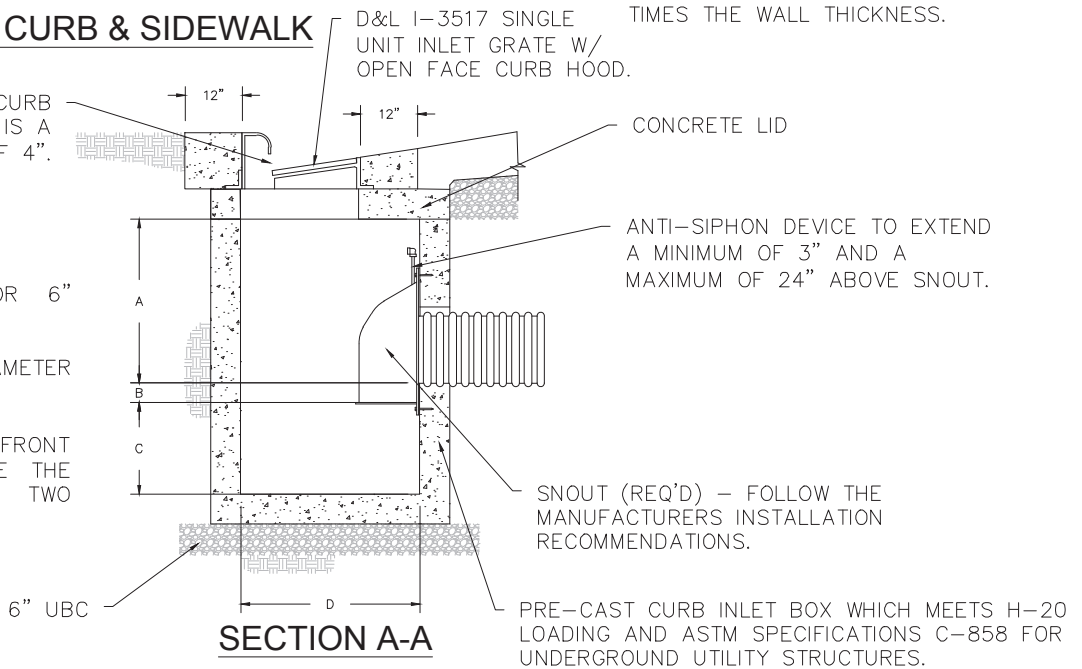
CONCRETE LID DETAILS

E) INSIDE BOX DIMENSIONS FROM FRONT TO BACK PLUS TWO TIMES THE WALL THICKNESS.

RECESS GRATE SO CURB FACE OPENING IS A MINIMUM OF 4\".

NOTES:

- A) 24\" MINIMUM.
- B) $\frac{1}{2}$ OUTLET PIPE DIAMETER OR 6\" MINIMUM.
- C) 2.5 TIMES THE OUTLET PIPE DIAMETER OR 36\" WHICHEVER IS GREATER.
- D) INSIDE BOX DIMENSION FROM FRONT TO BACK IS MINIMUM OF THE THE OUTLET PIPE DIAMETER PLUS TWO FEET. BOX HEIGHT AS NEEDED.



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REVISION			
NO.	BY	APR	DATE

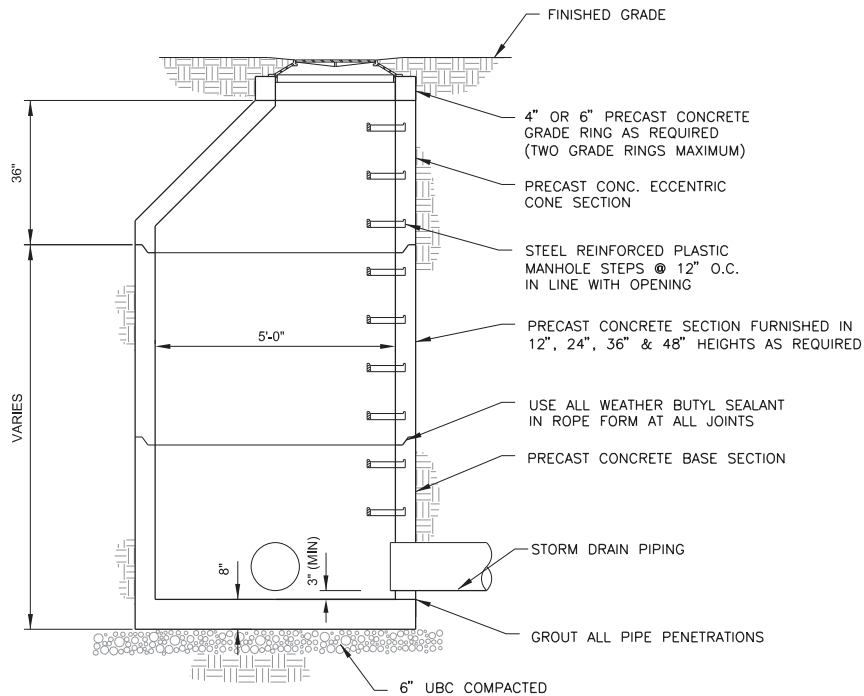


CURB INLET BOX ASSEMBLY

**SANTAQUIN CITY
275 WEST MAIN STREET**

SD1

ADOPTED DATE:
19 - OCT - 16

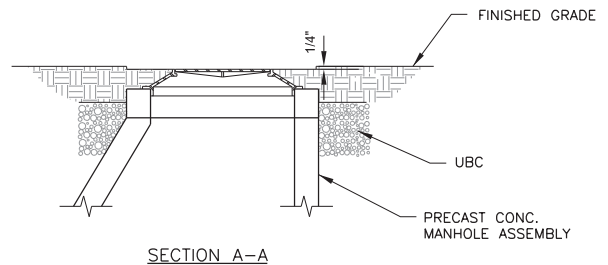
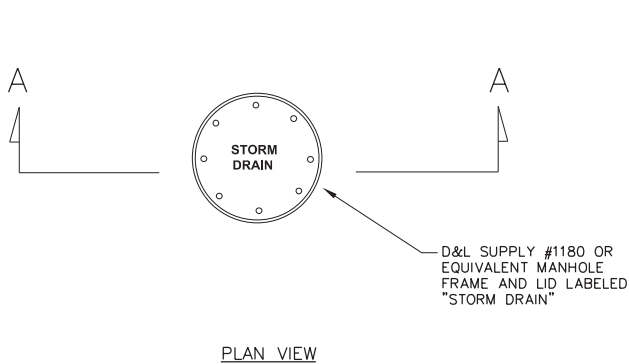


NOTES:

1. FLAT LIDS MAY BE USED IN LIEU OF ECCENTRIC CONES WHERE NECESSARY, AND UPON APPROVAL OF THE CITY ENGINEER. FLAT LIDS SHALL BE OF ECCENTRIC DESIGN AND MEET H2O LIVE LOADING.
2. MANHOLE RIMS PLACED IN FIELDS SHALL HAVE SOLID LIDS.

TYPICAL STORM DRAIN MANHOLE

NOT TO SCALE



NOTE:

1. NO COLLARS (CONCRETE NOR ASPHALT) ARE TO BE USED ON MANHOLES WITHIN SANTAQUIN CITY ROW. USE D & L SUPPLY MANHOLE ADAPTER RING(S) (RISER(S)) TO SET RING AND COVER TO FINISH GRADE.
2. EXCAVATIONS FOR MANHOLE ADAPTER RING(S) (RISER(S)) SHALL HAVE VERTICAL SIDE WALLS.
3. FINISH RING AND COVER 1/4" BELOW THE FINISH GRADE OF THE ROADWAY.

MANHOLE RING & COVER

NOT TO SCALE



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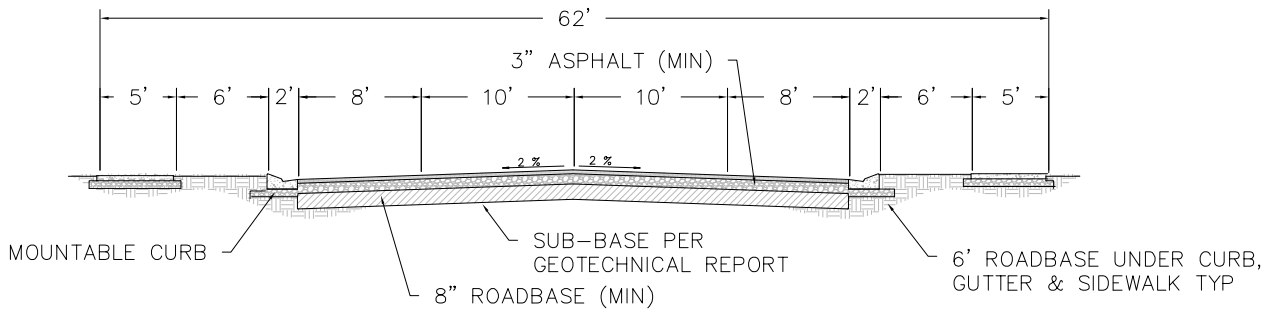
NO.	DESCRIPTION	BY	APR.	DATE
1	REMOVED CONCRETE COLLAR; ADDED CALL OUT FOR MANHOLE RISERS	NEB	MLC	11/2011
	REMOVED TROUGH; RAISED PIPE & MINOR NOTE CHANGES			



TYPICAL STORM DRAIN MANHOLE & MANHOLE RING & COVER

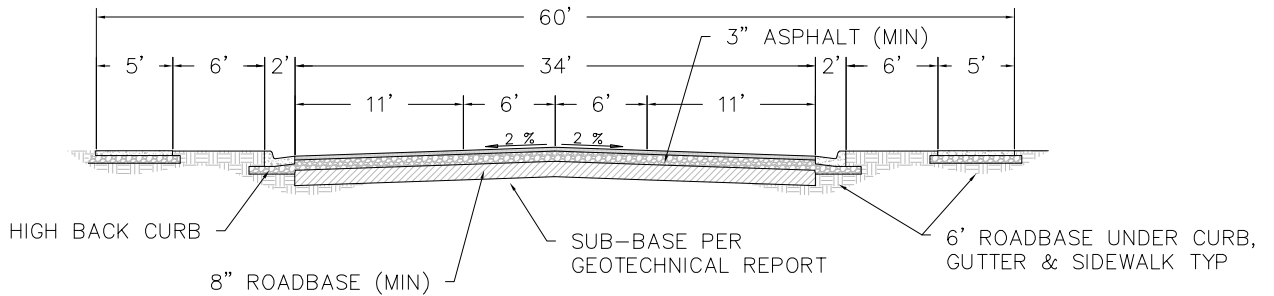
SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	SD2
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PLOT SCALE:	1:000
DRAWN BY:	BTW
DESIGN BY:	NEB
CHECKED BY:	MLC
ADOPTED DATE:	20 JUN 12



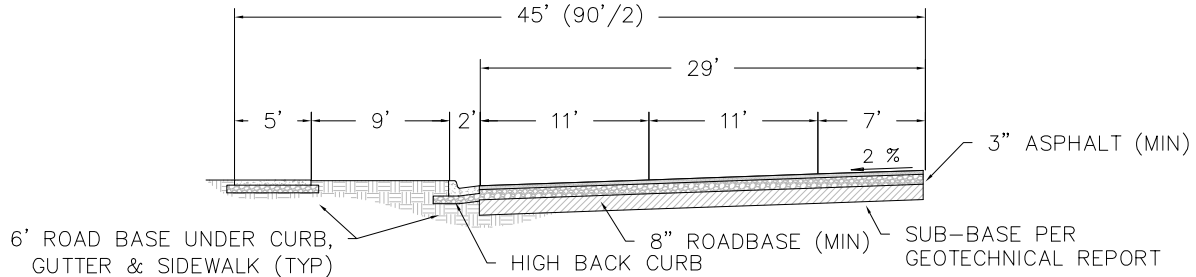
- NOTES:
1. THE DEVELOPMENT REVIEW COMMITTEE (DRC) MAY REQUIRE THE ADDITION OF RIGHT TURN LANES AT INTERSECTIONS.
 2. THE DEVELOPMENT REVIEW COMMITTEE (DRC) MAY MODIFY THIS SECTION FOR DEVELOPMENTS WITH AVERAGE BUILDABLE SLOPE > 10%.
 3. AS APPROVED BY CITY COUNCIL ON MARCH 1, 2022, THIS IS THE REQUIRED MINIMUM CROSS SECTION FOR ALL LOCAL STREETS/ROADS APPROVED FOR DEVELOPMENT PRIOR TO DECEMBER 19, 2023

2-LANE/PARKING BOTH SIDES
62' LOCAL
 NOT TO SCALE



- NOTES:
1. THE DEVELOPMENT REVIEW COMMITTEE (DRC) MAY REQUIRE THE ADDITION OF RIGHT TURN LANES AT INTERSECTIONS.
 2. THE DEVELOPMENT REVIEW COMMITTEE (DRC) MAY MODIFY THIS SECTION FOR DEVELOPMENTS WITH AVERAGE BUILDABLE SLOPE > 10%.

3-LANE/NO PARKING
60' COLLECTOR
 NOT TO SCALE



- NOTES:
1. THE DEVELOPMENT REVIEW COMMITTEE (DRC) MAY REQUIRE THE ADDITION OF RIGHT TURN LANES AT INTERSECTIONS.
 2. THE DEVELOPMENT REVIEW COMMITTEE (DRC) MAY MODIFY THIS SECTION FOR DEVELOPMENTS WITH AVERAGE BUILDABLE SLOPE > 10%.

5-LANE/NO PARKING
90' ARTERIAL
 NOT TO SCALE

NOTES:
 STANDARD ROAD CROSS SECTIONS MAY BE MODIFIED IN HILLSIDE DEVELOPMENT ZONES ACCORDING TO A DEVELOPMENT AGREEMENT.

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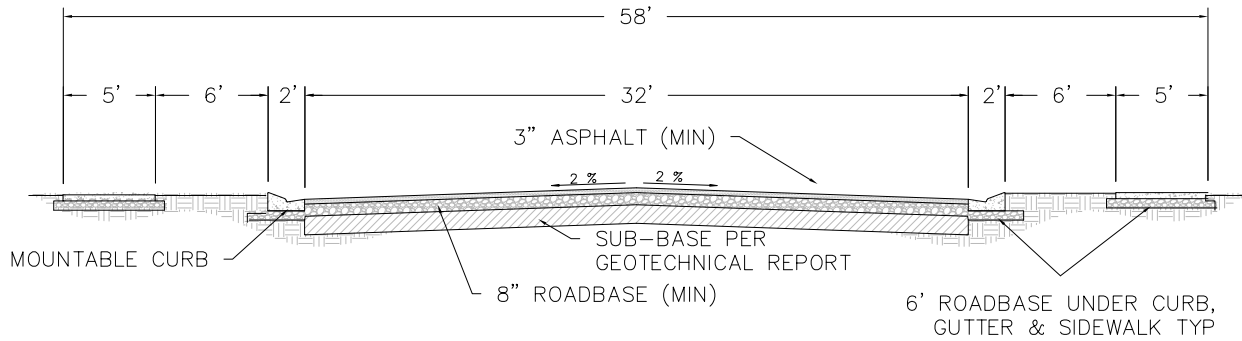
REVISION			
NO.	BY	APR	DATE



**STANDARD STREET
 CROSS SECTION**
SANTAQUIN CITY
110 SOUTH CENTER STREET

ST1

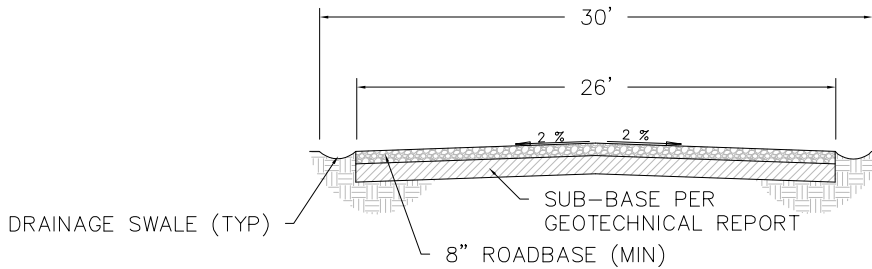
ADOPTED DATE:



2-LANE MINIMUM ASPHALT WIDTH
58' LOCAL
NOT TO SCALE

NOTES:

1. THE DEVELOPMENT REVIEW COMMITTEE (DRC) MAY REQUIRE THE ADDITION OF RIGHT TURN LANES AT INTERSECTIONS.
2. THE DEVELOPMENT REVIEW COMMITTEE (DRC) MAY MODIFY THIS SECTION FOR DEVELOPMENTS WITH AVERAGE BUILDABLE SLOPE > 10%.
3. AS APPROVED BY CITY COUNCIL ON DECEMBER 19, 2023, THIS IS NOW THE MINIMUM CROSS SECTION FOR ALL NEW LOCAL STREETS/ROADS



26' RURAL PRIVATE LANE
NOT TO SCALE

NOTES:

TURN-A-ROUND MUST MEET THE REQUIREMENTS OF THE INTERNATIONAL FIRE CODE APPENDIX D (LATEST ADOPTED VERSION)

NOTES:

1. THE DEVELOPMENT REVIEW COMMITTEE (DRC) MAY REQUIRE THE ADDITION OF RIGHT TURN LANES AT INTERSECTIONS.
2. THE DEVELOPMENT REVIEW COMMITTEE (DRC) MAY MODIFY THIS SECTION FOR DEVELOPMENTS WITH AVERAGE BUILDABLE SLOPE > 10%.

NOTES:

STANDARD ROAD CROSS SECTIONS MAY BE MODIFIED IN HILLSIDE DEVELOPMENT ZONES ACCORDING TO A DEVELOPMENT AGREEMENT.

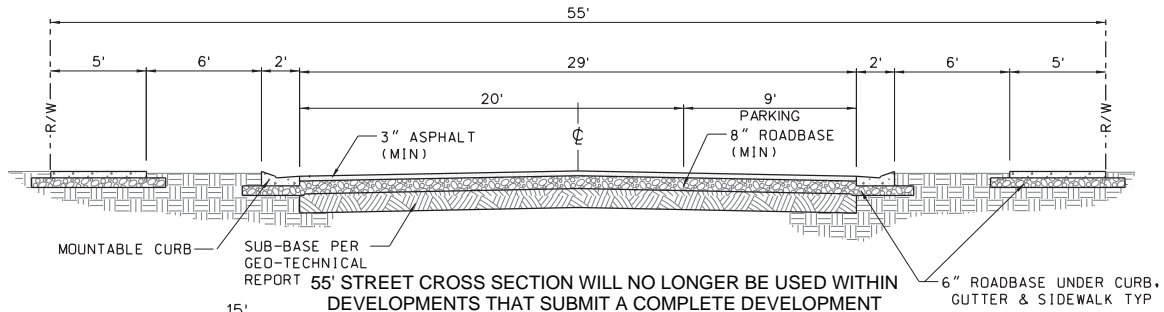
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REVISION			
NO.	BY	APR	DATE

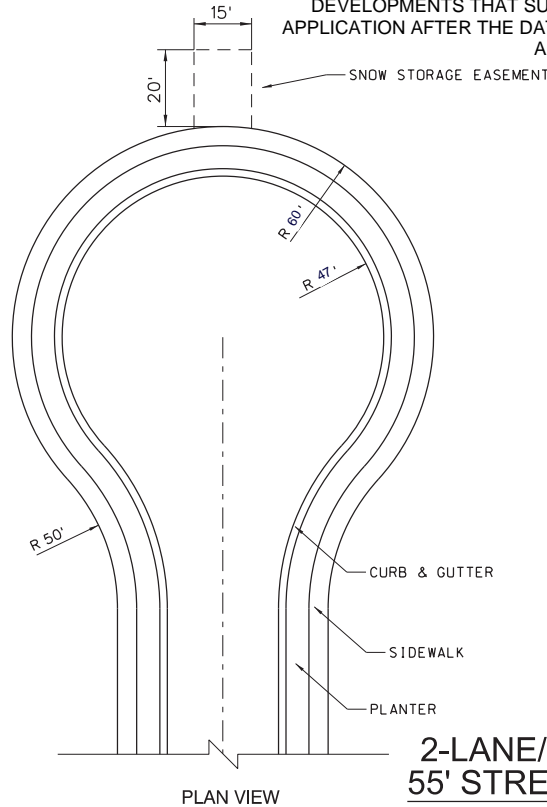


**STANDARD STREET
 CROSS SECTION
 SANTAQUIN CITY
 110 SOUTH CENTER STREET**

ST2
 ADOPTED DATE:



55' STREET CROSS SECTION WILL NO LONGER BE USED WITHIN DEVELOPMENTS THAT SUBMIT A COMPLETE DEVELOPMENT APPLICATION AFTER THE DATE THAT THESE SPECIFICATIONS ARE APPROVED.



**2-LANE/PARKING ONE SIDE
55' STREET CROSS-SECTION**
NOT TO SCALE

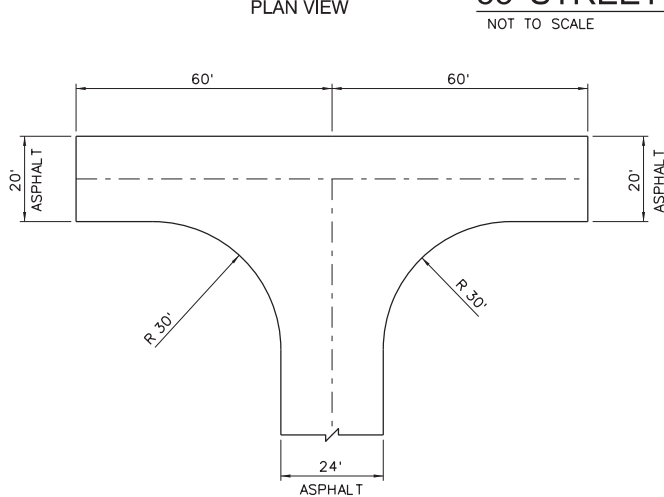
CUL-DE-SAC NOTES:

WHERE AVERAGE SLOPE OF PROPERTY > 10%

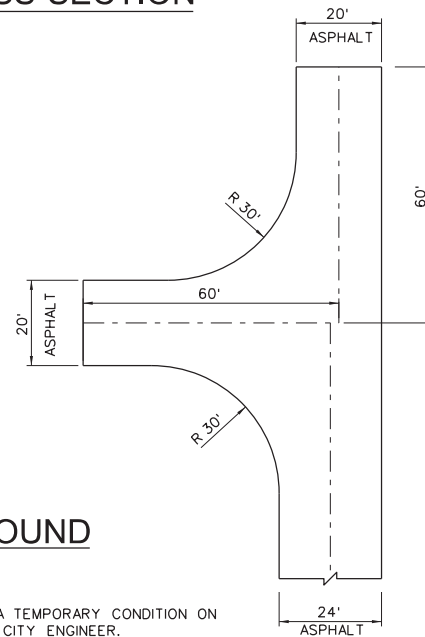
1. 20 LOT MAXIMUM
2. LENGTH OF STREET LIMITATION-1000 FEET MEASURED FROM CENTER OF INTERSECTION TO CENTER OF TURN AROUND.
3. INTERMEDIATE TURN AROUND AS PER THE INTERNATIONAL FIRE CODE APPENDIX D (LATEST EDITION) FOR CUL-DE-SAC > 750 FEET IN LENGTH.
4. TURN-A-ROUND TO MEET THE REQUIREMENTS OF THE INTERNATIONAL FIRE CODE APPENDIX D (LATEST CITY ADOPTED VERSION) (IFC D103.1)

WHERE AVERAGE SLOPE OF PROPERTY < 10%

1. 10 LOT MAXIMUM
2. LENGTH OF STREET LIMITATION-500 FEET MEASURED FROM CENTER OF INTERSECTION TO CENTER OF TURN AROUND.
3. TURN-A-ROUND TO MEET THE REQUIREMENTS OF THE INTERNATIONAL FIRE CODE APPENDIX D (LATEST CITY ADOPTED VERSION) (IFC D103.1)



HAMMERHEAD TURNAROUND
NOT TO SCALE



NOTE:
HAMMERHEAD TURNAROUNDS ARE TO BE INSTALLED AS A TEMPORARY CONDITION ON STANDARD STREETS AND ONLY BY PERMISSION OF THE CITY ENGINEER.



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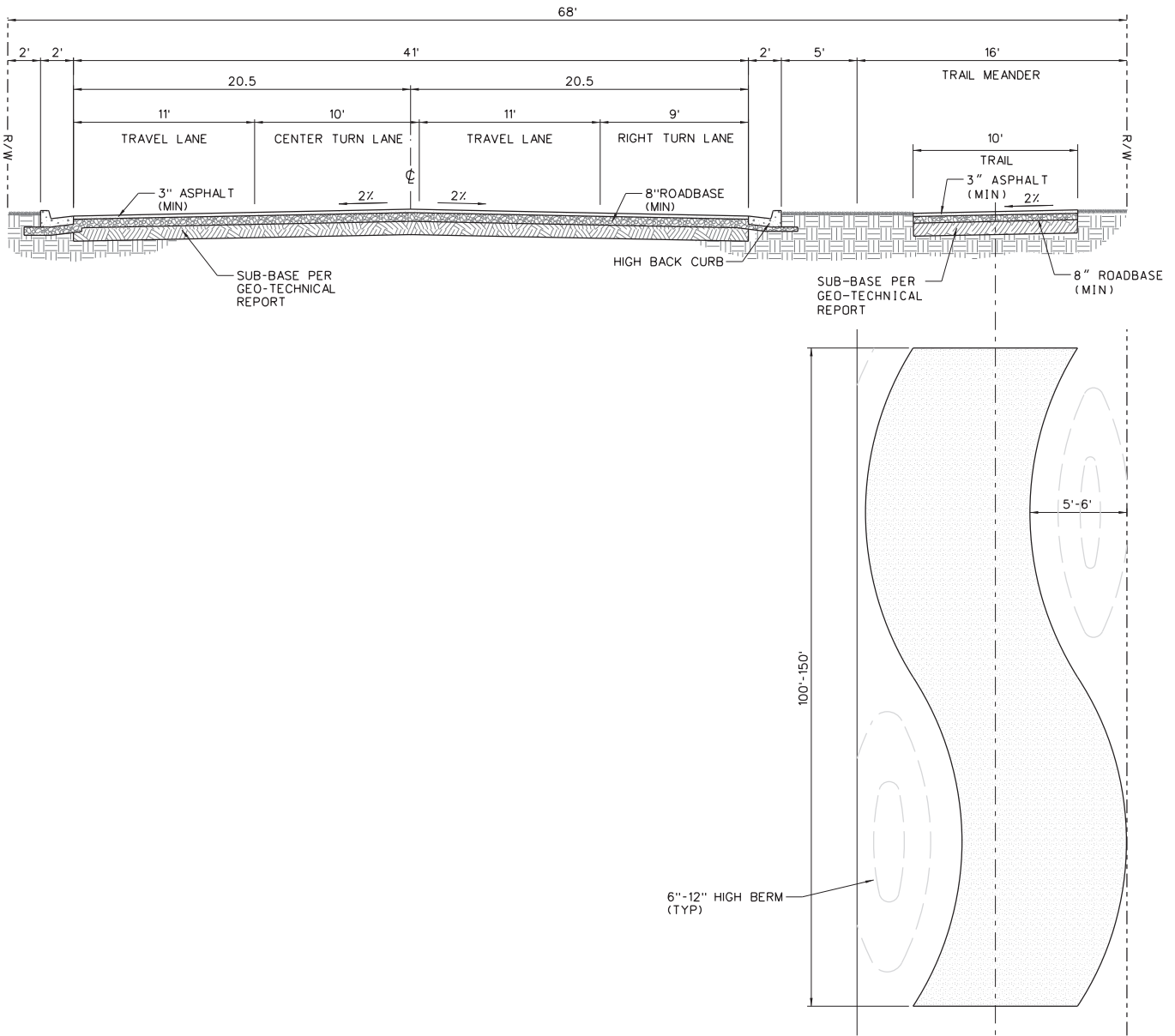
NO.	DESCRIPTION	BY	APR.	DATE
1	SNOW STORAGE AREA ADDED	NEB	MLC	11/20/11



**STANDARD STREET
CROSS SECTIONS**

SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	ST3
CAD DWG.dwg_6-12.dwg	
PLOT SCALE:	1:000
DRAWN BY:	BTW
DESIGN BY:	NEB
CHECKED BY:	MLC
ADOPTED DATE:	20 JUN 12



HIGHLAND DRIVE CROSS SECTION

NOT TO SCALE (LOOKING NORTH)



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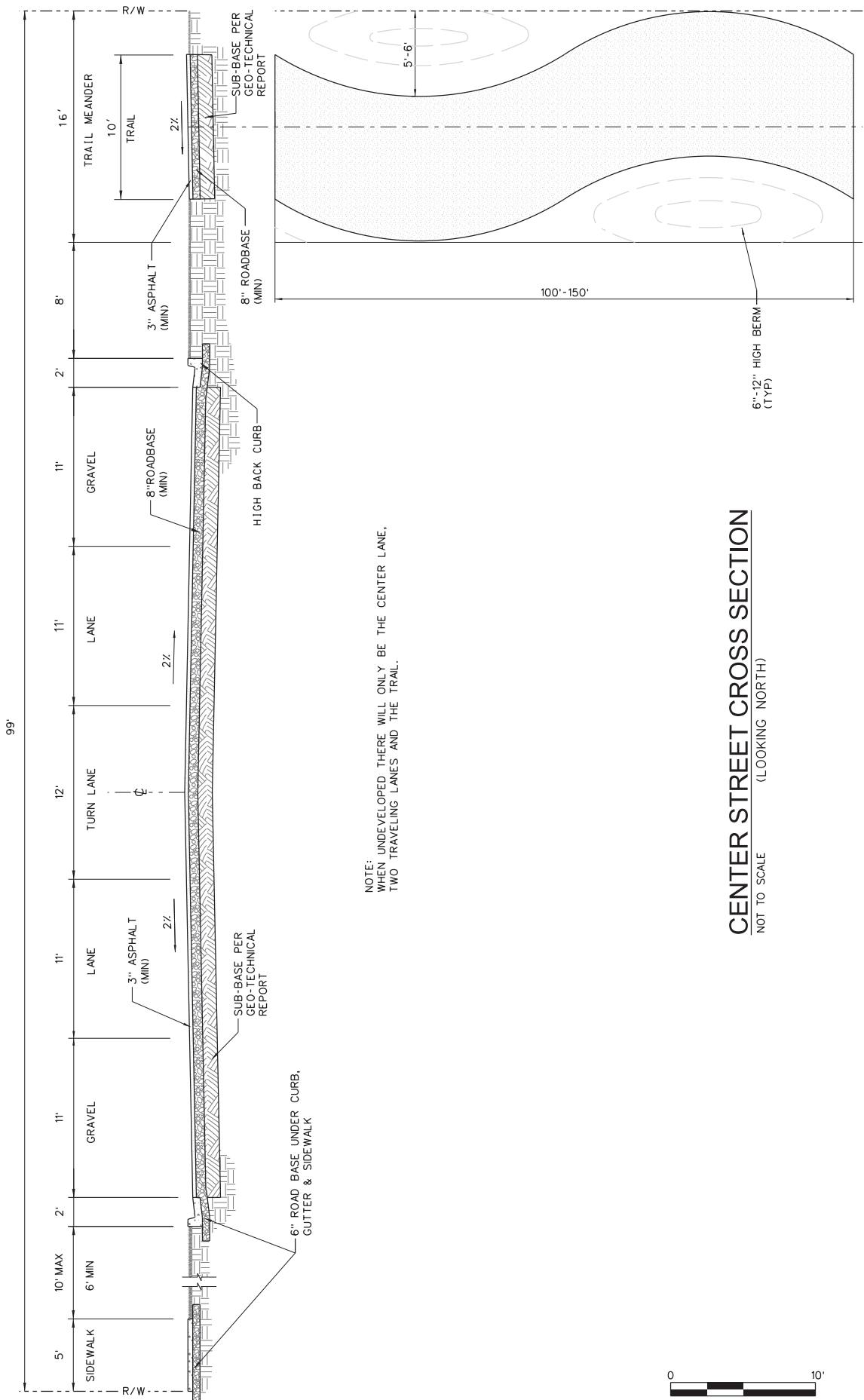
NO.	DESCRIPTION	BY	APR.	DATE



HIGHLAND DRIVE CROSS SECTION

SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	ST4
CAD DWG: dwgs_6-12.dwg	
PLOT SCALE:	1,000
DRAWN BY:	BTW
DESIGN BY:	NEB
CHECKED BY:	MLC
ADOPTED DATE:	20 JUN 12



NOTE: WHEN UNDEVELOPED THERE WILL ONLY BE THE CENTER LANE, TWO TRAVELING LANES AND THE TRAIL.

CENTER STREET CROSS SECTION
(LOOKING NORTH)

NOT TO SCALE



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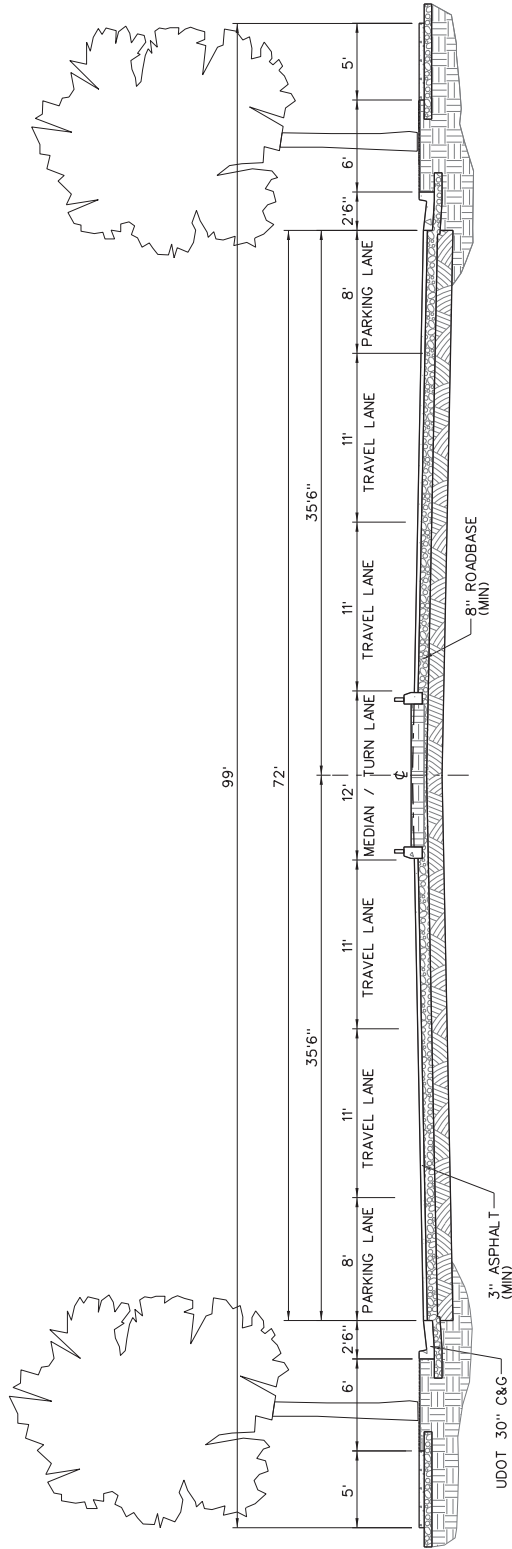
NO.	DESCRIPTION	BY	APR	DATE



CENTER STREET CROSS SECTION

SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	ST5
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PLOT SCALE:	1:000
DRAWN BY:	BTW
DESIGN BY:	MEB
CHECKED BY:	MLC
ADOPTED DATE:	20 JUN 12



99' SANTAQUIN MAIN STREET CROSS SECTION
NOT TO SCALE



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REVISION

NO.	DESCRIPTION	BY	APR.	DATE
1	CHANGED TO 99' CROSS SECTION	NEB	MLC	11/2011



**MAIN STREET
CROSS SECTION**

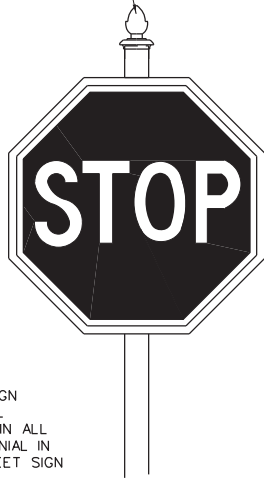
SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	ST6
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PLOT SCALE:	1,000
DRAWN BY:	NEB
DESIGN BY:	NEB
CHECKED BY:	MLC
ADOPTED DATE:	20 JUN 12

MAPLE LN.
200 SOUTH

STREETS WITH NAMES

BRANDON INDUSTRIES
BLACK ALUMINUM FINIAL
PART • FIN-A3



NOTE:
THE LOCAL STOP SIGN
MATCHES THE LOCAL
STREET/STOP SIGN IN ALL
ASPECTS EXCEPT FINIAL IN
PLACE OF THE STREET SIGN

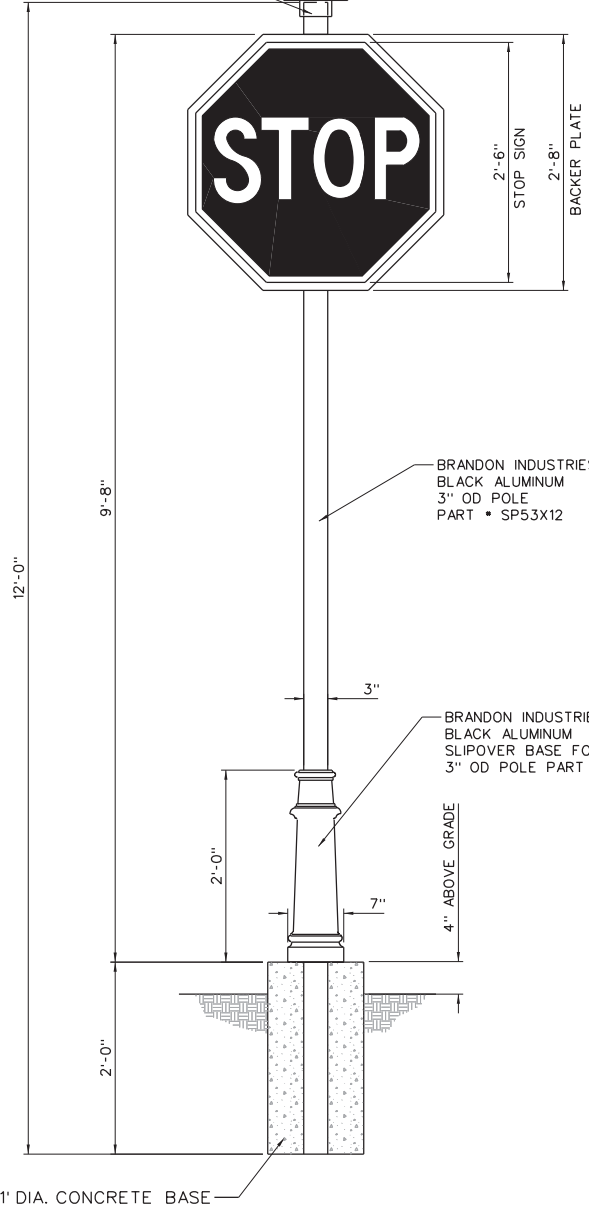
LOCAL STOP
SIGN DETAIL

6" x 36" STREET SIGN FOR NAMED STREET.

3" ID CUP WITH HOLDER FOR
TWO-WAY STREET SIGN. ONE
FOR EACH 3" OR 4" POLE.

4 WAY ADAPTER

100 WEST



BRANDON INDUSTRIES
BLACK ALUMINUM
3" OD POLE
PART • SP53X12

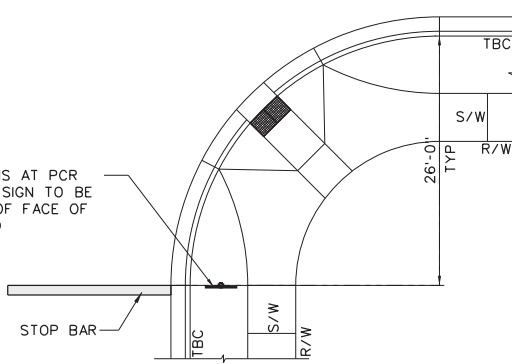
BRANDON INDUSTRIES
BLACK ALUMINUM
SLIPOVER BASE FOR
3" OD POLE PART • SB-33 BK

1' DIA. CONCRETE BASE

LOCAL STREET/STOP
SIGN DETAIL

NOT TO SCALE

STOP SIGNS AT PCR
(EDGE OF SIGN TO BE
2' CLEAR OF FACE OF
THE CURB)



TYPICAL LOCAL STREET/STOP SIGN
LOCATION PLAN VIEW

SCALE: 1"=20'



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REVISION

NO.	DESCRIPTION	BY	APR.	DATE



LOCAL STREET / STOP
SIGN DETAIL

SANTAQUIN CITY
275 WEST MAIN STREET

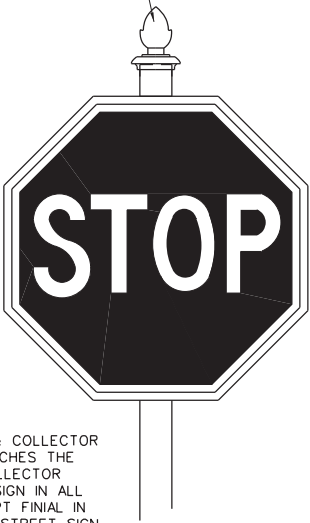
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PLOT SCALE:	1:000
DRAWN BY:	EEA/CJC
DESIGN BY:	DCT
CHECKED BY:	DCT
ADOPTED DATE:	20 JUN 12

OAK SUMMIT DR.
1250 EAST

STREETS WITH NAMES

6" x 36" STREET SIGN FOR NAMED STREET.

BRANDON INDUSTRIES
BLACK ALUMINUM FINIAL
PART • FIN-A4



3" ID CUP WITH HOLDER FOR
TWO-WAY STREET SIGN, ONE
FOR EACH 3" OR 4" POLE.

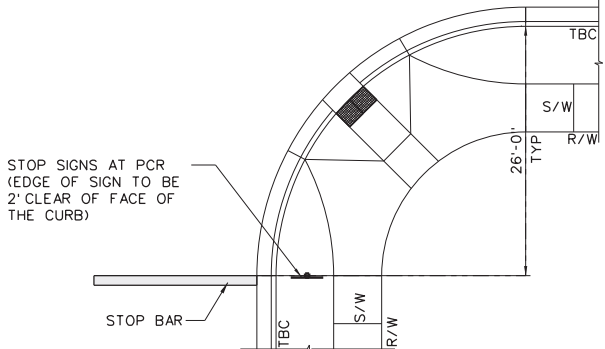
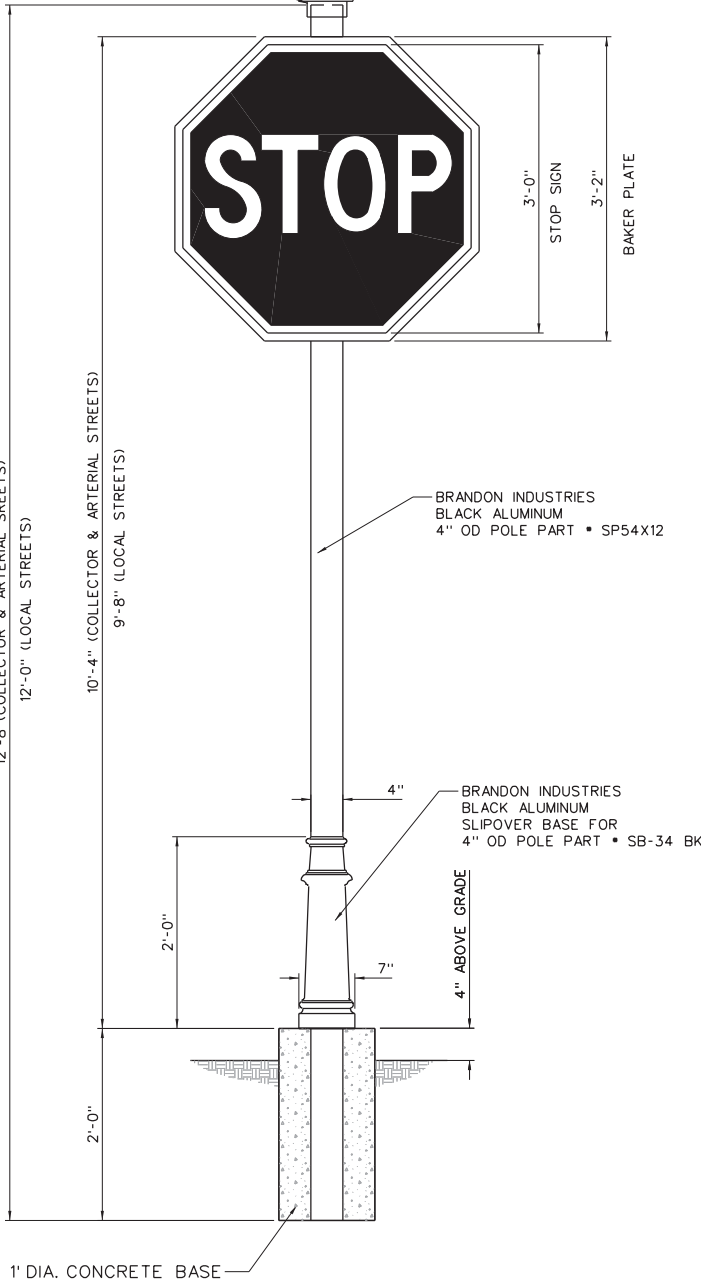
3" TENON FOR 4" OD POLE
TO ACCEPT 3" x 2WAY SIGN
HOLDER.

4 WAY ADAPTER



NOTE:
THE ARTERIAL & COLLECTOR
STOP SIGN MATCHES THE
ARTERIAL & COLLECTOR
STREET/STOP SIGN IN ALL
ASPECTS EXCEPT FINIAL IN
PLACE OF THE STREET SIGN

ARTERIAL & COLLECTOR
STOP SIGN



STOP SIGNS AT PCR
(EDGE OF SIGN TO BE
2' CLEAR OF FACE OF
THE CURB)

TYPICAL ARTERIAL & COLLECTOR
STREET/STOP SIGN LOCATION
PLAN VIEW

SCALE: 1"=20'

ARTERIAL & COLLECTOR
STREET/STOP SIGN DETAIL

NOT TO SCALE



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REVISION			
NO.	DESCRIPTION	BY	APR. DATE



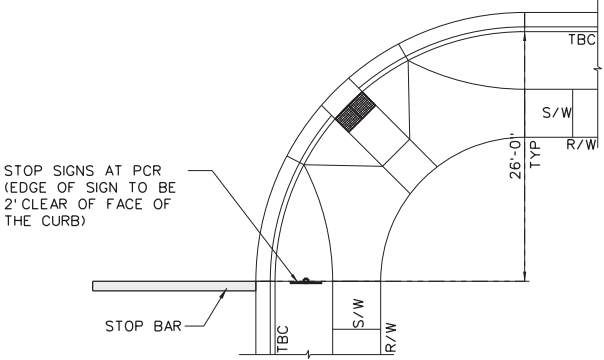
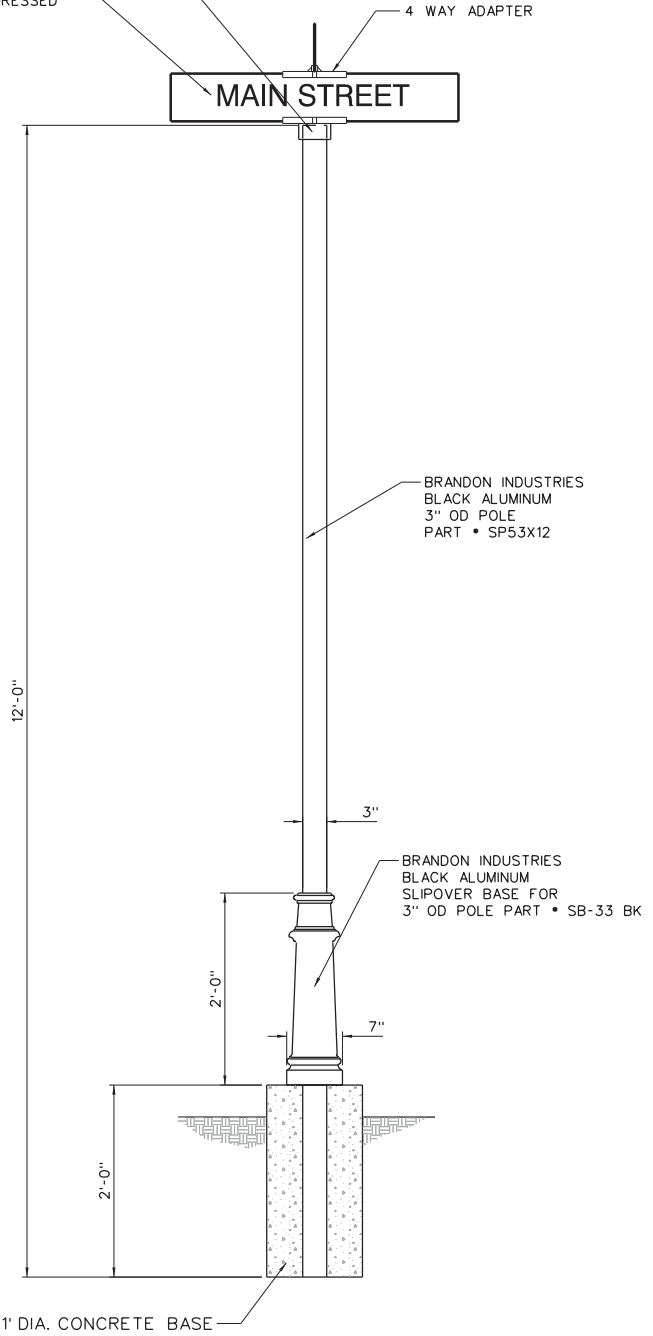
ARTERIAL & COLLECTOR STREET/STOP
SIGN DETAIL

SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	ST8
CAD DWG.dwg_6-12.dwg	
PLOT SCALE:	1:1000
DRAWN BY:	EEA/CJC
DESIGN BY:	DCT
CHECKED BY:	DCT
ADOPTED DATE:	20 JUN 12

MAPLE LN.
200 SOUTH
STREETS WITH NAMES

3" ID CUP WITH HOLDER FOR TWO-WAY STREET SIGN. ONE FOR EACH 3" OR 4" POLE.
6" x 36" STREET SIGN FOR NAMED STREET.
6" x 24" FOR STREET SIGN FOR ADDRESSED STREET.



TYPICAL STREET/STOP SIGN LOCATION
PLAN VIEW
SCALE: 1"=20'

TYPICAL STREET SIGN INSTALLATION
NOT TO SCALE



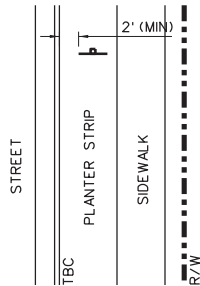
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REVISION			
NO.	DESCRIPTION	BY	APR. DATE

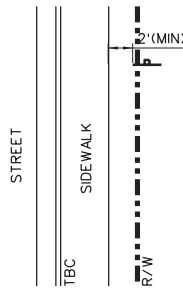


TYPICAL STREET SIGN DETAIL
(NO STOP SIGN)
SANTAQUIN CITY
275 WEST MAIN STREET

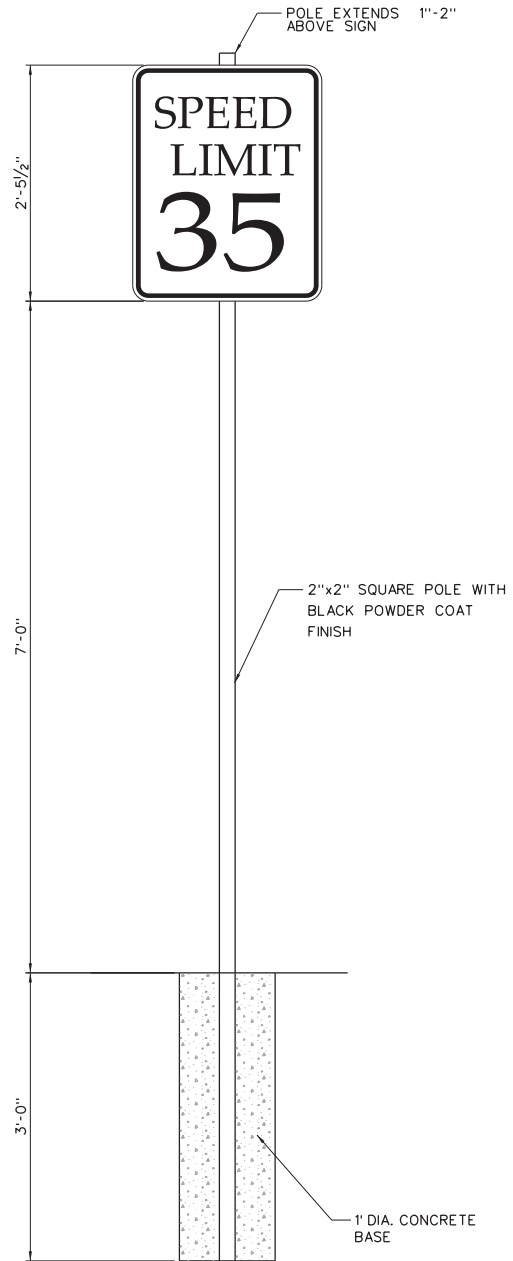
STANDARD DRAWING NUMBER:	ST9
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PLOT SCALE:	1:000
DRAWN BY:	EEA/CJC
DESIGN BY:	DCT
CHECKED BY:	DCT
ADOPTED DATE:	20 JUN 12



TYPICAL SPEED LIMIT SIGN LOCATION
WHEN SIDEWALK IS NOT ADJACENT TO C&G
PLAN VIEW
NOT TO SCALE



TYPICAL SPEED LIMIT SIGN LOCATION
WHEN SIDEWALK IS ADJACENT TO C&G
PLAN VIEW
NOT TO SCALE



TYPICAL SPEED LIMIT SIGN INSTALLATION
NOT TO SCALE



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REVISION

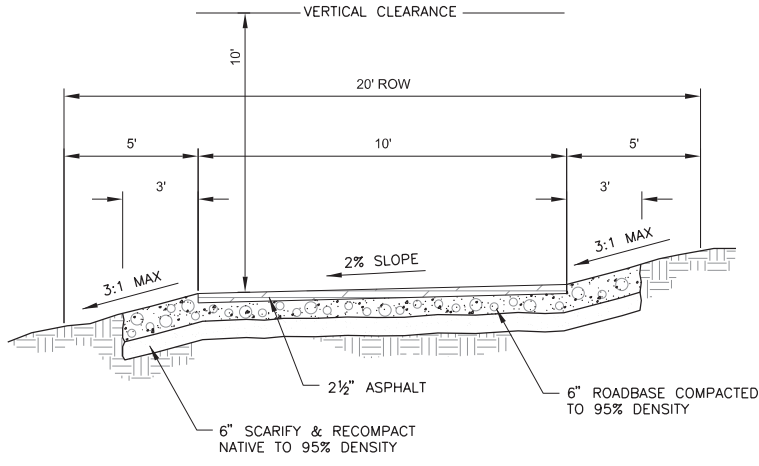
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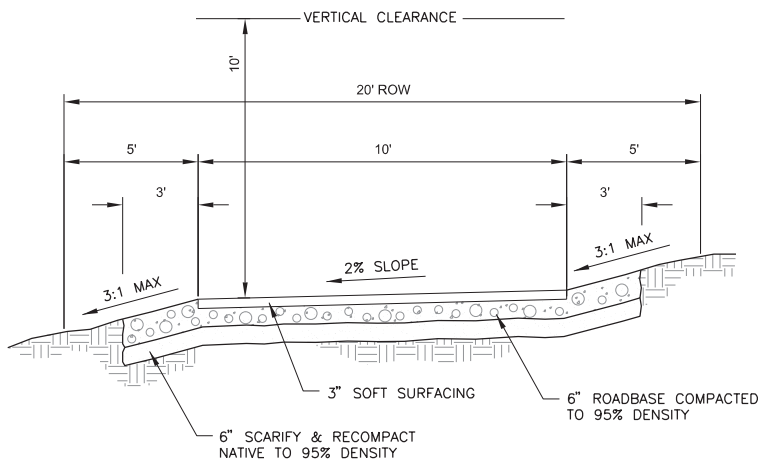
TYPICAL SPEED LIMIT SIGN DETAIL

SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	ST10
CAD DWG: dws_6-12.dwg	
PLOT SCALE:	1:1000
DRAWN BY:	EEA/CJC
DESIGN BY:	DCI
CHECKED BY:	DCI
ADOPTED DATE:	20 JUN 12



MULTI -USE TRAIL CROSS SECTION



SOFT SURFACE TRAIL CROSS SECTION

NOTES:

1. SLOPES MAY BE REVERSED TO MATCH NATURAL TOPOGRAPHICAL CONDITIONS
2. A 3' CLEARANCE AREA MUST BE MAINTAINED ON EACH SIDE OF THE TRAIL

SINGLE PATH TRAIL
NOT TO SCALE



STATEMENT OF USE

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REVISION

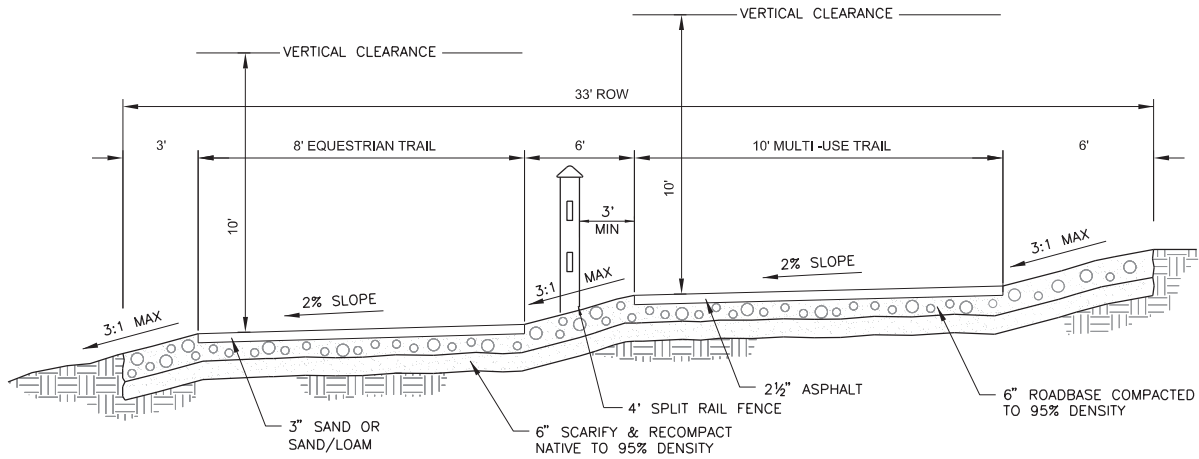
NO.	DESCRIPTION	BY	APR.	DATE
1	UPDATED TRAIL SECTIONS	NEB	MLC	11/2011



SINGLE PATH TRAIL
CROSS SECTIONS

SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	T1
CAD DWG dwg_6-12.dwg	
PLOT SCALE:	1:000
DRAWN BY:	BTW
DESIGN BY:	NEB
CHECKED BY:	MLC
ADOPTED DATE:	20 JUN 12



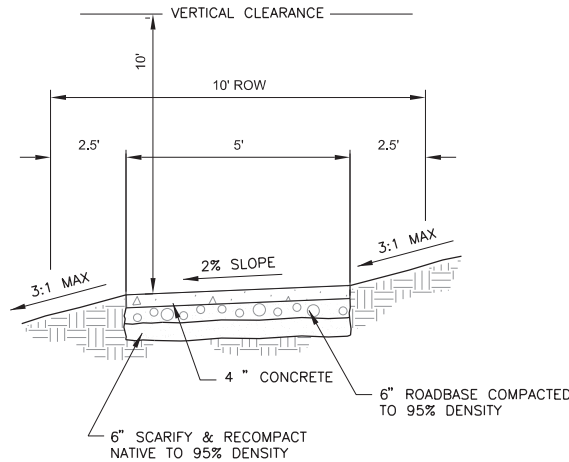
NOTES:

1. SLOPES MAY BE REVERSED TO MATCH NATURAL TOPOGRAPHICAL CONDITIONS
2. A 3' CLEARANCE AREA MUST BE MAINTAINED ON EACH SIDE OF THE PEDESTRIAN TRAIL

DUAL PATH TRAIL

NOT TO SCALE

THIS SECTION SUPERSEDES SIDEWALK SECTION ALONG STREETS WITH DESIGNATED DUAL PATH TRAILS.



NOTES:

1. SLOPES MAY BE REVERSED TO MATCH NATURAL TOPOGRAPHICAL CONDITIONS
2. A 2' CLEARANCE AREA MUST BE MAINTAINED ON EACH SIDE OF THE TRAIL

NEIGHBORHOOD PATH

NOT TO SCALE

THIS SECTION SUPERSEDES SIDEWALK SECTION ALONG STREETS WITH DESIGNATED PATH TRAILS.



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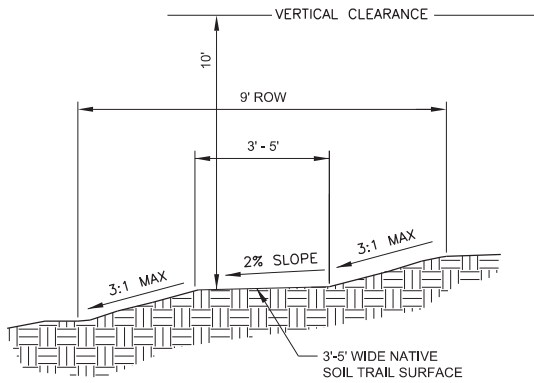
NO.	DESCRIPTION	BY	APR.	DATE
1	UPDATED TRAIL SECTIONS	NEB	MLC	11/20/11



DUAL PATH TRAIL & NEIGHBORHOOD PATH CROSS SECTIONS

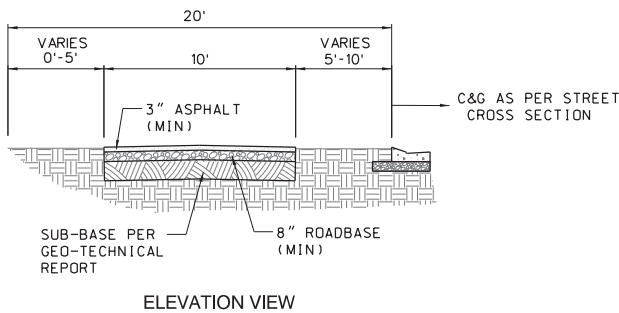
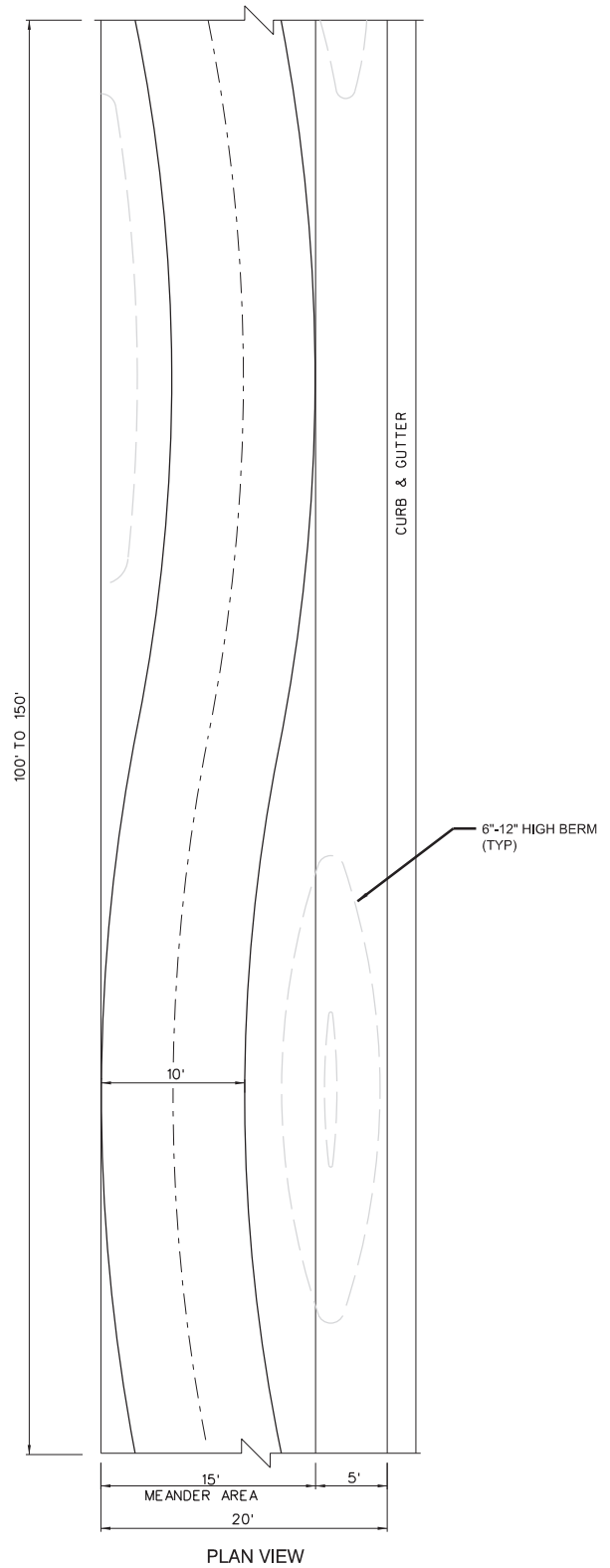
SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	T2
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PLOT SCALE:	1:000
DRAWN BY:	BTW
DESIGN BY:	NEB
CHECKED BY:	MLC
ADOPTED DATE:	20 JUN 12



LOW IMPACT NON-URBAN TRAIL

NOT TO SCALE



20' TRAIL ADJACENT TO STREET

(THIS SECTION SUPERSEDES SIDEWALK SECTION ALONG STREETS WITH DESIGNATED 20' TRAILS)



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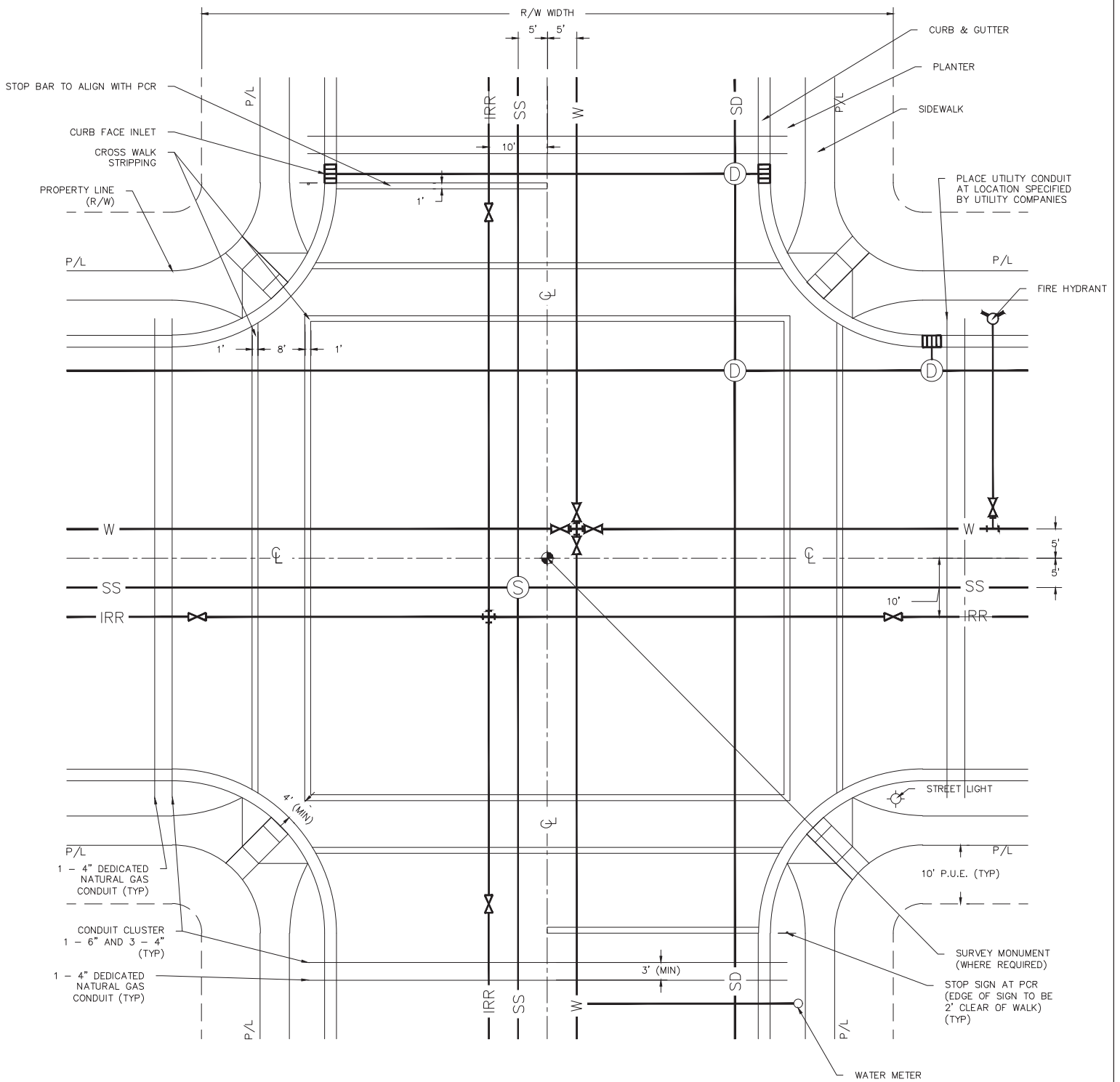
NO.	DESCRIPTION	BY	APR.	DATE
1	UPDATED TRAIL SECTIONS & ADDED TOPD FOR BERMS	NEB	MLC	11/2011



LOW IMPACT NON-URBAN & 20' TRAIL ADJACENT TO STREET CROSS SECTIONS

SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	T3
CAD DWG: dws_6-12.dwg	
PLOT SCALE:	1,000
DRAWN BY:	BTW
DESIGN BY:	NEB
CHECKED BY:	MLC
ADOPTED DATE:	20 JUN 12



1. IRRIGATION MAINS SHALL BE LOCATED ON THE SOUTH & WEST SIDE OF THE STREET
2. FOUR WATER VALVES SHALL BE REQUIRED ON A FOUR-WAY STREET INTERSECTION.
3. THREE WATER VALVES SHALL BE REQUIRED ON A THREE-WAY STREET INTERSECTION.
4. ALL VALVES SHALL BE LOCATED ON THE IN LINE WITH THE PROPERTY LINE, NEVER IN CONCRETE CROSS GUTTER.
5. WATER MAINS SHALL BE LOCATED ON THE NORTH & EAST SIDES OF THE STREET.
6. SEWER MAINS SHALL BE LOCATED ON THE SOUTH & WEST SIDES OF THE STREET.
7. ADA RAMPS SHALL BE PLACED ON ALL CORNERS.
8. AS A GENERAL RULE, LOCATE STREET LIGHTS ON THE OPPOSITE CORNER FROM HYDRANTS.
9. ATTACH STREET SIGN TO THE STREET LIGHTS.
10. CROSS GUTTERS ARE NOT PERMITTED WHERE SURFACE WATER CAN BE PICKED UP IN A STORM DRAIN.
11. ALL CONDUITS MUST HAVE MULE TAPE PULLED THROUGH PRIOR TO COVERING.
12. ALL UTILITY MUST BE SCHEDULE 40 PVC PIPE OR EQUIVALENT.

STREET UTILITY LOCATIONS

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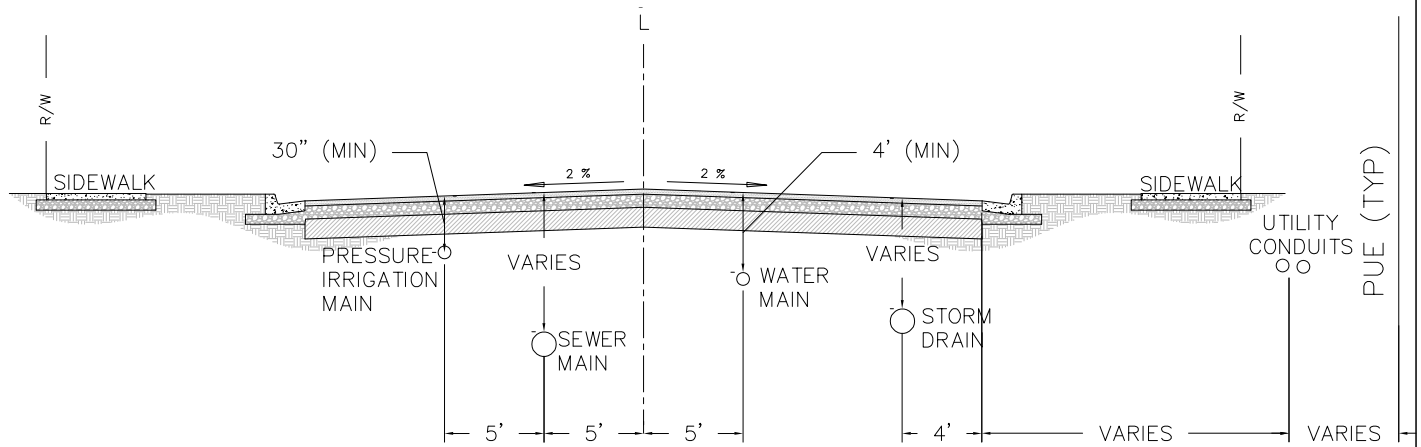
REVISION			
NO.	BY	APR	DATE



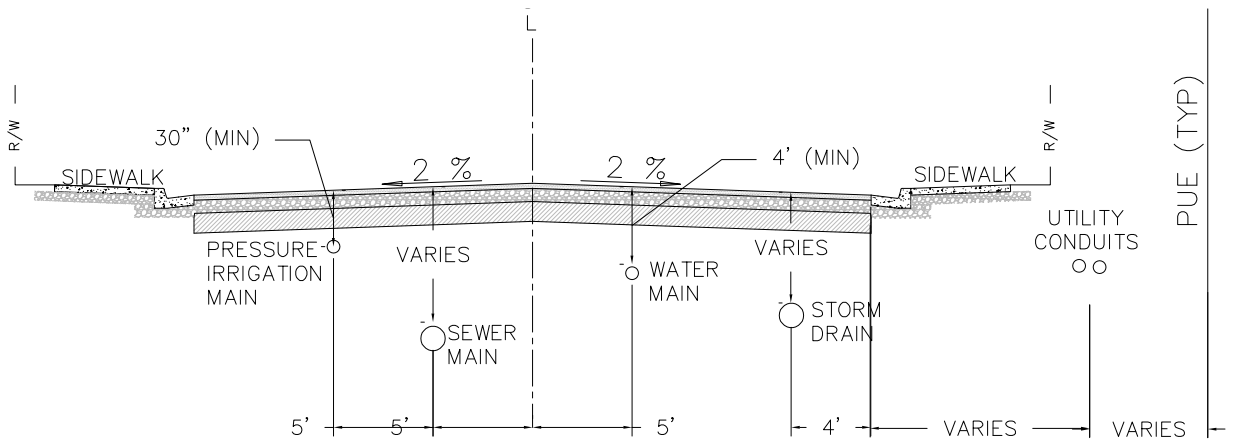
STREET UTILITY LOCATIONS
PLAN VIEW
 SANTAQUIN CITY
 275 WEST MAIN STREET

UT1

ADOPTED DATE:
 19 - OCT - 16



STREET UTILITY LOCATIONS WITH PLANT STRIP



STREET UTILITY LOCATIONS SECTIONS

1. IRRIGATION MAINS SHALL BE LOCATED 10 FEET SOUTH & WEST OF CENTER OF THE STREET.
2. WATER MAINS SHALL BE LOCATED 5 FEET NORTH & EAST OF CENTER OF THE STREET.
3. SEWER MAINS SHALL BE LOCATED 5 FEET SOUTH & WEST OF THE CENTER OF THE STREET.
4. STORM DRAIN SHALL BE LOCATED 4 FEET FROM THE LIP OF GUTTER ON NORTH & EAST SIDE OF THE STREET.
5. STORM DRAIN SHALL BE LOCATED LOWER THAN THE WATER MAIN.
6. UTILITY CONDUITS: SEE SECTION 17.02

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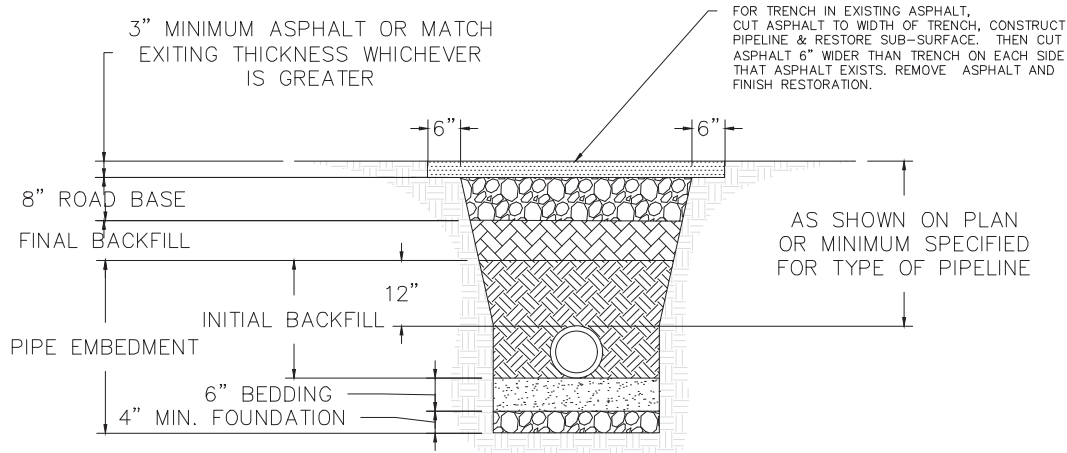
NO.	REVISION	BY	APR	DATE



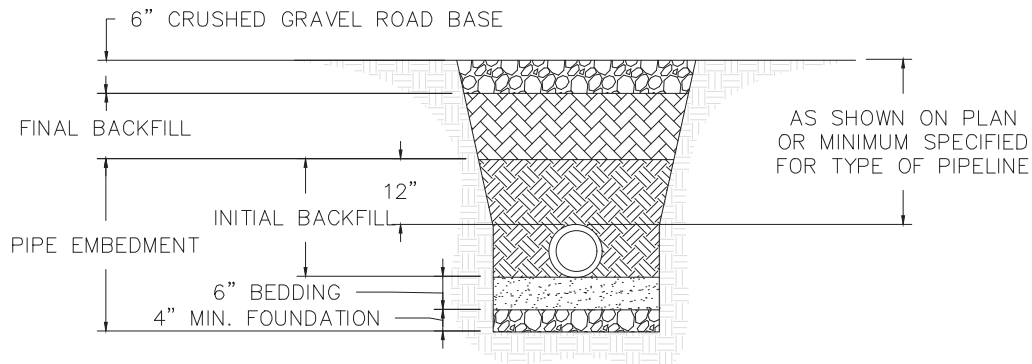
**STREET UTILITY LOCATIONS
PROFILE VIEW
SANTAQUIN CITY
275 WEST MAIN STREET**

UT2

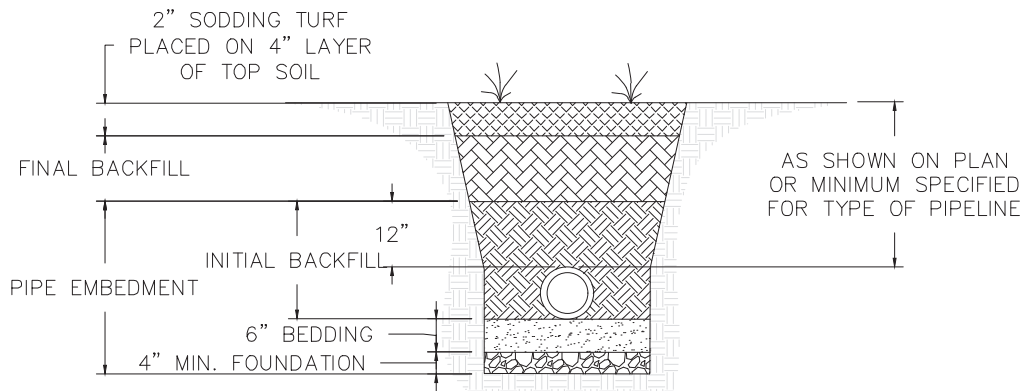
ADOPTED DATE:
19 - OCT - 16



ASPHALT SURFACE



GRAVEL SURFACE



TURF SURFACE

1. SLOPE TRENCH SIDES TO MEET OSHA REQUIREMENTS (LATEST EDITION) OR USE TRENCH BOX.
2. FOUNDATION AND BEDDING MATERIAL AS REQUIRED INSTALL PIPELINES ON STABLE FOUNDATION WITH UNIFORM BEARING FOR FULL LENGTH OF BARREL. EXCAVATE IN BEDDING FOR ALL PIPE JOINTS.

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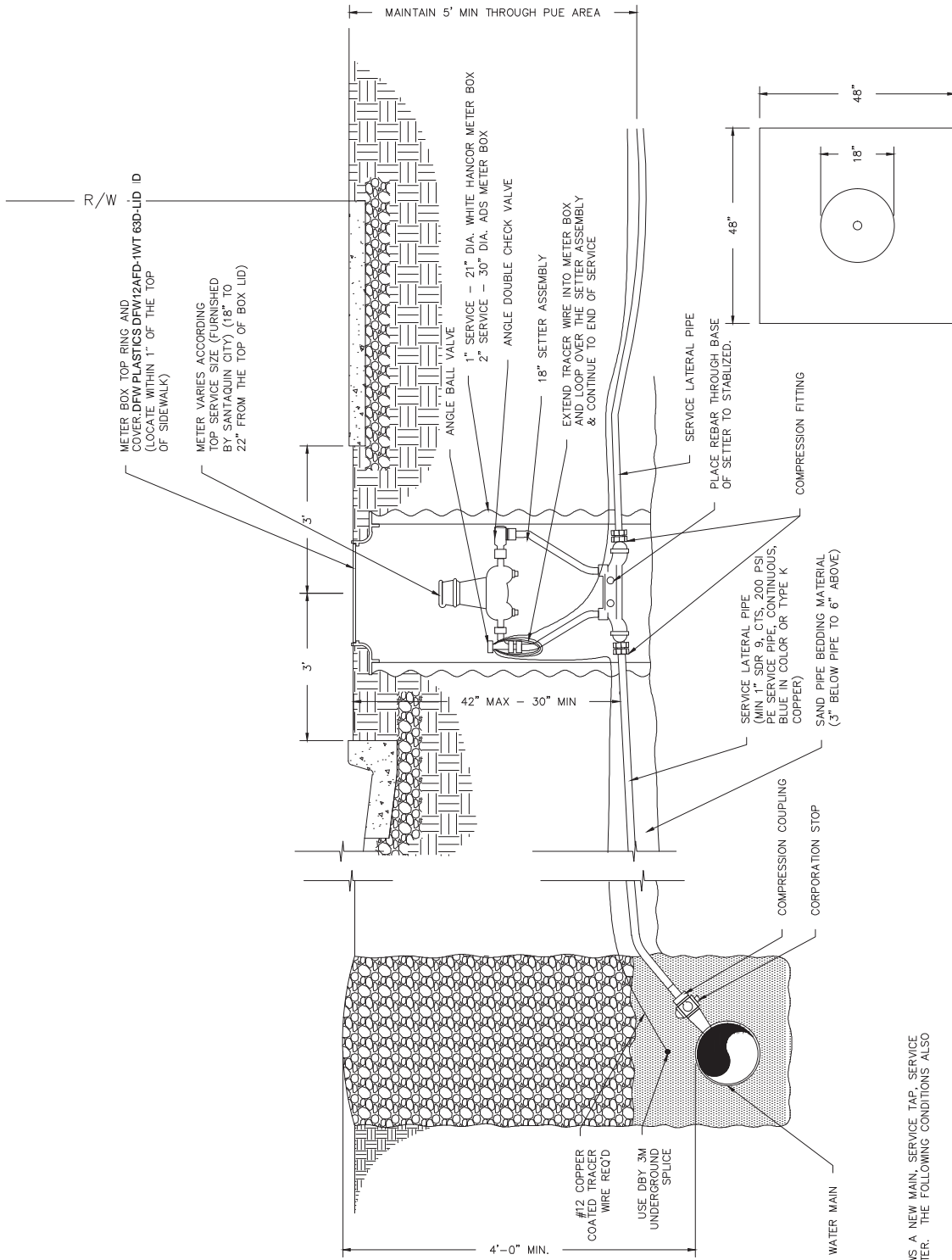
TYPICAL TRENCH SECTION

SANTAQUIN CITY
275 WEST MAIN STREET

UT3

ADOPTED DATE:
19 - OCT - 16

CULINARY WATER SERVICE CONNECTION



FOR METERS LOCATED IN DRIVEWAYS:
 1. TOOL JOINT OR CUT IN CONCRETE.
 2. INSTALL 18" FLAT LID WITH HOLE.
 EXISTING METERS THAT MUST BE RELOCATED MAY NEED TO BE TURNED IN ORDER FOR THEIR ORIENTATION TO MATCH THE ALIGNMENT OF THE SERVICE LINE.

- NOTES:
- A. THIS DETAIL SHOWS A NEW MAIN, SERVICE TAP, SERVICE LATERAL AND METER. THE FOLLOWING CONDITIONS ALSO APPLY:
 - A. NEW MAIN, SERVICE TAP AND SERVICE LATERAL CONNECTED TO EXISTING WATER.
 - B. NEW MAIN AND SERVICE TAP CONNECTED TO EXISTING SERVICE LATERAL.
 - C. NEW SERVICE TAP AND SERVICE LATERAL CONNECTED TO EXISTING MAIN AND METER.
 - D. ALL COUPLINGS SHALL BE SETTLER BEDDED BETWEEN THE MAIN AND METER. SETTLERS SHALL NOT BE PLACED IN WATER WEIRS. SHALL NOT BE PLACED IN CONCRETE SURFACE. (DRIVEWAYS, WALKWAYS ETC.)

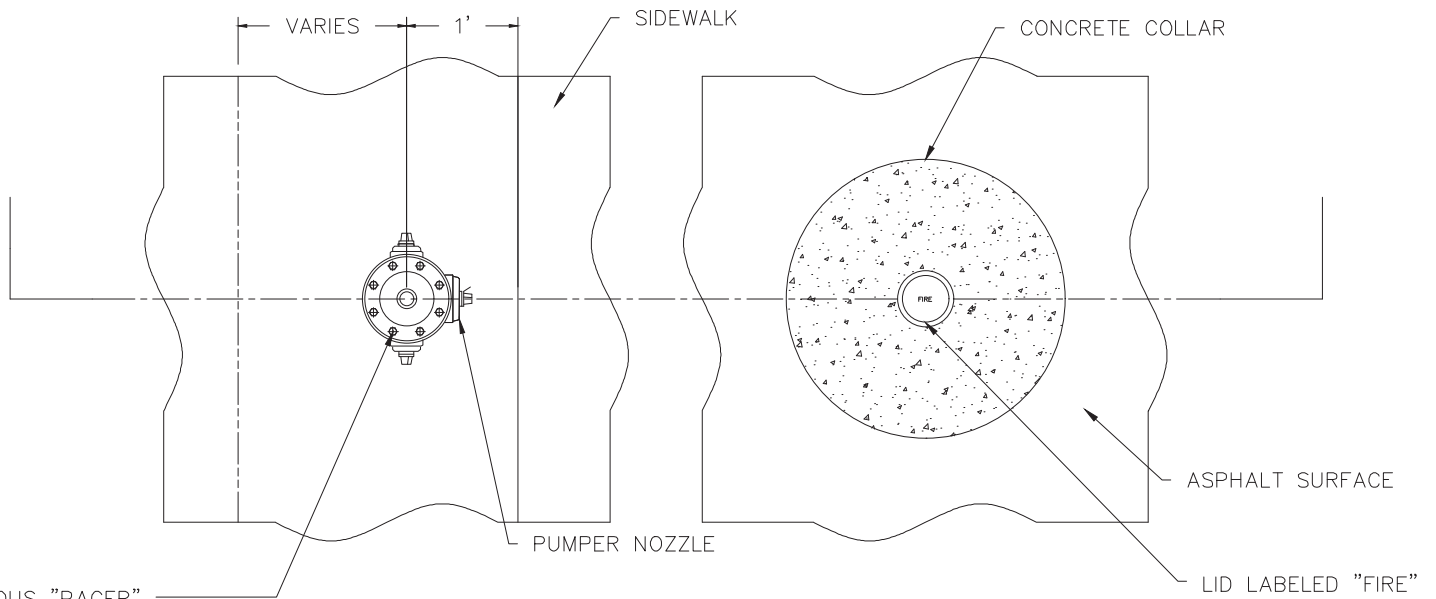
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NO.	BY	APR	DATE



CULINARY WATER SERVICE CONNECTION
SANTAQUIN CITY
275 WEST MAIN STREET

W1
 ADOPTED DATE:
 19 - OCT - 16

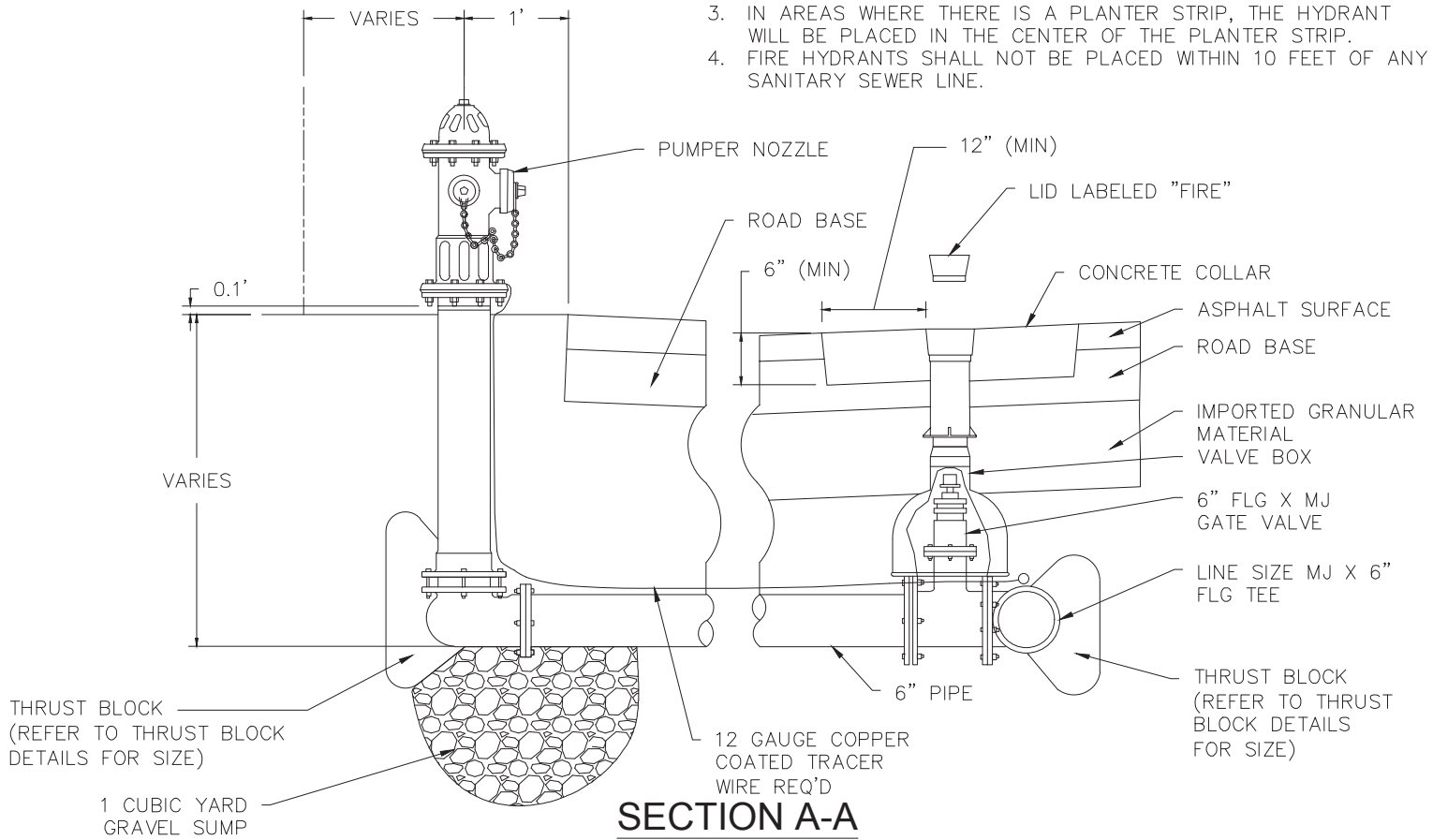


WATEROUS "PACER"
 5 1/4" FIRE HYDRANT OR AS
 APPROVED BY PUBLIC WORKS

PLAN VIEW

NOTES:

1. EACH HYDRANT SHALL HAVE A CLEAR ZONE OF 3 FEET ON THREE SIDES AND OPEN ON THE SIDE OF THE PUMPER NOZZLE.
2. HYDRANT INSTALLED WHERE THERE IS NO CURB & GUTTER SHALL HAVE BOLLARDS PLACED ON EITHER SIDE IN FRONT OF THE HYDRANT
3. IN AREAS WHERE THERE IS A PLANTER STRIP, THE HYDRANT WILL BE PLACED IN THE CENTER OF THE PLANTER STRIP.
4. FIRE HYDRANTS SHALL NOT BE PLACED WITHIN 10 FEET OF ANY SANITARY SEWER LINE.



SECTION A-A

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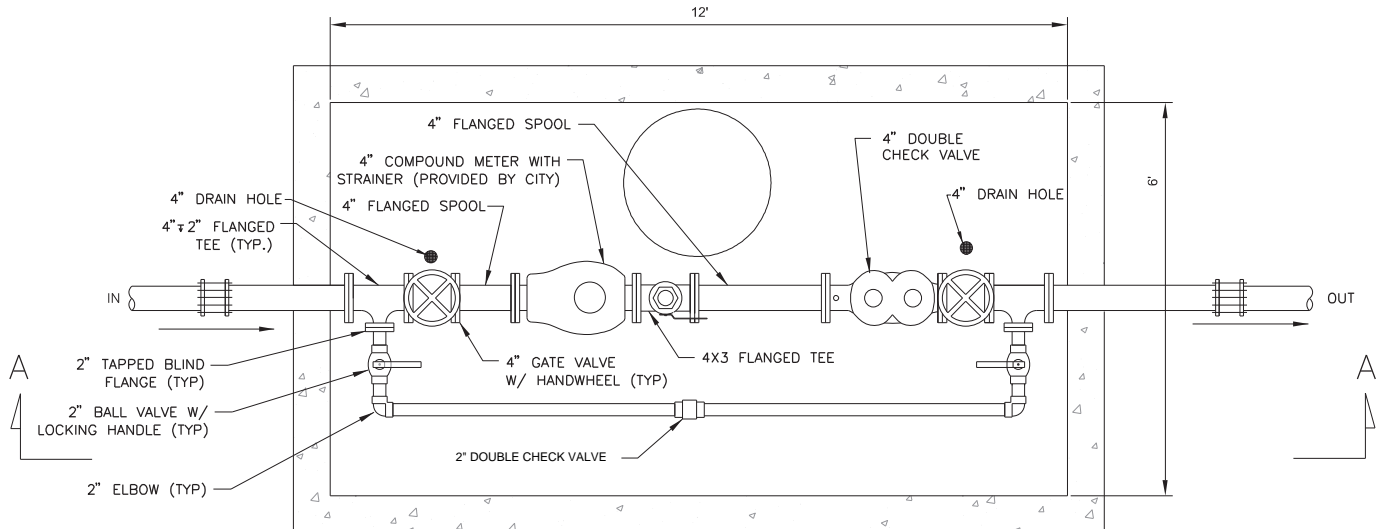
REVISION			
NO.	BY	APR	DATE



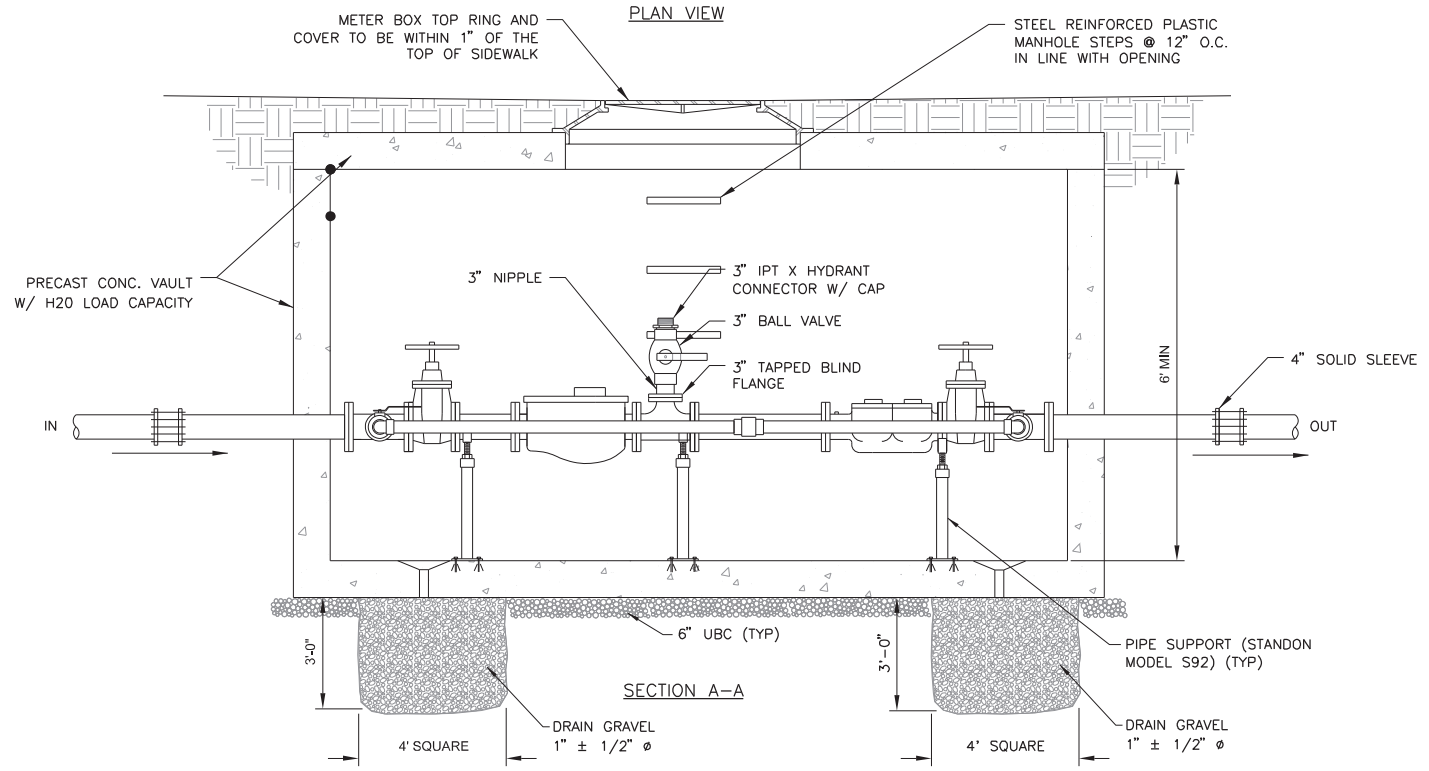
**FIRE HYDRANT &
 WATER VALVE DETAIL**
 SANTAQUIN CITY
 275 WEST MAIN STREET

W2

ADOPTED DATE:
 19 - OCT - 16



CONBRACO 40-10A-02
DOUBLE CHECK ASSEMBLY



- NOTES:
1. ALL 4" PIPE AND FITTINGS SHALL BE DUCTILE IRON.
 2. ALL DUCTILE IRON PIPING AND FITTINGS SHALL BE PAINTED W/ AN NSF APPROVED EPOXY BASED PAINT
 3. ALL 3" & 2" PIPE AND FITTINGS SHALL BE BRASS
 4. ALL REBAR SHALL HAVE 30" OVERLAPS.
 5. PORTLAND CEMENT CONCRETE MAY ONLY BE POURED ON UNDISTURBED SOIL, 3/4" CRUSHED GRAVEL, OR COMPACTED UNTREATED ROAD BASE.
 6. SEPARATE DRAWINGS MUST BE SUBMITTED FOR APPROVAL FOR LARGER WATER SERVICES.
 7. METER BOXES SHALL BE PLACED IN LANDSCAPE AREAS.

4" WATER SERVICE CONNECTION

NOT TO SCALE



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REVISION	DESCRIPTION	BY	APR.	DATE



4" WATER SERVICE CONNECTION

SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	W3
CAD DWG: dws_6-12.dwg	
PLOT SCALE:	1:000
DRAWN BY:	DSF
DESIGN BY:	DSF
CHECKED BY:	DCT
ADOPTED DATE:	20 JUN 12



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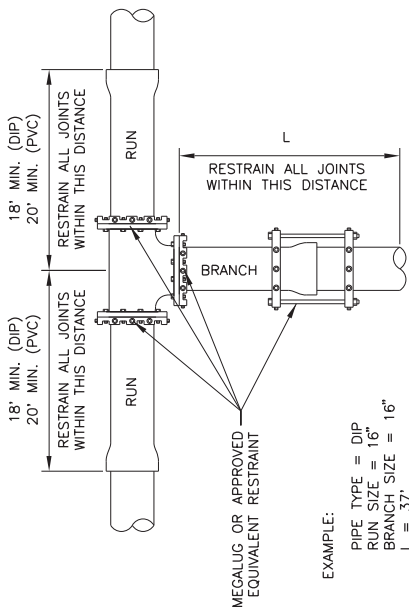
NO.	DESCRIPTION	BY	APR.	DATE
1	ADDED NOTE THAT THRUST BLOCKS ARE NOT SHOWN FOR CLARITY	MEB	MLC	11/2017



MEGALUG RESTRAINING SYSTEM DETAILS

SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	W5
CAD DWG.dwg_6-12.dgn	
PLOT SCALE:	1:000
DRAWN BY:	MEB
DESIGN BY:	MEB
CHECKED BY:	MLC
ADOPTED DATE:	20 JUN 12



PVC TEE RESTRAINED LENGTHS IN FT.

BRANCH SIZE DIA.	RUN SIZE DIAMETER									
	4	6	8	10	12	14	16	18	20	24
4	*	*	*	*	*	*	*	*	*	*
6	*	*	*	*	*	*	*	*	*	*
8	*	*	*	*	*	*	*	*	*	*
10	*	*	*	*	*	*	*	*	*	*
12	*	*	*	*	*	*	*	*	*	*
14	*	*	*	*	*	*	*	*	*	*
16	*	*	*	*	*	*	*	*	*	*
18	*	*	*	*	*	*	*	*	*	*
20	*	*	*	*	*	*	*	*	*	*
24	*	*	*	*	*	*	*	*	*	*

* = FOR THIS CONDITION NEED ONLY RESTRAIN THE OUTLETS OF TEE

NOTES:

- RESTRAIN THE THREE MECHANICAL JOINTS ON THE TEE.
- ALL JOINTS WITHIN THE "L" DISTANCE ON THE BRANCH SIDE OF TEE SHALL BE RESTRAINED AND ALL JOINTS WITHIN 20' ON THE RUN SIDE OF THE TEE SHALL BE RESTRAINED.

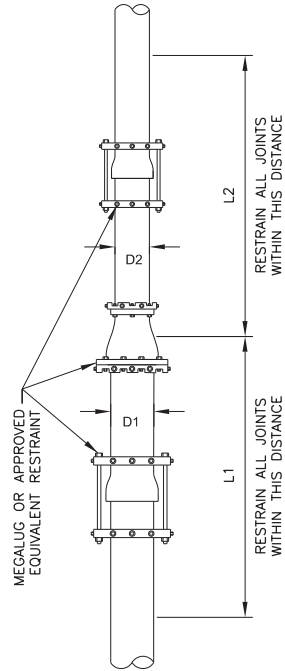
DIP TEE RESTRAINED LENGTHS IN FT.

BRANCH SIZE DIA.	RUN SIZE DIAMETER									
	4	6	8	10	12	14	16	18	20	24
4	*	*	*	*	*	*	*	*	*	*
6	*	*	*	*	*	*	*	*	*	*
8	*	*	*	*	*	*	*	*	*	*
10	*	*	*	*	*	*	*	*	*	*
12	*	*	*	*	*	*	*	*	*	*
14	*	*	*	*	*	*	*	*	*	*
16	*	*	*	*	*	*	*	*	*	*
18	*	*	*	*	*	*	*	*	*	*
20	*	*	*	*	*	*	*	*	*	*
24	*	*	*	*	*	*	*	*	*	*

* = FOR THIS CONDITION NEED ONLY RESTRAIN THE OUTLETS OF TEE

NOTES:

- RESTRAIN THE THREE MECHANICAL JOINTS ON THE TEE.
- ALL JOINTS WITHIN THE "L" DISTANCE ON THE BRANCH SIDE OF TEE SHALL BE RESTRAINED AND ALL JOINTS WITHIN 18' ON THE RUN SIDE OF THE TEE SHALL BE RESTRAINED.



EXAMPLE:

PIPE TYPE = PVC
D1 = 8"
D2 = 6"
L1 = 31'
L2 = 40'

PVC REDUCER RESTRAINED LENGTHS IN FT. (SMALL SIDE/LARGE SIDE)

D2/D1	6	8	10	12	14	16	18	20	24
4	42/29	100/52	171/71	258/90	*	*	*	*	*
6	40/31	88/54	147/75	217/95	297/113	*	*	*	*
8	37/29	82/55	135/77	197/98	266/117	*	*	*	*
10	36/30	79/56	128/80	183/100	244/120	*	*	*	*
12	36/30	77/57	123/80	174/102	293/142	*	*	*	*
14	35/30	74/57	118/81	219/124	*	*	*	*	
16	34/30	73/57	111/80	219/124	*	*	*	*	
18	34/30	73/57	111/80	219/124	*	*	*	*	
20	34/30	73/57	111/80	219/124	*	*	*	*	

NOTES:

- ALL JOINTS WITHIN THE "L" DISTANCE SHALL BE RESTRAINED

DIP REDUCER RESTRAINED LENGTHS IN FT. (SMALL SIDE/LARGE SIDE)

D2/D1	6	8	10	12	14	16	18	20	24
4	27/18	65/34	110/46	166/58	*	*	*	*	*
6	26/20	57/35	95/48	140/61	192/73	*	*	*	*
8	24/19	53/35	87/50	127/63	171/75	*	*	*	*
10	23/20	51/36	82/51	118/64	158/77	*	*	*	*
12	23/20	49/37	79/52	112/66	188/91	*	*	*	*
14	22/20	48/37	76/52	112/66	188/91	*	*	*	*
16	22/20	48/37	76/52	112/66	188/91	*	*	*	*
18	22/19	47/37	75/52	112/66	188/91	*	*	*	*
20	22/19	47/37	75/52	112/66	188/91	*	*	*	*

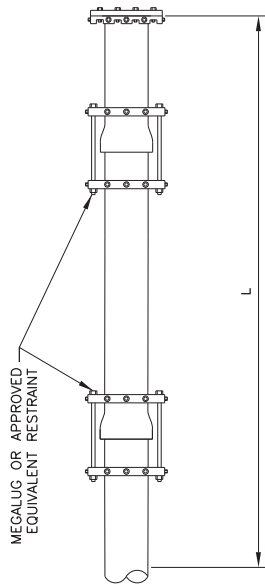
NOTES:

- ALL JOINTS WITHIN THE "L" DISTANCE SHALL BE RESTRAINED

BASED ON:

- TEST PRESSURE: 200 PSI
- SOIL TYPE: CM - SILTY GRAVEL, GRAVEL-SAND-SILT MIXTURE
- BURIAL DEPTH: 4 FT.
- TRENCH TYPE: 5 - PIPE BEDDED IN COMPACTED GRANULAR MATERIAL TO THE CENTER LINE OF PIPE, 4" MIN. UNDER PIPE.
- COMPACTED GRANULAR OR SELECT MATERIAL TO TOP OF PIPE: (APPROX. 95% OF MODIFIED PROCTOR, AASHTO T-180).
- SAFETY FACTOR: 1.5
- * CALCULATIONS DERIVED FROM EBAA IRON SALES

MEGALUG RESTRAINING SYSTEM DETAILS
NOT TO SCALE



EXAMPLE:
PIPE = 10" DIP
L = 52'

NOTE:
1. THRUST BLOCKS NOT SHOWN FOR CLARITY

PVC DEAD END RESTRAINED LENGTHS IN FT.								
PIPE SIZE								
4	6	8	10	12	14	16	18	20
44	62	82	99	118	135	153	169	187

NOTES:
1. ALL JOINTS WITHIN THE "L" DISTANCE SHALL BE RESTRAINED

DIP DEAD END RESTRAINED LENGTHS IN FT.								
PIPE SIZE								
4	6	8	10	12	14	16	18	20
23	33	45	52	62	71	80	89	98

NOTES:
1. ALL JOINTS WITHIN THE "L" DISTANCE SHALL BE RESTRAINED

BASED ON:

TEST PRESSURE: 200 PSI

SOIL TYPE: GM - SILTY GRAVEL, GRAVEL-SAND-SILT MIXTURE

BURIAL DEPTH: 4 FT.

TRENCH TYPE: 5 - PIPE BEDDED IN COMPACTED GRANULAR MATERIAL TO THE CENTER LINE OF PIPE, 4" MIN. UNDER PIPE.

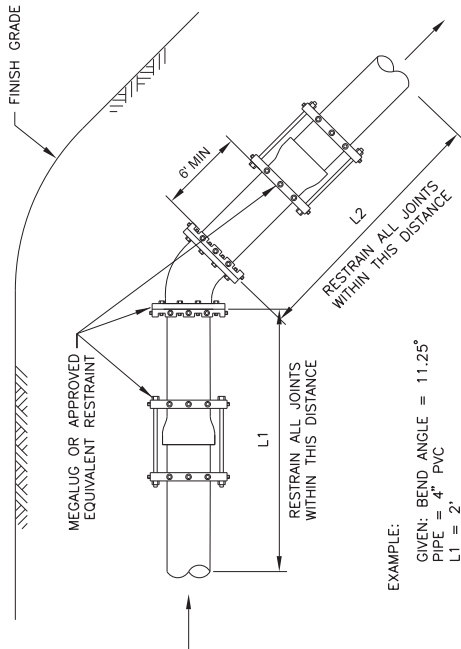
COMPACTED GRANULAR OR SELECT MATERIAL TO TOP OF PIPE (APPROX. 95% OF MODIFIED PROCTOR, AASHTO 1-180)

SAFETY FACTOR: 1.5

* CALCULATIONS DERIVED FROM EBAA IRON SALES

MEGALUG RESTRAINING SYSTEM DETAILS

NOT TO SCALE



EXAMPLE:
GIVEN: BEND ANGLE = 11.25°
PIPE = 4" PVC
L1 = 2'
L2 = 6'

PVC VERTICAL BEND RESTRAINED LENGTHS IN FT. (L1 -BEFORE CONNECTION/L2 -AFTER CONNECTION)									
PIPE SIZE									
BEND ANGLE	4	6	8	10	12	14	16	18	20
11.25	2/6	3/8	4/10	4/12	5/14	6/15	7/17	7/17	8/20
22.5	4/11	6/15	7/19	9/23	10/27	12/31	13/35	15/40	16/40
45	8/23	12/31	15/40	18/48	21/56	24/64	28/72	30/80	33/80

CALCULATIONS BASED ON THE ELEVATION OF THE PIPE REMAINING CONSTANT WITH THE CONTOUR OF THE GROUND.

DIP VERTICAL BEND RESTRAINED LENGTHS IN FT. (L1 -BEFORE CONNECTION/L2 -AFTER CONNECTION)									
PIPE SIZE									
BEND ANGLE	4	6	8	10	12	14	16	20	
11.25	3/3	2/5	3/7	3/8	4/8	4/10	5/11	6/13	
22.5	3/6	4/10	7/11	7/14	8/16	9/18	10/22	12/25	
45	6/14	9/18	12/24	14/28	16/33	19/38	21/43	26/53	

CALCULATIONS BASED ON THE ELEVATION OF THE PIPE REMAINING CONSTANT WITH THE CONTOUR OF THE GROUND.

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REVISION

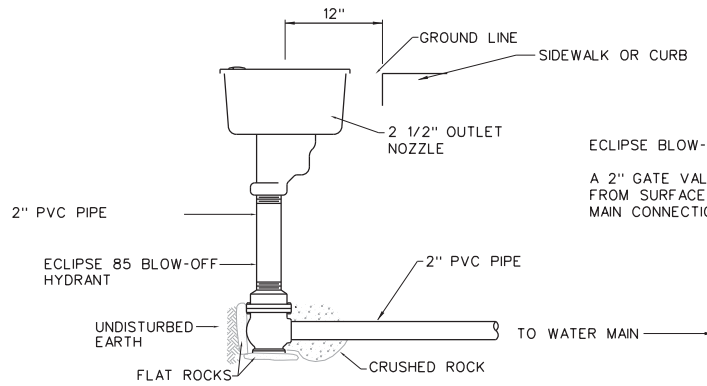
NO.	DESCRIPTION	BY	APR.	DATE
1	ADDED NOTE THAT THRUST BLOCKS ARE NOT SHOWN FOR CLARITY	MEB	MLC	11/20/11



MEGALUG RESTRAINING SYSTEM DETAILS

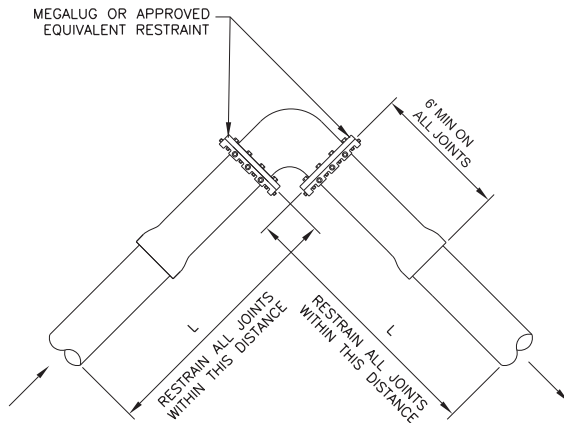
SANTAQUIN CITY
275 WEST MAIN STREET

STANDARD DRAWING NUMBER:	W6
CAD DWG.dwg_6-12.dwg	
PLOT SCALE:	1,000
DRAWN BY:	MEB
DESIGN BY:	MEB
CHECKED BY:	MLC
ADOPTED DATE:	20 JUN 12



ECLIPSE BLOW-OFF ASSEMBLY NOTES:
 A 2" GATE VALVE WITH VALVE BOX (ACCESSIBLE FROM SURFACE) TO BE INSTALLED AT WATER MAIN CONNECTION

ECLIPSE HYDRANT BLOW-OFF ASSEMBLY
 NOT TO SCALE



EXAMPLE:

PIPE = 6" PVC
 L = 28'

PVC HORIZONTAL BEND RESTRAINED LENGTHS IN FT.									
BEND ANGLE	PIPE SIZE								
	4	6	8	10	12	14	16	18	20
90	20	28	37	44	52	59	67	73	81

NOTES:

1. ALL JOINTS WITHIN THE "L" DISTANCE SHALL BE RESTRAINED

DIP HORIZONTAL BEND RESTRAINED LENGTHS IN FT.									
BEND ANGLE	PIPE SIZE								
	4	6	8	10	12	14	16	20	
90	15	21	28	34	40	45	51	62	

NOTES:

1. ALL JOINTS WITHIN THE "L" DISTANCE SHALL BE RESTRAINED

NOTE:

1. THRUST BLOCK NOT SHOWN FOR CLARITY

BASED ON:

TEST PRESSURE: 200 PSI
 SOIL TYPE: GM - SILTY GRAVEL,
 GRAVEL-SAND-SILT MIXTURE
 BURIAL DEPTH: 4 FT.
 TRENCH TYPE: 5 - PIPE BEDDED IN
 COMPACTED GRANULAR MATERIAL TO
 THE CENTER LINE OF PIPE, 4" MIN.
 UNDER PIPE. COMPACTED GRANULAR
 OR SELECT MATERIAL TO TOP OF
 PIPE. (APPROXIMATELY 95% OF
 MODIFIED PROCTOR, AASHTO T-180)

SAFETY FACTOR: 1.5

* CALCULATIONS DERIVED FROM EBAA
 IRON SALES



MEGALUG RESTRAINING SYSTEM DETAILS

NOT TO SCALE

STATEMENT OF USE
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MEGALUG RESTRAINING SYSTEM & ECLIPSE HYDRANT BLOW-OFF ASSEMBLY

SANTAQUIN CITY
 275 WEST MAIN STREET

STANDARD DRAWING NUMBER: **W7**
 CAD: DW610.dwg_6-12.dgn
 PLOT SCALE: 1:800
 DRAWN BY: NEB
 DESIGN BY: NEB
 CHECKED BY: MLC
 ADOPTED DATE: 20 JUN 12

REVISION			
NO.	DESCRIPTION	BY	APR. DATE
1	ADDED NOTE THAT THRUST BLOCKS ARE NOT SHOWN FOR CLARITY		