STANDARD SPECIFICATIONS

City of Universal City

Universal City,
Texas

UNIVERSAL CITY
Est.1960
Gateway to Randolph AFB

Standard Specifications for Public Works Construction

December 2015
***Revised March 2021*

Foreword

All references to “UC” within these specifications are henceforth referred to as “City of Universal City”. These specifications are based upon the most current UC, TxDOT, City of San Antonio, TCEQ, San Antonio River Authority, and/or San Antonio Water System specifications. For additional information on specifications or information on TxDOT Materials Specifications (DMS), Material Producer Lists (MPL), Test Procedures, Material Inspection Guide, and other materials information, go to http://www.txdot.gov.

OUTLINE OF SPECIFICATIONS

Each specification is outlined by Articles and Sections. The basic Articles required for a specification are:

1. **DESCRIPTION**
2. **MATERIALS**
3. **EQUIPMENT**
4. **CONSTRUCTION OR WORK METHODS**
5. **MEASUREMENT**
6. **PAYMENT**

Some Articles are not used in every Item. Measurement and Payment Articles are combined when the work described is subsidiary to bid items of the Contract.

HIERARCHY OF ORGANIZATIONAL ELEMENTS

Here “XXX” represents the Item number. The hierarchy of organizational elements available below the Item level is as follows:

XXX.1., Article
XXX.1.1., Section
XXX.1.1.1., Section
XXX.1.1.1.1. Section
XXX.1.1.1.1.1., Section
XXX.1.1.1.1.1.1. Section

The term Section is used for all breaks below the Article.

This page is intentionally left blank

Table of Contents

ITEMS 1–9 GENERAL REQUIREMENTS AND COVENANTS 1

Item 1 Abbreviations and Definitions 3
2 Instructions to Bidders 14
3 Award and Execution of Contract 19
4 Scope of Work 23
5 Control of the Work 27
6 Control of Materials 33
7 Legal Relations and Responsibilities 37
8 Prosecution and Progress 47
9 Measurement and Payment 56

100 ITEMS 61

Item 100 Mobilization 63
101 Preparing Right Of Way 64
102 Restoring Right of Way 66

200 ITEMS 69

Item 200 Flexible Base 71
201 Prime Coat 72
203 Hot Mix Asphaltic Concrete Pavement 73
204 Cutting and Patching Pavement 75
205 Mastic Surface Treatment- Parking Lot 76
206 Mastic Surface Treatment- Roadway 80
207 Surface Sealing Treatment- Tire Rubber Modified Surface Sealer (TRMSS) 84

300 ITEMS 87

Item 300 Concrete (Natural Aggregate) 89
301 Reinforcing Steel 90
302 Concrete Structures 91
303 Expansion Joint Materials 94

400 ITEMS 99

Item 400 Excavation, Trenching and Backfilling 101
401 Storm Drainage Pipe 106
402 Storm Sewer Manholes and Inlets 110
403 Jacking, Boring and Tunneling 111
405 Cast Iron Castings 113
406 Subgrade Filler 114
407 Granular Fill Materials 116
408 Flowable Backfill 118
409 Riprap 119

Table of Contents
(Continued)

500 ITEMS 121

Item 500 Temp Erosion, Sedimentation and Water Pollution Prevention Control 123
550 Trench Excavation Safety Protection 125

800 ITEMS 127

Item 804 Excavation, Trenching, and Backfill 129
812 Water Main Installation 138
814 Ductile Iron Pipe 146
818 PVC (C-905 and C-909) Pipe Installation 149
824 Service Supply Line (Water) 151
828 Gate Valves 158
830 Butterfly Valves 160
833 Meter and Meter Box Installation 162
834 Fire Hydrants 164
841 Hydrostatic Testing Operations 167
848 Sanitary Sewers 171
849 Air and Deflection Testing (Sanitary Sewer) 176
852 Sanitary Sewer Manholes 180
854 Sanitary Sewer Laterals 187
856 Jacking, Boring or Tunneling Pipes 189
858 Concrete Encasement, Cradles, Saddles, and Collars 191
870 Sanitary Sewer Lift Station 193

900 ITEMS 237

Item 900 Excavation, Trenching, and Backfill For Utilities 239

Items 1–9

General Requirements and Covenants

This page is intentionally left blank

Item 1
Abbreviations and Definitions

1. APPLICABILITY

Wherever the following terms are used in these specifications or other Contract documents, the intent and meaning will be interpreted as shown below.

2. ABBREVIATIONS

AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AI	Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALSC	American Lumber Standard Committee, Inc.
AMRL	AASHTO Materials Reference Laboratory
ANLA	American Nursery and Landscape Association
ANSI	American National Standards Institute
APA	The Engineered Wood Association
API	American Petroleum Institute
APWA	American Public Works Association
AREMA	American Railway Engineering and Maintenance-of-Way Association
ASBI	American Segmental Bridge Institute
ASCE	American Society of Civil Engineers
ASLA	American Society of Landscape Architects
ASME	American Society of Mechanical Engineers
ASNT	American Society for Nondestructive Testing
ASTM	American Society for Testing and Materials
AWC	American Wood Council
AWG	American Wire Gage
AWPA	American Wood Protection Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BMP	Best Management Practices
CFR	Code of Federal Regulations
CMP	Corrugated Metal Pipe
COE	U.S. Army Corps of Engineers
CRSI	Concrete Reinforcing Steel Institute
DBE	Disadvantaged Business Enterprise
DMS	Departmental Material Specification
EIA	Electronic Industries Alliance
EPA	United States Environmental Protection Agency
FHWA	Federal Highway Administration, U.S. Department of Transportation
FSS	Federal Specifications and Standards (General Services Administration)
GSA	General Services Administration
HUB	Historically Underutilized Business
ICEA	Insulated Cable Engineers Association

IEEE	Institute of Electrical and Electronics Engineers
IESNA	Illuminating Engineering Society of North America
IMSA	International Municipal Signal Association
ISO	International Organization for Standardization
ITS	Intelligent Transportation System
ITE	Institute of Transportation Engineers
LRFD	Load and Resistance Factor Design
MASH	Manual for Assessing Safety Hardware
MPL	Material Producer List
NCHRP	National Cooperative Highway Research Program
NCR	Nonconformance Report
NEC	National Electrical Code (Published by NFPA)
NEMA	National Electrical Manufacturers Association
NEPA	National Environmental Policy Act
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NRM	Nonhazardous Recyclable Material
NRMCA	National Ready Mixed Concrete Association
NSBA	National Steel Bridge Alliance
NTPEP	National Transportation Product Evaluation Program
OSHA	Occupational Safety & Health Administration, U.S.
PCA	Portland Cement Association
PCI	Precast/Prestressed Concrete Institute
PPI	Plastics Pipe Institute
PS&E	Plans, Specifications, and Estimates
PSL	Project-Specific Location
PTI	Post-Tension Institute
QA	Quality Assurance
QC	Quality Control
RCP	Reinforced Concrete Pipe
RMC	Routine Maintenance Contract
RPLS	Registered Professional Land Surveyor
RRC	Railroad Commission of Texas
SBE	Small Business Enterprise
SFPA	Southern Forest Products Association
SI	International System of Units
SPIB	Southern Pine Inspection Bureau
SSPC	The Society for Protective Coatings
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TDLR	Texas Department of Licensing and Regulation
TMUTCD	Texas Manual on Uniform Traffic Control Devices
UC	City of Universal City
UL	Underwriters Laboratory, Inc.
USC	United States Code
WRI	Wire Reinforcement Institute
WWPA	Western Wood Products Association

3. DEFINITIONS

3.1. **Abrasive Blasting**. Spraying blasts of pressurized air combined with abrasive media.

3.2. **Actual Cost**. Contractor's actual cost to provide labor, material, equipment, and project overhead necessary for the work.

3.3. **Addendum**. Change in bid forms developed between advertising and bid submittal

deadline.

3.4. **Additive Alternate**. A bid item contained in a bid that is not a regular item or a replacement alternate bid item. The additive alternate item(s) include work that may be added to the base bid work.

3.5. **Advertisement**. The public announcement required by law inviting bids for work to be performed or materials to be furnished.

3.6. **Affiliates**. Two or more firms are affiliated if they share common officers, directors, or stockholders; a family member of an officer, director, or stockholder of one firm serves in a similar capacity in another of the firms; an individual who has an interest in, or controls a part of, one firm either directly or indirectly also has an interest in, or controls a part of, another of the firms; the firms are so closely connected or associated that one of the firms, either directly or indirectly, controls or has the power to control another firm; or the firms are closely allied through an established course of dealings including, but not limited to the lending of financial assistance.

3.7. **Air Blasting**. Spraying blasts of pressurized air free of oil and moisture.

3.8. **Air Temperature**. The temperature measured in degrees Fahrenheit (°F) in the shade, not in the direct rays of the sun, and away from artificial heat.

3.9. **Anticipated Profit**. Profit for work not performed.

3.10. **Apparent Low Bidder**. The Bidder determined to have the numerically lowest total bid as a result of the tabulation of bids by UC.

3.11. **Architect of Record**. A person registered as an architect or licensed as a landscape architect, in accordance with State law, exercising overall responsibility for the design or a significant portion of the design and performs certain Contract administration responsibilities as described in the Contract; or a firm employed by the State to provide professional architectural services.

3.12. **Arterial Highway**. A highway used primarily for through traffic and usually on a continuous route.

3.13. **Available Bidding Capacity**. The Contractor's approved bidding capacity less uncompleted work on UC Contracts.

3.14. **Award**. The City Council's acceptance of a Contractor's bid for a proposed Contract that authorizes UC to enter into a Contract.

3.15. **Base Bid**. The total bid amount without additive alternates.

3.16. **Bid**. The offer from the Bidder submitted on the prescribed form, including addenda issued, giving unit bid prices for performing the work described in the plans and Specifications.

3.17. **Bid Bond**. The security executed by the Contractor and the Surety furnished to UC to guarantee payment of liquidated damages if the Contractor fails to enter into an awarded Contract.

3.18. **Bid Error**. A mathematical mistake made by a Bidder in the unit price entered into the bid.

3.19. **Bid Form**. The form printed and sent to the Bidder by UC's consulting engineer or printed by the Bidder from UC's bidding system.

3.20. **Bid Guaranty**. The security furnished by the Bidder as a guarantee that the Bidder will enter into a Contract if awarded the work.

3.21. **Bidder**. An individual, partnership, limited liability company, corporation, or joint venture submitting a bid for a proposed Contract.

3.22. **Bidders Questionnaire**. A prequalification form completed by a prospective Bidder reflecting a Bidder's financial data and experience.

3.23. **Bidding Capacity**. The maximum dollar value a Contractor may have under Contract with UC at any given time.

3.24. **Blast Cleaning**. Using one of the blasting methods including, but not limited to water blasting, low-pressure water blasting, high-pressure water blasting, abrasive blasting, water-abrasive blasting, shot blasting, slurry blasting, water injected abrasive blasting, and brush blasting.

3.25. **Bridge**. A structure, including supports, erected over a depression or an obstruction (e.g., water, a highway, or a railway) having a roadway or track for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than 20 ft. between faces of abutments, spring lines of arches, or extreme ends of the openings for multiple box culverts.

3.26. **Brush Blasting**. Sweeping lightly with an abrasive blast to remove loose material.

3.27. **Building Contract**. A Contract entered under Transportation Code, Chapter 223, Subchapter A, "Competitive Bids," for the construction or maintenance of a UC building or appurtenance facilities. Building Contracts are considered to be construction Contracts.

3.28. **Callout Work**. Contracts, or work items in Contracts, that require a Contractor's response on an as-needed basis (e.g., see Item 351, "Flexible Pavement Structure Repair").

3.29. **Certificate of Insurance**. A form approved by UC covering insurance requirements stated in the Contract.

3.30. **Change Order**. Written order to the Contractor detailing changes to the specified work, item quantities or any other modification to the Contract.

3.31. **Commission**. The Texas Transportation Commission or authorized representative.

3.32. **Concrete Construction Joint**. A joint formed by placing plastic concrete in direct contact with concrete that has attained its initial set.

3.33. **Concrete Repair Manual**. TxDOT manual specifying methods and procedures for concrete repair as an extension of the standard specifications.

3.34. **ConcreteWorks©**. TxDOT-owned software for concrete heat analysis. Software is available on TxDOT website.

3.35. **Construction Contract**. A Contract entered under Transportation Code, Chapter 223, Subchapter A, for the construction, reconstruction, or maintenance of a segment of the State highway system.

3.36. **Consultant**. The licensed professional engineer or engineering firm, or the architect or architectural firm, registered in the State of Texas and under Contract to UC to perform

professional services. The consultant may be the Engineer, architect, or sub consultant to the Engineer or Architect of record.

3.37. **Contract**. The agreement between UC and the Contractor establishing the obligations of the parties for furnishing of materials and performance of the work prescribed in the Contract documents.

3.38. **Contract Documents**. Elements of the Contract including, but not limited to the plans, specifications incorporated by reference, special provisions, special specifications, Contract bonds, change orders, and supplemental agreements.

3.39. **Contract Time**. The number of working days specified for completion of the work, including authorized additional working days.

3.40. **Contractor**. The individual, partnership, limited liability company, corporation, or joint venture and all principals and representatives with which the Contract is made by UC.

3.41. **Controlled Access Highway**. Any highway to or from which access is denied or controlled, in whole or in part, from or to abutting land or intersecting streets, roads, highways, alleys, or other public or private ways.

3.42. **Control of Access**. The condition in which the right to access of owners or occupants of abutting land or other persons in connection with a highway is fully or partially controlled by public authority.

3.43. **Control Point**. An established point shown on the plans to provide vertical and horizontal references for geometric control for construction.

3.44. **Cross-Sections**. Graphic representations of the original ground and the proposed facility, at right angles to the centerline or base line.

3.45. **Culvert**. Any buried structure providing an opening under a roadway for drainage or other purposes. Culverts may also be classified as bridges. (See Section 1.3.23., “Bridge.”)

3.46. **Cycle**. The activity necessary for performing the specified work within the right of way project limits once.

3.47. **Daily Road-User Cost**. Damages based on the estimated daily cost of inconvenience to the traveling public resulting from the work.

3.48. **Date of Written Authorization**. Date of the written work order authorizing the Contractor to begin work.

3.49. **Detour**. A temporary traffic route around a closed portion of a road.

3.50. **Department**. The Texas Department of Transportation (TxDOT).

3.51. **Departmental Material Specifications**. Reference specifications for various materials published by the T x D O T Construction Division.

3.52. **Direct Traffic Culvert**. Concrete box culvert whose top slab is used as the final riding surface or is to have an overlay or other riding surface treatment.

3.53. **Divided Roadway**. A roadway with separate roadways intended to move traffic in opposite directions.

3.54. **Easement**. A real property right acquired by one party to use land belonging to another party for a specified purpose.

3.55. **Engineer**. The Consulting Engineer of UC.

3.56. **Expressway**. A divided arterial highway for through traffic with full or partial control of access and generally with grade separations at intersections.

3.57. **Frontage Road**. A local street or road auxiliary to and located along an arterial highway for service to abutting property and adjacent areas and for control of access (sometimes known as a service road, access road, or insulator road).

3.58. **Hazardous Materials or Waste**. Hazardous materials or waste include but are not limited to explosives, compressed gas, flammable liquids, flammable solids, combustible liquids, oxidizers, poisons, radioactive materials, corrosives, etiologic agents, and other material classified as hazardous by 40 CFR 261, or applicable state and federal regulations.

3.59. **Holidays**. January 1,the third Monday in January, the third Monday in February, the last Monday in May, July 4, the first Monday in September, the second Monday in October, November 11, the fourth Thursday in November, the Friday after Thanksgiving Day, December 24, and December 25.

3.60. **High-Pressure Water Blasting**. Water blasting with pressures between 5,000 and 10,000 psi.

3.61. **Highway, Street, or Road**. General terms denoting a public way for purposes of vehicular travel, including the entire area within the right of way. Recommended usage in urban areas is highway or street; in rural areas, highway or road.

3.62. **Independent Assurance Tests**. Tests used to evaluate the sampling and testing techniques and equipment used in the acceptance program. The tests are performed by UC and are not used for acceptance purposes.

3.63. **Inspector**. The person assigned by UC to inspect for compliance with the Contract any or all parts of the work and the materials used.

3.64. **Intelligent Transportation System**. An integrated system that uses video and other electronic detection devices to monitor traffic flows.

3.65. **Intersection**. The general area where 2 or more highways, streets, or roads join or cross, including the roadway and roadside facilities for traffic movements within it.

3.66. **Island**. An area within a roadway from which vehicular traffic is intended to be excluded, together with any area at the approach occupied by protective deflecting or warning devices.

3.67. **Joint Venture**. Any combination of individuals, partnerships, limited liability companies, or corporations submitting a single bid.

3.68. **Letting**. The receipt, opening, tabulation, and determination of the apparent low Bidder.

3.69. **Letting Official**. UC City Clerk or any UC employee empowered by the City Clerk to officially receive bids and close the receipt of bids at a letting.

3.70. **Licensed Professional Engineer**. A person who has been duly licensed by the Texas Board of Professional Engineers to engage in the practice of engineering in the State of Texas; also referred to as a Professional Engineer.

3.71. **Limits of Construction**. An area with established boundaries, identified within UC's right of way and easements, where the Contractor is permitted to perform the work.

3.72. **Local Street or Road**. A street or road primarily for access to residence, business, or other abutting property.

3.73. **Low-Pressure Water Blasting**. Water blasting with pressures between 3,000 and 5,000 psi.

3.74. **Manual of Testing Procedures**. TxDOT manual outlining test methods and procedures maintained by TxDOT's Materials and Pavements Section of the Construction Division.

3.75. **Material Producer List**. TxDOT maintained list of approved products located on their website.

3.76. **Median**. The portion of a divided highway separating the traffic lanes in opposite directions.

3.77. **Milestone Date**. The date that a specific portion of the work is to be completed, before the completion date for all work under the Contract.

3.78. **Monolithic Concrete Placement**. The placement of plastic concrete in such manner and sequence to prevent a construction joint.

3.79. **Nonhazardous Recyclable Material**. A material recovered or diverted from the nonhazardous waste stream for the purposes of reuse or recycling in the manufacture of products that may otherwise be produced using raw or virgin materials.

3.80. **Nonresident Bidder**. A Bidder whose principal place of business is not in Texas. This includes a Bidder whose ultimate parent company or majority owner does not have its principal place of business in Texas.

3.81. **Notice to Proceed**. Written notice to the Contractor to begin the work. The work order may include the date on which work or time charges are to begin, the number of working days for specified work (for multiple work order Contracts), and plan sheets providing additional details specific to a location or to an item of work for non-site-specific work.

3.82. **Notification**. Either written or oral instruction to the Contractor concerning the work. Voice mail is oral notification.

3.83. **Pavement**. That part of the roadway having a constructed surface for the use of vehicular traffic.

3.84. **Pavement Structure**. Combination of surface course and base course placed on a subgrade to support the traffic load and distribute it to the roadbed.

3.85. **Surface Course**. Pavement structure layers designed to accommodate the traffic load. The top layer resists skidding, traffic abrasion, and the disintegrating effects of climate and is sometimes called the wearing course.

3.86. **Base Course**. One or more layers of specified material thickness placed on a subgrade to support a surface course.

3.87. **Subgrade**. The top surface of a roadbed upon which the pavement structure, shoulders, and curbs are constructed.

3.88. **Subgrade Treatment**. Modifying or stabilizing material in the subgrade.

3.89. **Payment Bond**. The security executed by the Contractor and the Surety, furnished to UC to guarantee payment of all legal debts of the Contractor pertaining to the Contract.

3.90. **Performance Bond**. The security executed by the Contractor and the Surety, furnished to UC to guarantee the completion of the work in accordance with the terms of the Contract.

3.91. **Plans**. The drawings approved by the Engineer, including true reproductions of the drawings that show the location, character, dimensions, and details of the work and are a part of the Contract.

3.92. **Power of Attorney for Surety Bonds**. An instrument under corporate seal appointing an attorney-in-fact to act on behalf of a Surety in signing bonds.

3.93. **Prequalification**. The process for determining a Contractor's eligibility to bid work.

3.94. **Prequalification Statement**. The forms on which required information is furnished concerning the Contractor's ability to perform and finance the work.

3.95. **Project-Specific Location**. A material source, plant, waste site, parking area, storage area, field office, staging area, haul road, or other similar location either outside the project limits or within the project limits but not specifically addressed in the Contract.

3.96. **Bid**. The offer from the Bidder submitted on the prescribed form, including addenda issued, giving unit bid prices for performing the work described in the plans and Specifications.

3.97. **Quality Assurance**. Sampling, testing, inspection, and other activities conducted by the Engineer to determine payment and make acceptance decisions.

3.98. **Quality Control**. Sampling, testing, and other process control activities conducted by the Contractor to monitor production and placement operations.

3.99. **Ramp**. A section of highway for the primary purpose of making connections with other highways.

3.100. **Recurring Maintenance Work Contracts**. Contracts or work for which maintenance is needed at the same location on more than one occasion (e.g., mowing contracts for which mowing cycles are requested on multiple occasions).

3.101. **Referee Tests**. Tests requested to resolve differences between Contractor and Engineer test results. The referee laboratory is the Construction Division.

3.102. **Regular Item**. A bid item contained in a bid and not designated as an additive alternate or replacement alternate bid item.

3.103. **Rental Rate Blue Book for Construction Equipment**. Publication containing equipment rental rates.

3.104. **Replacement Alternate**. A bid item identified the bid form that a Bidder may substitute for a specific regular item of work.

3.105. **Responsive Bid**. A bid that meets all requirements of the bid form for acceptance.

3.106. **Right of Way**. A general term denoting land or property devoted to transportation purposes.

3.107. **Roadbed**. The graded portion of a highway prepared as foundation for the pavement structure and shoulders. On divided highways, the depressed median type and the raised median type highways are considered to have 2 roadbeds. Highways with a flush median are considered to have 1 roadbed. Frontage roads are considered separate roadbeds.

3.108. **Road Master**. A railroad maintenance official in charge of a division of railway.

3.109. **Roadside**. The areas between the outside edges of the shoulders and the right of way boundaries. Unpaved median areas between inside shoulders of divided highways and areas within interchanges are included.

3.110. **Roadway**. The portion of the highway (including shoulders) used by the traveling public.

3.111. **Routine Maintenance Contract**. A Contract let through the routine maintenance contracting procedure to preserve and repair roadways, rights of way, and appurtenances.

3.112. **Sandblasting, Dry**. Spraying blasts of pressurized air combined with sand.

3.113. **Sandblasting, Wet**. Spraying blasts of pressurized water combined with sand.

3.114. **Shoulder**. That portion of the roadway contiguous with the traffic lanes for accommodation of stopped vehicles for emergency use or for lateral support of base and surface courses.

3.115. **Shot Blasting**. Spraying blasts of pressurized air combined with metal shot.

3.116. **Sidewalk**. Portion of the right of way constructed exclusively for pedestrian use.

3.117. **Slurry Blasting**. Spraying blasts of pressurized air combined with a mixture of water and abrasive media.

3.118. **Special Provisions**. Additions or revisions to these standard specifications or special specifications.

3.119. **Special Specifications**. Supplemental specifications applicable to the Contract not covered by these standard specifications.

3.120. **Specifications**. Directives or requirements issued or made pertaining to the method and manner of performing the work or to quantities and qualities of materials to be furnished under the Contract. References to DMSs, ASTM or AASHTO specifications, or TXDOT bulletins and manuals, imply the latest standard or tentative standard in effect on the date of the bid. The Engineer will consider incorporation of subsequent changes to these documents in accordance with Item 4, “Scope of Work.”

3.121. **State**. The State of Texas.

3.122. **Station**. A unit of measurement consisting of 100 horizontal feet.

3.123. **Subcontract**. The agreement between the Contractor and subcontractor establishing the obligations of the parties for furnishing of materials and performance of the work prescribed in the Contract documents.

3.124. **Subcontractor**. A Subcontractor is defined as an individual, partnership, limited liability company, corporation, or any combination thereof that the Contractor sublets, or proposes to sublet, any portion of a Contract, excluding a material supplier, a hauling firm hauling only from a commercial source to the project, truck owner-operator, wholly-owned

subsidiary, or specialty-type businesses such as security companies and rental companies.

3.125. **Subsidiary**. Materials, labor, or other elements that because of their nature or quantity have not been identified as a separate item and are included within the items on which they necessarily depend.

3.126. **Superintendent**. The representative of the Contractor who is available at all times and able to receive instructions from the Engineer or authorized UC representatives and to act for the Contractor.

3.127. **Supplemental Agreement**. Written agreement entered into between the Contractor and UC and approved by the Surety, covering alterations and changes in the Contract. A supplemental agreement is used by UC whenever the modifications include assignment of the Contract from one entity to another or other cases as desired by UC.

3.128. **Surety**. The corporate body or bodies authorized to do business in Texas bound with and for the Contractor for the faithful performance of the work covered by the Contract and for the payment for all labor and material supplied in the prosecution of the work.

3.129. **Surplus Materials**. Any debris or material related to the Contract not incorporated into the work.

3.130. **Suspension**. Action taken by UC or federal government pursuant to regulation that prohibits a person or company from entering into a Contract, or from participating as a subcontractor, or supplier of materials or equipment used in a highway improvement Contract as defined in Transportation Code, Chapter 223, Subchapter A.

3.131. **Traffic Lane**. The strip of roadway intended to accommodate the forward movement of a single line of vehicles.

3.132. **Traveled Way**. The portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes.

3.133. **Truck Owner-Operator**. An individual who owns and operates 1 truck for hire.

3.134. **Utility**. Privately, publicly, or cooperatively owned lines, facilities, and systems for producing, transmitting, or distributing communications, power, heat, gas, oil, water, waste, or storm water that are not connected with the highway drainage, signal systems, or other products that directly or indirectly serve the public; the utility company.

3.135. **Verification Tests**. Tests used to verify accuracy of QC and QA and mixture design testing.

3.136. **Water-Abrasive Blasting**. Spraying blasts of pressurized water combined with abrasive media.

3.137. **Water Blasting**. Spraying blasts of pressurized water of at least 3,000 psi.

3.138. **Water-Injected Abrasive Blasting**. Abrasive blasting with water injected into the abrasive/air stream at the nozzle.

3.139. **Wholly-Owned Subsidiary**. A legal entity owned entirely by the Contractor or subcontractor.

3.140. **Work**. The furnishing of all labor, materials, equipment, and other incidentals necessary for the successful completion of the Contract.

3.141. **Written Notice**. Written notice is considered to have been duly given if delivered in person to the individual or member to whom it is intended or if sent by regular, registered, or certified mail and delivered to the last known business address; sent by facsimile to the last known phone number; or sent by e-mail to the last known address. The date of the letter will serve as the beginning day of notice. Unclaimed mail or failure to provide current mailing address will not be considered a failure to provide written notice.

Item 2
Instructions to Bidders

1. INTRODUCTION

Instructions to the Contractor in these Specifications are generally written in active voice, imperative mood. The subject of imperative sentences is understood to be “the Contractor. UCs responsibilities are generally written in passive voice, indicative mood. Phrases such as “as approved,” “unless otherwise approved,” “upon approval,” “as directed,” “as verified,” “as ordered,” and “as determined” refer to actions of UC unless otherwise stated, and it is understood that the directions, orders, or instructions to which they relate are within the limitations of and authorized by the Contract.

2. ISSUING BID FORMS

UC will issue a bid form to a Bidder if the Engineer’s estimate is within that Bidder’s available bidding capacity. Request a bid form electronically from UC’s Consultant.

UC will not issue a bid form if one or more of the following apply:

- the Bidder is suspended or debarred by any governmental agency,
- the Bidder does not have the available bidding capacity,
- the Bidder is prohibited from rebidding a specific bid form due to a bid error on the original bid form,
- the Bidder failed to enter into a Contract on the original award,
- the Bidder was defaulted or terminated on the original Contract, unless UC terminated for convenience.

3. INTERPRETING ESTIMATED QUANTITIES

The quantities listed in the bid form are approximate and will be used for the comparison of bids. Payments will be made for the work performed in accordance with the Contract.

4. EXAMINING DOCUMENTS AND WORK LOCATIONS

Examine the bid form, plans, specifications, and specified work locations before submitting a bid for the work. Submitting a bid will be considered evidence that the Bidder has performed this examination. If borings, soil profiles, water elevations, and underground utilities shown on the plans were obtained, they are for the use of UC in the preparation of plans. This information is provided for the Bidder’s information only and UC makes no representation as to the accuracy of the data. Be aware of the difficulty of accurately classifying all material encountered in making foundation investigations, the possible erosion of stream channels and banks after survey data have been obtained, and the unreliability of water elevations other than for the date recorded.

Oral explanations, instructions, or consideration for Contractor-proposed changes in the bid form given during the bidding process are not binding. Only requirements included in the bid form, associated specifications, plans, and UC-issued addenda are binding. Request explanations of documents in adequate time to allow UC to reply before the bid opening.

Immediately notify UC of any error, omission, or ambiguity discovered in any part of the

bid form and Contract documents. UC will issue addenda when appropriate.

5. PREPARING THE BID

Prepare the bid on the forms furnished by the Consulting Engineer.

Specify a unit price in dollars and cents for each regular Item and additive alternate Item, or replacement alternate Item for which an estimated quantity is given.

When "Working Days" is an Item, submit the number of working days to be used to complete the Contract or phases of the Contract shown on the plans.

UC will not accept an incomplete bid. A bid that has one or more of the deficiencies listed below is considered incomplete:

- the bid form was not signed,
- certifications were not acknowledged,
- a regular item or the additive alternate item are left blank;
- a regular item and the corresponding replacement alternate item are left blank,
- the bid form submitted had the incorrect number of items, or
- The Bidder did not acknowledge all addenda.

6. NONRESPONSIVE BID

UC will not accept a nonresponsive bid. A bid that has one or more of the deficiencies listed below is considered nonresponsive:

- The bid was not in the hands of the UC Clerk at the time and location specified in the advertisement.
- A bid was submitted for the same bid form by a Bidder or Bidders and one or more of its partners or affiliates.
- The Bidder was not authorized to receive a bid form under Section 2, "Issuing Bid Forms."
- The Bidder failed to acknowledge receipt of all addenda issued.
- The bid form was signed by a person who was not authorized to bind the Bidder or Bidders.
- The bid guaranty did not comply with the requirements contained in this Article.
- The bid was in a form other than the official bid form issued by UC.
- The Bidder modified the bid in a manner that altered the conditions or requirements for work as stated in the bid form.
- The Bidder bid more than the maximum or less than the minimum number of allowable working days shown on the plans when working days was an Item.
- The Bidder did not attend a specified mandatory pre-bid conference.
- The Bidder did not meet the requirements of the technical qualification.

7. PRINTED BID

7.1. **Bid Form**. Mark all entries in ink. As an alternative to hand writing the unit prices in the bid form, submit a typed bid form. A typed bid form must contain the information in the format shown on the "Example of Bid Prices Submitted by Computer Printout" in the bid form.

When regular bid items have corresponding replacement alternate items, select the bid item or group of items to be used for the bid tabulation. Acknowledge all addenda by checking the appropriate box on the addendum acknowledgement page. Provide the complete and correct name of the Bidder submitting the bid. A person authorized to bind

the Bidder must sign the bid form. In the case of a joint venture, provide the complete and correct name of all Bidders submitting the bid. In the case of a joint venture, the person signing the bid form must be authorized to bind all joint venture participants.

Bid form shall contain regular items for domestic steel or iron materials only. Bid form shall not contain replacement alternative items for foreign steel or iron materials.

7.2. **Bid Guaranty**. Provide a bid guaranty in the amount indicated on the bid form. Use either a guaranty check or a printed bid bond.

7.3. **Guaranty Check**. Make the check payable to the City of Universal City. The check must be a cashier's check, money order, or teller's check drawn by or on a state or national bank, or a state or federally chartered credit union (collectively referred to as "bank"). The check must be dated on or before the date of the bid opening. Postdated checks will not be accepted. The type of check or money order must be indicated on the face of the instrument, except in the case of a teller's check, and the instrument must be no more than 90 days old. A check must be made payable at or through the institution issuing the instrument; be drawn by a bank and on a bank; or be payable at or through a bank. UC will accept personal checks, certified checks, or other types of money orders.

7.4. **Bid Bond**. Use the bid bond form provided by UC. Submit the bid bond with the powers of attorney attached and in the amount specified. The bond must be dated on or before the date of the bid opening, bear the impressed seal of the Surety, and be signed by the Bidder or Bidders and an authorized individual of the Surety. As an alternative for joint venture Bidders, each of the Bidders may submit a separate bid bond completed as outlined in this Section. Bid bonds will only be accepted from Sureties authorized to execute a bond under and in accordance with state law.

7.5. **Submittal of Bid.** Place the completed bid form and the bid guaranty in a sealed envelope marked to indicate the contents.

When submitting by mail or delivery service, place the envelope in another sealed envelope and address as indicated in the official advertisement. It is the Bidder's responsibility to ensure that the sealed bid arrives at the location described on or before the time and date set for the bid opening. To be accepted, the bid must be in the hands of the City Clerk by that time of opening regardless of the method chosen for delivery.

7.6. **Revising the Bid Form**. Make desired changes to the bid form in ink and submit the bid to the City Clerk. UC will not make revisions to a bid on behalf of a Bidder.

7.7. **Withdrawing a Bid**. Submit a written request to withdraw a bid before the time and date set for the opening. UC will not accept oral requests. A written request must be signed and submitted to the City Clerk with proof of identification. The request must be made by a person authorized to bind the Bidder or Bidders. In the case of joint venture, UC will accept a request from any person authorized to bind a party to the joint venture. UC may require written delegation of authority to withdraw a bid when the individual sent to withdraw the bid is not authorized to bind the Bidder or Bidders.

8. OPENING AND READING OF BIDS

At the time, date, and location specified in the official advertisement, the UC City Clerk and/or the City Engineer will publicly open and read bids.

9. TABULATING BIDS

9.1. **Official Total Bid Amount**. UC will sum the products of the quantities and the unit prices bid in the bid form to determine the official total bid amount, except as provided in Section 2.9.5., "Consideration of Unit Prices." The official total bid amount is the basis for determining the apparent low Bidder. The total bid amounts will be compared and the results made public.

9.2. **Consideration of Bid Format**. When a Bidder submits a printed bid that is responsive, the unit bid prices in the printed bid will be used to determine the total bid amount.

If a Bidder submits 2 or more printed bids, all responsive bids will be tabulated. The bid with the lowest tabulation will be used to determine the total bid amount.

9.3. **Rounding of Unit Prices**. UC will round off all unit bids involving fractional parts of a cent to the nearest one-tenth cent ($0.001) in determining the amount of the bid as well as computing the amount due for payment of each item under the Contract. For rounding purposes, entries of five-hundredths of a cent ($0.0005) or more will be rounded up to the next highest tenth of a cent, while entries less than five- hundredths of a cent will be rounded down to the next lowest tenth of a cent.

9.4. **Interpretation of Unit Prices**. UC will make a documented determination of the unit bid price if a unit bid price is illegible or conflicting in the case of replacement alternate items. UC's determination will be final.

9.5. **Consideration of Unit Prices**.

9.5.1. **Rubber Additives**. No rubber additives are allowed with the Hot-Mix Asphalt or Warm Mix Asphaltic Concrete material.

9.5.2. **"Buy America."** The use of foreign steel is not allowed.

9.5.3. **Home State Bidding Preference**. For the purpose of determining the apparent low Bidder on proposed Contracts without federal funds, UC will select the option that results in the greatest bidding preference to the resident Bidder.

10. CONSIDERATION OF BID ERRORS

UC will consider a claim of a bid error by the apparent low Bidder if the following requirements have been met:

- Submit written notification to UC within 5 business days after the date the bid is opened.
- Identify the items of work involved and include bidding documentation. UC may request clarification of submitted documentation.

UC will evaluate the claim of an error by the apparent low Bidder by considering the following:

- The bid error relates to a material item of work.
- The bid error amount is a significant portion of the total bid.
- The bid error occurred despite the exercise of ordinary care.
- The delay of the proposed work will not impact cost and safety to the public.

Acceptance of the bid error claim by UC will result in the rejection of all bids. The erring Contractor will not be allowed to bid the project when it is relet. Rejection of bids due to the Contractor's bid error may result in the application of sanctions by UC.

11. TIE BIDS

If the official total bid amount for 2 or more Bidders is equal and those bids are the lowest submitted, each tie Bidder will be given an opportunity to withdraw their bid. If 2 or more tie Bidders do not withdraw their bids, the low Bidder will be determined by a coin toss. If all tie Bidders request to withdraw their bids, no withdrawals will be allowed and the low Bidder will be determined by a coin toss. The City Clerk will preside over the proceedings for the coin toss.

Item 3
Award and Execution of Contract

1. AWARD OF CONTRACT

The City Council or designated representative will award, reject, or defer the Contract within 30 days after the opening of the bid. UC reserves the right to reject any or all bids and to waive technicalities in the best interest of UC.

1.1. **Award**. The City Council or designated representative will award the Contract to the low Bidder as determined by Article 2.9., "Tabulating Bids." The City Council may award a Contract to the second lowest Bidder when the following requirements have been met:

- The low Bidder withdraws its bid.
- The second lowest Bidder's unit bid prices are reasonable.
- The second lowest Bidder agrees to perform the work at its submitted unit bid prices.
- UC's Director of Public Works recommends in writing the award of the Contract to the second lowest Bidder.
- The City Council agrees with UC's City Manager and Director of Public Works' recommendation for award to the second lowest Bidder.

1.2. **Rejection**. The City Council or designated representative will reject the Contract if:

- Collusion may have existed among the Bidders. Collusion participants will not be allowed to bid future bids for the same Contract.
- The low bid is mathematically and materially unbalanced. The Bidder will not be allowed to bid future bids for the same Contract.
- The lowest bid is higher than UC's estimate and re-advertising for bids may result in a lower bid.
- The low bid contains a bid error that satisfies the requirements and criteria in Article 2.10., "Consideration of Bid Errors."
- Rejection of the Contract is in the best interest of UC.

1.3. **Deferral**. The City Council may defer the award or rejection of the Contract when deferral is in the best interest of UC.

2. RESCINDING OF AWARD

The City Council or designated representative reserves the right to cancel the award of any Contract before contract execution with no compensation due when the cancellation is in the best interest of UC. UC will return the bid guaranty to the Contractor.

3. EXECUTION OF CONTRACT

Provide the following within 15 days after written notification of award of the Contract:

3.1. **Contracts**. Executed by Contractor and Surety.

3.2. **Bonds**. Executed performance bond and payment bond in the full amount of the Contract price with powers of attorney. Provide bonds in accordance with Table 1. Furnish the payment and performance bonds as a guaranty for the protection of the claimants and UC for labor and materials and the faithful performance of the work.

Table 1

Minimum Bonding Requirements

Contract Amount	Required Bonds
Less than $25,000	None
$25,000 to $100,000	Payment
More than $100,000	Performance and Payment

Sample versions of the standard performance and payment bonds may be viewed on the TxDOT's website.

3.3. **Insurance**. For construction and building Contracts, submit a certificate of insurance showing coverages in accordance with Contract requirements. For routine maintenance Contracts, refer to Article 3.7., "Beginning of Work," for submission requirements.

Insurances must cover the contracted work for the duration of the Contract and must remain in effect until final acceptance. Failure to obtain and maintain insurance for the contracted work may result in suspension of work or default of the Contract and loss of preferred status. If the insurance expires and coverage lapses for any reason, stop all work until UC receives an acceptable Certificate of Insurance.

Provide UC with a Certificate of Insurance verifying the types and amounts of coverage shown in Table 2. The Certificate of Insurance must be in a form approved by the Texas Department of Insurance. Any Certificate of Insurance provided must be available for public inspection.

Table 2

Minimum Insurance Requirements

Type of Insurance	Amount of Coverage
Commercial General Liability Insurance	Not Less Than: $600,000 each occurrence
Business Automobile Policy	Not Less Than: $600,000 combined single limit
Workers' Compensation	Not Less Than:
All Risk Builder's Risk Insurance (For building-facilities contracts only)	100% of Contract Price

By signing the Contract, the Contractor certifies compliance with all applicable laws, rules, and regulations pertaining to workers' compensation insurance. This certification includes all subcontractors. Pay all deductibles stated in the policy. Subcontractors must meet the requirements of Table 2 either through their own coverage or through the Contractor's coverage.

The Workers' Compensation policy must include a waiver of subrogation endorsement in favor of UC.

For building-facilities contracts, provide All Risk Builder's Risk Insurance to protect UC

against loss by storm, fire or extended coverage perils on work and materials intended for use on the project including the adjacent structure. Name UC under the Lost Payable Clause.

For contracts with railroad requirements, see project-specific details for additional insurance requirements.

Provide a substitute Surety on the Contract bonds in the original full Contract amount within 15 days of notification if the Surety is declared bankrupt or insolvent, the Surety's underwriting limitation drops below the Contract amount or the Surety's right to do business is terminated by the State. The substitute Surety must be authorized by the laws of the State and acceptable to UC. Work will be suspended until a substitute Surety is provided. Working day charges will be suspended for 15 days or until an acceptable Surety is provided, whichever is sooner.

The work performed under this section will not be measured or paid for directly but will be subsidiary to pertinent Items.

3.4. **Business Ownership Information**. Submit the names and social security numbers of all individuals owning 25% or more of the firm, or firms in the case of a joint venture, on UC's form.

3.5. **List of Quoting Suppliers and Subcontractors**. For a construction Contract, submit a list of all suppliers and subcontractors that quoted on the Contract. Include names, addresses, telephone numbers, and types of work required.

3.6. **Railroad Documents**. Provide all required documents for satisfaction of railroad requirements for projects that have work which involves railroad right of way.

4. FAILURE TO ENTER CONTRACT

If the Contractor fails to comply with all of the requirements in Article 3.3., "Execution of Contract," the bid guaranty will become the property of UC, not as a penalty, but as liquidated damages. The Contractor forfeiting the bid guaranty will not be considered in future bids for the same work unless there has been a substantial change in design of the work.

5. APPROVAL AND EXECUTION OF CONTRACT

The Contract will be approved and signed under authority of the City Council.

6. RETURN OF BID GUARANTY

The bid guaranty check of the low Bidder will be retained until after the Contract has been rejected or awarded and executed. Bid bonds will not be returned.

7. BEGINNING OF WORK

Do not begin work until authorized in writing by the City Engineer. For a routine maintenance Contract, do not begin work until work is authorized in writing and a Certificate of Insurance showing coverage in accordance with the Contract requirements is provided and accepted. Upon execution of the Contract UC may begin issuing notice to proceed. Notice to proceed may include additional plans describing the work and the allowable number of working days. The additional plans associated with the notice to proceed will become a part of the Contract.

For work with emergency mobilization, provide a method of contact available from 8 A.M.

until 5 P.M. every work day and 24 hr. a day, 7 days a week, unless otherwise shown on the plans. The time of notice will be the transmission time of the notice sent, provided orally, or provided in person by UC's representative.

Verify all quantities of materials shown on the plans before ordering. For callout Contracts, purchase of materials before a notice to proceed is issued or without prior written approval of the City Engineer, is at the Contractor's risk, and UC is not obligated for the cost of the materials or work to acquire the materials.

For projects with additive alternate bid items, the notice to proceed will identify the base bid work and additive alternate work to be performed. UC makes no guarantee that the additive alternate work will be required.

8. ASSIGNMENT OF CONTRACT

Do not assign, sell, transfer, or otherwise dispose of the Contract or any portion rights, title, or interest (including claims) without the approval of the City Council or designated representative. UC must deem any proposed assignment justified and legally acceptable before the assignment can take place.

9. EXCLUDED PARTIES

The Contractor certifies by signing the Contract that the Contractor will not enter into any subcontract with a subcontractor that is debarred or suspended by UC or any federal agency.

Item 4
Scope of Work

1. CONTRACT INTENT

The intent of the Contract is to describe the completed work to be performed. Furnish materials, supplies, tools, equipment, labor, and other incidentals necessary for the proper prosecution and completion of the work in accordance with Contract documents.

2. PRECONSTRUCTION CONFERENCE

Before starting work, schedule and attend a preconstruction conference with the Engineer or UC representative. Failure to schedule and attend a preconstruction conference is not grounds for delaying the beginning of working day charges.

Work with the Engineer to resolve or escalate all issues. Execute the project pledge and establish an issue escalation ladder.

2.1. **Project Pledge**. Contractor representatives at the level of foreman and above will certify in writing they will approach the construction of this project in a manner consistent with delivering a high quality project in a safe, cost-effective, and timely manner, and they will be committed to not allowing personality conflicts or personal interests to interfere with providing the public with a quality project. Failure to uphold this commitment may result in grounds for removal from the project.

2.2. **Issue Resolution Process**. An issue is any aspect of the Contract where parties of the Contract do not agree. The individuals identified at the lowest level of the issue escalation ladder will initiate the issue resolution process by escalating any issue that remains unresolved within the time frame outlined in the issue escalation ladder.

Work with the Engineer to resolve all issues during the course of the Contract. Refer to Section 4.6., “Dispute or Claims Procedure” for all unresolved issues.

3. CHANGES IN THE WORK

The City Engineer reserves the right to make changes in the work including addition, reduction, or elimination of quantities and alterations needed to complete the Contract. Perform the work as altered. These changes will not invalidate the Contract nor release the Surety. The Contractor is responsible for notifying the sureties of any changes to the Contract.

If the changes in quantities or the alterations do not significantly change the character of the work under the Contract, the altered work will be paid for at the Contract unit price. If the changes in quantities or the alterations significantly change the character of the work, the Contract will be amended by a change order. If no unit prices exist, this will be considered extra work and the Contract will be amended by a change order. Provide cost justification as requested, in an acceptable format. Payment will not be made for anticipated profits on work that is eliminated.

Agree on the scope of work and the basis of payment for the change order before beginning the work. If there is no agreement, the City Engineer may order the work to

proceed by making an interim adjustment to the Contract. In the case of an adjustment, the City Engineer will consider modifying the compensation after the work is performed.

A significant change in the character of the work occurs when:

- the character of the work for any Item as altered differs materially in kind or nature from that in the Contract or
- a major item of work varies by more than 25% from the original Contract quantity. (The 25% variance is not applicable to non-site-specific Contracts.)

When the quantity of work to be done under any major item of the Contract is more than 125% of the original quantity stated in the Contract, then either party to the Contract may request an adjustment to the unit price on the portion of the work that is above 125%.

When the quantity of work to be done under any major item of the Contract is less than 75% of the original quantity stated in the Contract, then either party to the Contract may request an adjustment to the unit price. When mutually agreed, the unit price may be adjusted by multiplying the Contract unit price by the factor in Table 1. If an adjusted unit price cannot be agreed upon, the City Engineer may determine the unit price by multiplying the Contract unit price by the factor in Table 1.

Table 1
Quantity-Based Price Adjustment Factors

% of Original Quantity	Factor
≥ 50 and < 75	1.05
≥ 25 and < 50	1.15
< 25	1.25

If the changes require additional working days to complete the Contract, Contract working days will be adjusted in accordance with Item 8, “Prosecution and Progress.”

4. DIFFERING SITE CONDITIONS

During the progress of the work, differing subsurface or latent physical conditions may be encountered at the site. The 2 types of differing site conditions are defined as:

- those that differ materially from those indicated in the Contract and
- unknown physical conditions of an unusual nature differing materially from those ordinarily encountered and generally recognized as inherent in the work provided for in the Contract.

Notify the City Engineer in writing when differing site conditions are encountered. The City Engineer will notify the Contractor when UC discovers differing site conditions. Unless directed otherwise, suspend work on the affected items and leave the site undisturbed. The City Engineer will investigate the conditions and determine whether differing site conditions exist. If the differing site conditions cause an increase or decrease in the cost or number of working days specified for the performance of the Contract, the City Engineer will make adjustments, excluding the loss of anticipated profits, in accordance with the Contract. Additional compensation will be made only if the required written notice has been provided.

5. REQUESTS FOR ADDITIONAL COMPENSATION

Notify the City Engineer in writing of any intent to request additional compensation once there is knowledge of the basis for the request. An assessment of damages is not required to be part of this notice but is desirable. The intent of the written notice requirement is to provide the City Engineer an opportunity to evaluate the request and to keep an accurate account of the actual costs that may arise. Minimize impacts and costs.

If written notice is not given, the Contractor waives the right to additional compensation unless the circumstances could have reasonably prevented the Contractor from knowing the

cost impact before performing the work. Notice of the request and the documentation of the costs will not be construed as proof or substantiation of the validity of the request. Submit the request in enough detail to enable the City Engineer to determine the basis for entitlement, adjustment in the number of working days specified in the Contract, and compensation.

UC will not consider fees and interest on requests for additional compensation. Fees include, but are not limited to: preparation, attorney, printing, shipping, and various other fees.

Damages occur when impacts that are the responsibility of UC result in additional costs to the Contractor that could not have been reasonably anticipated at the time of letting. Costs of performing additional work are not considered damages. For Contractor damages, the intent is to reimburse the Contractor for actual expenses arising out of a compensable impact. No profit or markups, other than labor burden, will be allowed. For damages, labor burden will be reimbursed at 35% unless the Contractor can justify higher actual cost. Justification for a higher percentage must be in accordance with the methodology provided by UC, submitted separately for project overhead labor and direct labor, and determined and submitted by a Certified Public Accountant (CPA). Submit CPA-prepared labor burden rates directly to the UC Public Works Director.

If the Contractor requests compensation for delay damages and the delay is determined to be compensable, then standby equipment costs and project overhead compensation will be based on the duration of the compensable delay and will be limited as follows:

5.1. **Project Overhead**. Project overhead is defined as the administrative and supervisory expenses incurred at the work locations. When delay to project completion occurs, reimbursement for project overhead for the Contractor will be made using the following options:

- reimbursed at 6% (computed as daily cost by dividing 6% of the original Contract amount by the number of original Contract work days), or
- actual documented costs for the impacted period.

Project overhead for delays impacting subcontractors will be determined from actual documented costs submitted by the Contractor.

Time extensions and suspensions alone will not be justification for reimbursement for project overhead.

5.2. **Home Office Overhead**. UC will not compensate the Contractor for home office overhead.

6. DISPUTE OR CLAIMS PROCEDURE

The dispute resolution policy promotes a cooperative attitude between the Engineer and Contractor. Emphasis is placed on resolving issues while they are still current, at the area office, and in an informal manner. Open sharing of information is encouraged by all parties involved so the information provided completely and accurately reflects the issues and facts. If information is not shared, decisions may be limited to relying on the documentation that is available for review.

It is UC's goal to have a dispute settled project level before elevating it to UC's Director of Public Works as a claim.

If a dispute cannot be resolved, initiate the Contract claim procedure by filing a Contract claim after the completion of the Contract or when required for orderly performance of the Contract. Submit the claim to UC's Director of Public Works.

TxDOT Contract claim procedure has been established in accordance with Title 43 of the Texas Administrative Code, Part 1, Chapter 9, Subchapter A, Rule §9.2, *Contract Claim Procedure*. Detailed instructions for submitting a claim and its components can be found on the TxDOT website.

If a claim has been submitted and the Contractor wishes to resume negotiations with the field personnel, notify UC's Director of Public Works in writing of their intent to resume negotiations at the construction level and request review of the claim be suspended by UC's Director of Public Works pending the outcome of the negotiations.

File a claim after completion of the Contract or when required for orderly performance of the Contract. For a claim resulting from enforcement of a warranty period, file the claim no later than one year after expiration of the warranty period. For all other claims, file the claim no later than the date UC issues notice to the Contractor that they are in default, the date UC terminates the Contract, or one year after the date of final acceptance of the Contract. It is the Contractor's responsibility to submit requests in a timely manner.

Item 5
Control of the Work

1. AUTHORITY OF ENGINEER

The City Engineer has the authority to observe, test, inspect, approve, and accept the work. The City Engineer decides all questions about the quality and acceptability of materials, work performed, work progress, Contract interpretations, and acceptable Contract fulfillment. The City Engineer has the authority to enforce and make effective these decisions.

The City Engineer acts as a referee in all questions arising under the terms of the Contract. The City Engineer's decisions will be final and binding.

2. PLANS AND WORKING DRAWINGS

When required, provide working drawings to supplement the plans with all necessary details not included on the Contract plans. Prepare and furnish working drawings in a timely manner and obtain approval, if required, before the beginning of the associated work. For all working drawing submittal requirements, the Engineer may allow electronic and other alternative submission procedures. Have a licensed professional engineer sign, seal, and date the working drawings as indicated in Table 1.

Prepare working drawings using United States standard measures in the English language. The routing of submittals for review and approval will be established at the preconstruction conference. The Contractor is responsible for the accuracy, coordination, and conformity of the various components and details of the working drawings. UC approval of the Contractor's working drawings will not relieve the Contractor of any responsibility under the Contract. The work performed under this Article will not be measured or paid for directly but will be subsidiary to pertinent Items.

Table 1
Signature and Approval Requirements for Working Drawings

Working Drawings For		Requires Licensed Professional Engineer's Signature, Seal, and Date	Requires UC Approval
1. Alternate or optional designs submitted by Contractor		Yes	Yes
2. Supplementary shop and fabrication drawings for structural Items		Yes	Yes
3. Contractor-proposed temporary facilities that affect the public safety, not included on the plans		Yes	Yes
4. Form and falsework details	Bridges, retaining walls, and other major structures	Yes	Yes
	Minor structures	Yes	Yes
5. Erection drawings		Yes	Yes
6. Contractor-proposed major modifications to traffic control plan		Yes	Yes

Submit shop drawings as hard copies, pdf format, scanned bitmap (1-bit) tifs, and CAD (.dwg or .dgn) for the fabrication of structural items and as directed for other items required by the Contract to UC.

At the start and during the job progress, contractor is responsible to maintain a set of as-built blueprints for construction notes and mark ups showing any and all deviations from the contract documents. Deviations include, but are not limited to pavement section, project limits, driveways, utility alignment and elevations, signage and pavement markings, and traffic signals, etc. If required, changes must be accompanied by documentation. When construction is complete, contractor is responsible to coordinate with UC field representative for approval of as-built blueprints. Once approved the Contractor shall provide UC with final as-built blueprints.

3. CONFORMITY WITH PLANS, SPECIFICATIONS, AND SPECIAL PROVISIONS

Furnish materials and perform work in reasonably close conformity with the lines, grades, cross-sections, dimensions, details, gradations, physical and chemical characteristics of materials, and other requirements shown in the Contract (including additional plans for non-site-specific work). Reasonably close conformity limits will be as defined in the respective Items of the Contract or, if not defined, as determined by the Engineer. Obtain approval before deviating from the plans and approved working drawings. Do not perform work beyond the lines and grades shown on the plans or any extra work without the City Engineer's authority. Work performed beyond the lines and grades shown on the plans or any extra work performed without authority is considered unauthorized and excluded from pay consideration. UC will not pay for material rejected due to improper fabrication, excess quantity, or any other reasons within the Contractor's control.

3.1. **Acceptance of Defective or Unauthorized Work**. When work fails to meet Contract requirements, but is adequate to serve the design purpose, the City Engineer will decide the extent to which the work will be accepted and remain in place. The City Engineer will document the basis of acceptance by a letter and may adjust the Contract price.

3.2. **Correction of Defective or Unauthorized Work**. When work fails to meet Contract requirements and is inadequate to serve the design purpose it will be considered defective. Correct, or remove and replace, the work at the Contractor's expense, as directed by UC.

UC has the authority to correct or to remove and replace defective or unauthorized work. The cost may be deducted from any money due or to become due to the Contractor.

4. COORDINATION OF PLANS, SPECIFICATIONS, AND SPECIAL PROVISIONS

The specifications, accompanying plans (including additional plans for non-site-specific work), special provisions, change orders, and supplemental agreements are intended to work together and be interpreted as a whole.

Numerical dimensions govern over scaled dimensions. Special provisions govern over plans (including general notes), which govern over standard specifications and special specifications. Job-specific plan sheets govern over standard plan sheets.

However, in the case of conflict between plans (including general notes) and

specifications regarding responsibilities for hazardous materials and traffic control in Items 1 through 9 and TxDOT Item 502, “Barricades, Signs, and Traffic Handling,” special provisions govern over standard specifications and special specifications, which govern over the plans.

Notify the City Engineer promptly of any omissions, errors, or discrepancies discovered so that necessary corrections and interpretations can be made. Failure to promptly notify the City Engineer will constitute a waiver of all claims for misunderstandings or ambiguities that result from the errors, omissions, or discrepancies discovered.

5. COOPERATION OF CONTRACTOR

Cooperate with the City Engineer. Respond promptly to instructions from the City Engineer. Provide all information necessary to administer the Contract.

Designate in writing a competent, English-speaking Superintendent employed by the Contractor. The Superintendent must be experienced with the work being performed and capable of reading and understanding the Contract and Plans. Ensure the Superintendent is available at all times and able to receive instructions from the Engineer or authorized UC representatives and to act for the Contractor. The Engineer may suspend work without suspending working day charges if a Superintendent is not available or does not meet the above criteria.

At the written request of the City Engineer, immediately remove from the project any employee or representative of the Contractor or a subcontractor who, in the opinion of the City Engineer, does not perform work in a proper and skillful manner or who is disrespectful, intemperate, disorderly, uncooperative, or otherwise objectionable. Do not reinstate these individuals without the written consent of the City Engineer.

Furnish suitable machinery, equipment, and construction forces for the proper prosecution of the work. Provide adequate lighting to address quality requirements and inspection of nighttime work.

The City Engineer may suspend the work without suspending working day charges until the Contractor complies with this requirement. All work associated with fulfilling this requirement is subsidiary to the various Items of the Contract and no direct compensation will be made.

6. COOPERATING WITH UTILITIES

Use established safety practices when working near utilities. Consult with the appropriate utilities before beginning work. Notify the City Engineer immediately of utility conflicts. The City Engineer will decide whether to adjust utilities or adjust the work to eliminate or lessen the conflict. Unless otherwise shown on the plans, the City Engineer will make necessary arrangements with the utility owner when utility adjustments are required.

Use work procedures that protect utilities or appurtenances that remain in place during construction. Cooperate with utilities to remove and rearrange utilities to avoid service interruption or duplicate work by the utilities. Allow utilities access to the right of way.

Immediately notify the appropriate utility of service interruptions resulting from damage due to construction activities. Cooperate with utilities until service is restored. Maintain access to fire hydrants at all times.

7. COOPERATION BETWEEN CONTRACTORS

Cooperate and coordinate with other Contractors working within the limits or adjacent to the limits.

8. COOPERATION WITH RAILROADS

Plan and prosecute portions of the work involving a railway to avoid interference with or hindrance to the railroad company.

If the work is on railroad right of way, do not interfere with the operation of the railroad company's trains or other property.

8.1. **Project-Specific Information**. Refer to project-specific plan sheets in the Contract for specific information concerning the work to be completed by both the Contractor and the railroad within railroad right of way; railroad right of way locations impacted by construction; percentage of contract work at each location; train movements at each location; and requirements for railroad insurance, flagging, and Right of Entry (ROE) Agreements.

8.2. **Right of Entry Agreement (if required)**. The process for obtaining a fully executed ROE Agreement shall be as follows:

8.2.1. UC will send the unexecuted ROE Agreement to the Contractor with the unexecuted construction Contract.

8.2.2. Partially execute the ROE Agreement and return it to UC with the required insurance attached.

8.2.3. UC will coordinate with the railroad company regarding the further execution of the ROE Agreement and associated fees. UC will pay any ROE Agreement fees directly to the railroad company.

8.2.4. Once UC has received the fully-executed ROE Agreement from the railroad company, UC will forward the fully-executed ROE Agreement to the Contractor.

9. CONSTRUCTION SURVEYING

Use Method A or B as described below to set construction stakes for the project. Upon request, the Engineer will allow the Contractor to copy available earthwork cross-sections, computer printouts or data files, and other information necessary to establish and control work. Maintain the integrity of control points. Preserve all control points, stakes, marks, and right of way markers. Assume cost and responsibility of replacing disturbed control points, stakes, marks, and right of way markers damaged by the Contractor's or its subcontractor operations. If UC repairs disturbed control points, stakes, marks, or right of way markers, the cost of repair may be deducted from money due or to become due to the Contractor. Replace right of way markers under the direction of a Registered Professional Land Surveyor (RPLS). This work will be subsidiary to pertinent Items.

The Engineer reserves the right to obtain measurements and surveys from an RPLS to determine the accuracy of the work and determine pay quantities. The Engineer's RPLS measurements and surveys do not relieve the Contractor's responsibility for accuracy of work. Contractor to allow the Engineer adequate time to verify the surveying.

9.1. **Method A**. The Contractor's RPLS shall verify the existing control and set additional control

as required for construction of the project for establishing lines, slopes, grades, and centerlines and for providing both vertical and horizontal control.

Furnish materials, equipment, and qualified workforce necessary for the construction survey work. Place construction points, stakes, and marks at intervals sufficient to control work to established tolerances. Place construction stakes at intervals of no more than 100 ft., or as directed. Place stakes and marks so as not to interfere with normal maintenance operations.

9.2. **Method B**. The Contractor shall verify the existing control and set additional control points, stakes, and marks to establish lines, slopes, grades, and centerlines.

Furnish materials, equipment, and qualified workforce necessary for the construction survey work. Place construction points, stakes, and marks at intervals sufficient to control work to established tolerances. Place construction stakes at intervals of no more than 100 ft., or as directed. Place stakes and marks so as not to interfere with normal maintenance operations

10. PRE-FINAL INSPECTION

Inspectors are authorized representatives of the Engineer. Inspectors are authorized to examine all work performed and materials furnished, including preparation, fabrication, and material manufacture. Inspectors inform the Contractor of failures to meet Contract requirements. Inspectors may reject work or materials and may suspend work until any issues can be referred to and decided by the Engineer. Inspectors cannot alter, add, or waive Contract provisions, issue instructions contrary to the Contract, act as foremen for the Contractor, or interfere with the management of the work. Inspection or lack of inspection will not relieve the Contractor from obligation to provide materials or perform the work in accordance with the Contract.

Provide safe access to all parts of the work and provide information and assistance to the Engineer to allow a complete and detailed inspection. Give the Engineer sufficient notice to inspect the work. Work performed without suitable inspection, as determined by the Engineer, may be ordered removed and replaced at Contractor's expense. Remove or uncover portions of finished work as directed. Once inspected, restore work to Contract requirements. If the uncovered work is acceptable, the costs to uncover, remove, and replace or make good the parts removed will be paid for in accordance with Article 4.3., "Changes in the Work." If the work is unacceptable, assume all costs associated with repair or replacement, including the costs to uncover, remove, and replace or make good the parts removed.

When a government entity, utility, railroad company, or other entity accepts or pays a portion of the Contract, that organization's representatives may inspect the work but cannot direct the Contractor. The right of inspection does not make that entity a party to the Contract and does not interfere with the rights of the parties to the Contract.

After the pre-final inspection is conducted and unsatisfactory work is corrected, the Engineer will notify the Contractor in writing of the commencement of a 1 year preliminary acceptance period, or as defined by the Contract, whichever is greater.

11. FINAL CLEANUP

Upon completion of the work, remove litter, debris, objectionable material, temporary structures, excess materials, and equipment from the work locations. Clean and restore property damaged by the Contractor's operations during the prosecution of the work. Leave the work locations in a neat and presentable condition. This work will not be paid for directly but will be considered subsidiary to Items of the Contract.

Remove from the right of way cofferdams, construction buildings, material and fabrication plants, temporary structures, excess materials, and debris resulting from construction. Where work is in a stream, remove debris to the ground line of the bed of the stream. Leave stream channels and rights of way in a neat and presentable condition. Clean structures to the flow line or the elevation of the outfall channel, whichever is higher. Dispose of all excess material in accordance with federal, state, and local regulations.

12. FINAL ACCEPTANCE

12.1. **Final Inspection**. After all work is complete and the preliminary acceptance period ends, the Engineer in charge of the work will request a final inspection by the Engineer authorized to accept the work.

The final inspection will be made as soon as possible, and not later than 10 calendar days after the request, unless otherwise agreed upon. No working day charges will be made between the date of request and final inspection.

After the final inspection, if the work is satisfactory, the Engineer will notify the Contractor in writing of the final acceptance of the work. If the final inspection finds any work to be unsatisfactory, the Engineer will identify in writing all deficiencies in the work requiring correction. Correct the deficiencies identified. Working day charges will resume if these deficiencies are not corrected within 7 calendar days, unless otherwise authorized by the Engineer. Upon correction, the Engineer will make an inspection to verify that all deficiencies were corrected satisfactorily. The Engineer will provide written notice of the final acceptance.

12.2. **Work Completed**. Work completed must include work for vegetative establishment and maintenance, test, and performance periods and work to meet the requirements of Article 5.11., “Final Cleanup.”

12.3. **Construction Contracts**. Final acceptance is made when all work is complete, the preliminary acceptance period ends, and the City Engineer, in writing, accepts all work for the work locations in the Contract. Final acceptance, by the City Council if required, relieves the Contractor from further Contract responsibilities.

12.4. **Final Measurement**. Final measurements and pay quantity adjustments may be made after final acceptance.

12.5. **Removal of Traffic Control Devices**. Remove construction traffic control devices and advance warning signs upon final acceptance or as directed.

Item 6
Control of Materials

1. SOURCE CONTROL

Use only materials that meet Contract requirements. Unless otherwise specified or approved, use new materials for the work. Secure the Engineer's approval of the proposed source of materials to be used before their delivery. Materials can be approved at a supply source or staging area but may be reinspected in accordance with Article 6.4., "Sampling, Testing, and Inspection."

1.1. **Buy America**. Comply with the latest provisions of Buy America as listed at 23 CFR 635.410. Use steel or iron materials manufactured in the United States except when:

- the cost of materials, including delivery, does not exceed 0.1% of the total Contract cost or $2,500, whichever is greater;
- the Contract contains an alternate Item for a foreign source steel or iron product and the Contract is awarded based on the alternate Item; or
- the materials are temporarily installed.

Provide a notarized original of the FORM D-9-USA-1 (TxDOT Form 1818) with the proper attachments for verification of compliance.

Manufacturing is any process that modifies the chemical content, physical shape or size, or final finish of a product. Manufacturing begins with initial melting and mixing and continues through fabrication (cutting, drilling, welding, bending, etc.) and coating (paint, galvanizing, epoxy, etc.).

2. MATERIAL QUALITY

Correct or remove materials that fail to meet Contract requirements or that do not produce satisfactory results. Reimburse UC for cost incurred if additional sampling and testing is required.

Materials not meeting Contract requirements will be rejected, unless the City Engineer approves corrective actions. Upon rejection, immediately remove and replace rejected materials.

If the Contractor does not comply with this Article, UC may remove and replace defective material. The cost of testing, removal, and replacement will be deducted from the estimate.

3. MANUFACTURER WARRANTIES

Transfer to UC warranties and guarantees required by the Contract or received as part of normal trade practice.

4. SAMPLING, TESTING, AND INSPECTION

Incorporate into the work only material that has been inspected, tested, and accepted by UC. Remove, at the Contractor's expense, materials from the work locations that are used without prior testing and approval or written permission of the City Engineer.

Unless otherwise mutually agreed, the material requirements and standard test methods in effect at the time the proposed Contract is advertised govern. Unless otherwise noted, UC will perform testing at its expense. In addition to facilities and equipment required by the Contract, furnish facilities and calibrated equipment required for tests to control the manufacture of construction Items. If requested, provide a complete written statement of the origin, composition, and manufacture of materials.

All materials used are subject to inspection or testing at any time during preparation or use. Material which has been tested and approved at a supply source or staging area may be reinspected or tested before or during incorporation into the work, and rejected if it does not meet Contract requirements. Copies of test results are available upon request. Do not use material that, after approval, becomes unfit for use.

5. STORAGE OF MATERIALS

Store and handle materials to preserve their quality and fitness for the work. Store materials so that they can be easily inspected and retested. Place materials under cover, on wooden platforms, or on other hard, clean surfaces as necessary or when directed.

Obtain approval to store materials on the right of way. Storage space off the right of way is at the Contractor's expense.

6. UC-FURNISHED MATERIAL

UC will supply materials as shown on the plans. The cost of handling and placing materials supplied by UC will not be paid for directly but is subsidiary to the Item in which they are used. Assume responsibility for materials upon receipt.

7. USE OF MATERIALS FOUND ON THE RIGHT OF WAY

Material found in the excavation areas and meeting UC's specifications may be used in the work. This material will be paid for at the Contract bid price for excavation and under the Item for which the material is used.

Do not excavate or remove any material from within the right of way that is not within the limits of the excavation without written permission. If excavation is allowed within a right of way project-specific location (PSL), replace the removed material with suitable material at no cost to UC as directed.

8. RECYCLED MATERIALS

UC does not allow recycled materials.

9. HAZARDOUS MATERIALS

UC is responsible for testing, removing, and disposing of hazardous materials not introduced by the Contractor unless the plans indicate the paint is to be removed by the Contractor. The plans will indicate locations where paint on steel is suspected to contain hazardous materials. The City Engineer may suspend work wholly or in part during the testing, removing, or disposing of hazardous materials, except in the case where hazardous materials are introduced by the Contractor.

Use materials that are free of hazardous materials. Notify the City Engineer immediately if materials are suspected to contain hazardous materials. If materials delivered to the

project by the Contractor are suspected to contain hazardous materials, have an approved commercial laboratory test the materials for contamination. Remove, remediate, and dispose of any of these materials found to be contaminated. The work required to comply with this section will be at the Contractor's expense. Working day charges will not be suspended and extensions of working days will not be granted for activities related to handling hazardous material introduced by the Contractor.

9.1. **Painted Steel Requirements**. Paint containing hazardous materials will be removed as shown on the plans.

9.1.1. **Paint Removed by Third Party.** UC will provide a third party to remove paint containing hazardous materials where paint must be removed to perform work or to allow dismantling of the steel.

9.1.2. **Paint Removed by the Contractor.** This work may only be performed by a firm or company with one of the following certifications:

- SSPC-QP2 certification for lead painting operations, or
- Certified Lead Firm by the Texas Department of State Health Services.

Maintain certifications for the duration of the work. Provide copies of audits or certification if requested.

Comply with worker and public safety regulations including but not limited to OSHA 29 CFR Parts 1910.1025, 1926.62, and 1926.63. Monitor permissible exposure limits in accordance with OSHA requirements.

Remove paint containing hazardous materials from designated areas shown on the plans or as directed by the City Engineer. Comply with access limitations shown on the plans.

Provide power hand tools, equipped with high-efficiency particulate air filter vacuums to mechanically remove paint.

Contain, collect, store, transport, and dispose of all waste generated by cleaning operation in accordance with local, state and federal requirements including 40 CFR 302. Properly characterize and dispose of all wastes. Manage any hazardous wastes in accordance with regulatory requirements and dispose in a facility authorized to accept such wastes. Provide copies of disposal manifests to the City Engineer.

The work performed, materials furnished, equipment, labor, tools, and incidentals will be paid for in accordance with TxDOT Item 446, "Field Cleaning and Painting Steel."

9.2. **Removal and Disposal of Painted Steel**. Painted steel may be reused or disposed of at a steel recycling or smelting facility. If the paint contains hazardous materials, maintain and make available to the City Engineer invoices and other records obtained from the facility showing the received weight of the steel and the facility name. Painted steel to be retained by UC will be shown on the plans and will require removal of all hazardous materials.

For steel that is dismantled by unbolting, no paint stripping will be required. Use care to not damage existing paint. When dismantling is performed using flame or saw-cutting methods to remove steel elements coated with paint containing hazardous materials, the plans will show stripping locations.

The work provided, materials furnished, equipment, labor, tools, and incidentals will be paid for in accordance with Item 496, "Removing Structures" and Item 497, "Sale of

Salvageable Materials".

9.3. **Asbestos Requirements**. The plans will indicate locations or elements where asbestos containing materials (ACM) have been found. At these locations or at locations where previously unknown ACM has been found, UC will arrange for abatement by a third party. For work at these locations, notify the City Engineer of proposed dates of demolition or removal of structural elements with ACM at least 60 days before work is to begin to allow UC sufficient time to abate the asbestos.

9.4. **Work Performed by a Third Party**. When the work for removal of paint or asbestos abatement is to be provided by a third party, coordinate and cooperate with the third party and UC. Continue other work detailed in the plans not directly involved in the paint removal or asbestos abatement work. Provide notice to UC regarding the progress of the work to allow UC sufficient time to schedule the third party work.

Traffic control will be provided by the third party or as agreed.

10. SURPLUS MATERIALS

Take ownership of surplus materials unless otherwise shown on the plans or directed. Remove and dispose of materials in accordance with federal, state, and local regulations. If requested, provide an appropriate level of documentation to verify proper disposal. When materials are disposed of on private property, provide written authorization from the property owner for the use of the property for this purpose upon request.

Item 7
Legal Relations and Responsibilities

1. ETHICS

Honor TxDOT's ethics policy. TxDOT's ethics policy has been established in accordance with Title 43 of the Texas Administrative Code, Part 1, Chapter 10. A complete copy of TxDOT's ethics policy can be found on the TxDOT's website.

By entering into Contract, the Contractor certifies that the Contractor has read and understands TxDOT's ethics policy.

Failure to honor this policy may result in action by UC, which includes but is not limited to verbal warning, removal of project personnel, termination of the Contract, and sanctions under the Texas Administrative Code.

2. SAFETY

2.1. **Safety Point of Contact.** Designate a Contractor Safety Point of Contact (CSPOC). UC will assign a UC employee for their point of contact designated as DSPOC. The CSPOC will ensure that the Contractor's and Subcontractor's employees' use the appropriate personal protection equipment (hard hats, safety vests, protective toe footwear, etc.).

2.2. **Public Safety and Convenience**

Ensure the safety and convenience of the public and property as provided in the Contract and as directed. Keep existing roadways open to traffic or construct and maintain detours and temporary structures for safe public travel. Manage construction to minimize disruption to traffic. Maintain the roadway in a good and passable condition, including proper drainage and provide for ingress and egress to adjacent property.

Store all equipment not in use in a manner and at locations that will not interfere with the safe passage of traffic.

Provide qualified flaggers in accordance with TxDOT Item/Section 502.2.2., "Flaggers," for the safety and convenience of the traveling public and workers, as directed.

If the City Engineer determines that any of the requirements of this Article have not been met, the City Engineer may take any necessary corrective action. This will not change the legal responsibilities set forth in the Contract. The cost to UC for this work will be deducted from any money due or to become due to the Contractor.

2.3. **Use of Blue Warning Lights**. Texas Transportation Code 547.105 authorizes the use of warning lights to promote safety and provides an effective means of gaining the travelling public's attention as they drive in areas where construction crews are present. In order to influence the public to move over when high risk construction activities are taking place, minimize the utilization of blue warning lights. These lights must be used only while performing work on or near the travel lanes or shoulder where the travelling public encounters construction crews that are not protected by a standard work zone set up such as a lane closure, shoulder closure, or one-way traffic control. Refrain from leaving the warning lights engaged while travelling from one work location to another or while parked on the right of way away from the pavement or a work zone.

2.4. **Barricades, Warning and Detour Signs, and Traffic Handling**. Provide, install, move, replace, maintain, clean, and remove all traffic control devices in accordance with TxDOT Item 502 "Barricades, Signs, and Traffic Handling," as shown on the plans and as directed. If details are not shown on the plans, provide devices and work in accordance with the TMUTCD and as directed. When authorized or directed, provide additional signs or traffic control devices not required by the plans.

If an unexpected situation arises that causes the Contractor to believe that the traffic control should be changed, make all reasonable efforts to promptly contact the Engineer. Take prudent actions until the Engineer can be contacted.

The Engineer may authorize or direct in writing the removal or relocation of project limit advance warning signs. When project limit advance warning signs are removed before final acceptance, traffic control in accordance with the TMUTCD may be used for minor operations as approved. Removal or relocation of project limit advance warning signs does not imply final acceptance.

3. LAWS TO BE OBSERVED

Comply with all federal, state, and local laws, ordinances, and regulations that affect the performance of the work. The Contractor is also required to comply with city electrical ordinances not included in this Contract. Indemnify and save harmless UC and its representatives against any claim arising from violation by the Contractor of any law, ordinance, or regulation.

This Contract is between UC and the Contractor only. No person or entity may claim third-party beneficiary status under this Contract or any of its provisions, nor may any non-party sue for personal injuries or property damage under this Contract.

4. PERMITS, LICENSES, AND TAXES

Procure all permits and licenses; pay all charges, fees, and taxes; and give all notices necessary and incidental to the due and lawful prosecution of work.

5. PATENTED DEVICES, MATERIAL, AND PROCESSES

Indemnify and save harmless UC from any claims for infringement from the Contractor's use of any patented design, device, material, process, trademark, or copyright selected by the Contractor and used in connection with the work. Indemnify and save harmless UC against any costs, expenses, or damages that it may be obliged to pay, by reason of this infringement, at any time during the prosecution or after the completion of the work.

6. PERSONAL LIABILITY OF PUBLIC OFFICIALS

UC employees are agents and representatives of UC and will incur no liability, personal or otherwise, in carrying out the provisions of the Contract or in exercising any power or authority granted under the Contract.

7. PRESERVATION OF CULTURAL AND NATURAL RESOURCES AND THE ENVIRONMENT

If the Contractor initiates changes to the Contract and UC approves the changes, the Contractor is responsible for obtaining clearances and coordinating with the appropriate regulatory agencies.

7.1. **Cultural Resources**. Cease all work immediately if a site, building, or location of historical, archeological, educational, or scientific interest is discovered within the right of way. The site, building, or location will be investigated and evaluated by UC.

7.2. **Texas Pollutant Discharge Elimination System (TPDES) Permits and Storm Water Pollution Prevention Plans (SWP3)**. The Contractor will file the Notice of Intent (NOI) and the Notice of Termination (NOT) for work shown on the plans in the right of way. Adhere to all requirements of the SWP3.

7.3. **Work in Waters of the United States**. For work in the right of way, UC will obtain any required Section 404 permits from the U.S. Army Corps of Engineers before work begins. Adhere to all agreements, mitigation plans, and standard best management practices required by the permit. When Contractor-initiated changes in the construction method changes the impacts to waters of the U.S., obtain new or revised Section 404 permits.

7.4. **Work in Navigable Waters of the United States**. For work in the right of way, UC will obtain any required Section 9 permits from the U.S. Coast Guard before work begins. Adhere to the stipulations of the permits and associated best management practices. When Contractor-initiated changes in the construction method changes the impacts to navigable waters of the U.S., obtain new or revised Section 9 permits.

8. SANITARY PROVISIONS

Provide and maintain adequate, neat, and sanitary toilet accommodations for employees, including UC employees, in compliance with the requirements and regulations of the Texas Department of Health or other authorities having jurisdiction.

9. ABATEMENT AND MITIGATION OF EXCESSIVE OR UNNECESSARY NOISE

Minimize noise throughout all phases of the Contract. Noise shall only be allowed during the work hours of 7:00 AM – 10:00 PM unless prior written approval is given. Exercise particular and special efforts to avoid the creation of unnecessary noise impact on adjacent noise sensitive receptors in the placement of non-mobile equipment such as air compressors, generators, pumps, etc. Place mobile and stationary equipment to cause the least disruption of normal adjacent activities.

All equipment associated with the work must be equipped with components to suppress excessive noise and these components must be maintained in their original operating condition considering normal depreciation. Noise-attenuation devices installed by the manufacturer such as mufflers, engine covers, insulation, etc. must not be removed nor rendered ineffectual nor be permitted to remain off the equipment while the equipment is in use.

10. RESPONSIBILITY FOR HAZARDOUS MATERIALS

Indemnify and save harmless UC and its agents and employees from all suits, actions, or claims and from all liability and damages for any injury or damage to any person or property arising from the generation or disposition of hazardous materials introduced by the Contractor on any work done by the Contractor on UC -owned or controlled sites. Indemnify and save harmless UC and its representatives from any liability or responsibility arising out of the Contractor's generation or disposition of any hazardous materials obtained, processed, stored, shipped, etc., on sites not owned or controlled by UC. Reimburse UC for all payments, fees, or restitution UC is required to make as a result of the Contractor's actions.

11. ASBESTOS CONTAINING MATERIAL

In Texas, the Department of State Health Services (DSHS), Asbestos Programs Branch, is responsible for administering the requirements of the National Emissions Standards for Hazardous Air Pollutants, 40 CFR, Subpart M (NESHAP) and the Texas Asbestos Health Protection Rules (TAHPR). Based on EPA guidance and regulatory background information, bridges are considered to be a regulated "facility" under NESHAP. Therefore, federal standards for demolition and renovation apply.

Provide notice to UC of demolition or renovation to the structures listed on the plans at least 30 calendar days before initiating demolition or renovation of each structure or load bearing member. Provide the scheduled start and completion date of structure demolition, renovation, or removal.

When demolition, renovation, or removal of load-bearing members is planned for several phases, provide the start and completion dates identified by separate phases.

DSHS requires that notifications be postmarked at least 10 working days before initiating demolition or renovation. If the date of actual demolition, renovation, or removal is changed, UC will be required to notify DSHS at least 10 days in advance of the work. This notification is also required when a previously scheduled (notification sent to DSHS) demolition, renovation, or removal is delayed. Therefore, if the date of actual demolition, renovation, or removal is changed, provide the Engineer, in writing, the revised dates in sufficient time to allow for UC's notification to DSHS to be postmarked at least 10 days in advance of the actual work.

Failure to provide the above information may require the temporary suspension of work under Article 8.3., "Temporary Suspension of Work or Working Day Charges," due to reasons under the control of the Contractor. UC retains the right to determine the actual advance notice needed for the change in date to address post office business days and staff availability.

12. RESTORING SURFACES OPENED BY PERMISSION

Do not authorize anyone to make an opening in the street for utilities, drainage, or any other reason without written permission from the City Engineer. Repair all openings as directed. Payment for repair of surfaces opened by permission will be made in accordance with pertinent Items or Article 4.3., "Changes in the Work." Costs associated with openings made with Contractor authorization but without UC approval will not be paid.

13. PROTECTING ADJACENT PROPERTY

Protect adjacent property from damage. If any damage results from an act or omission on the part of or on behalf of the Contractor, take corrective action to restore the damaged property to a condition similar or equal to that existing before the damage was done.

14. RESPONSIBILITY FOR DAMAGE CLAIMS

Indemnify and save harmless UC and its agents and employees from all suits, actions, or claims and from all liability and damages for any injury or damage to any person or property due to the Contractor's negligence in the performance of the work and from any claims arising or amounts recovered under any laws, including workers'

compensation and the Texas Tort Claims Act. Indemnify and save harmless UC and assume responsibility for all damages and injury to property of any character occurring during the prosecution of the work resulting from any act, omission, neglect, or misconduct on the Contractor's part in the manner or method of executing the work; from failure to properly execute the work; or from defective work or material.

Pipelines and other underground installations that may or may not be shown on the plans may be located within the right of way. Indemnify and save harmless UC from any suits or claims resulting from damage by the Contractor's operations to any pipeline or underground installation. Make available the scheduled sequence of work to the respective utility owners so that they may coordinate and schedule adjustments of their utilities that conflict with the proposed work.

If the Contractor asserts any claim or brings any type of legal action (including an original action, third-party action, or cross-claim) against any City Council or individual employee of UC for any cause of action or claim for alleged negligence arising from the Contract, the Contractor will be ineligible to bid on any proposed Contract with UC during the pendency of the claim or legal action.

15. HAULING AND LOADS ON ROADWAYS AND STRUCTURES

Comply with federal and state laws concerning legal gross and axle weights. Except for the designated Interstate system, vehicles with a valid yearly overweight tolerance permit may haul materials to the work locations at the permitted load. Provide copies of the yearly overweight tolerance permits to the Engineer upon request. Construction equipment is not exempt from oversize or overweight permitting requirements on roadways open to the traveling public.

Protect existing bridges and other structures that will remain in use by the traveling public during and after the completion of the Contract. Construction traffic on roadways, bridges, and culverts within the limits of the work, including any structures under construction that will remain in service during and after completion of the Contract is subject to legal size and weight limitations.

Additional temporary fill may be required by the Engineer for hauling purposes for the protection of certain structures. This additional fill will not be paid directly but will be subsidiary.

Replace or restore to original condition any structure damaged by the Contractor's operations.

The City Engineer may allow equipment with oversize or non-divisible overweight loads to operate without a permit within the work locations on pavement structures not open to the traveling public. Submit Contractor- proposed changes to traffic control plans for approval, in accordance with TxDOT Item 502, "Barricades, Signs, and Traffic Handling." The following sections further address overweight allowances. UC will make available to the Contractor any available plans and material reports for existing structures.

15.1. **Overweight Construction Traffic Crossing Structures**. The Engineer may allow crossing of a structure not open to the public within the work locations, when divisible or non-divisible loads exceed legal weight limitations, including limits for load-posted bridges. Obtain written permission to make these crossings. Submit for approval a structural analysis by a licensed professional engineer indicating that the excessive loads should be allowed. Provide a manufacturer's certificate of equipment weight that includes the weight distribution on the various axles and any additional parts such as counterweights, the configuration of the axles, or other information necessary for the

analysis. Submit the structural analysis and supporting documentation sufficiently in advance of the move to allow for review by the Engineer. Permission may be granted if the Engineer finds that no damage or overstresses in excess of those normally allowed for occasional overweight loads will result to structures that will remain in use after Contract completion. Provide temporary matting or other protective measures as directed.

Schedule loads so that only one vehicle is on any span or continuous unit at any time. Use barricades, fences, or other positive methods to prevent other vehicular access to structures at any time the overweight load is on any span or continuous unit.

15.2. **Construction Equipment Operating on Structures**. Cranes and other construction equipment used to perform construction operations that exceed legal weight limits may be allowed on structures. Before any operation that may require placement of equipment on a structure, submit for approval a detailed structural analysis prepared by a licensed professional engineer.

Submit the structural analysis and supporting documentation sufficiently in advance of the use to allow for review by the Engineer. Include all axle loads and configurations, spacing of tracks or wheels, tire loads, outrigger placements, center of gravity, equipment weight, and predicted loads on tires and outriggers for all planned movements, swings, or boom reaches. The analysis must demonstrate that no overstresses will occur in excess of those normally allowed for occasional overweight loads.

15.3. **Loads on Structures**. Do not store or stockpile material on bridge structures without written permission. If required, submit a structural analysis and supporting documentation by a licensed professional engineer for review by the Engineer. Permission may be granted if the Engineer finds that no damage or overstresses in excess of those normally allowed for occasional overweight loads will result to structures that will remain in use after Contract completion. Provide temporary matting or other protective measures as directed.

15.4. **Hauling Divisible Overweight Loads on Pavement Within the Work Locations**. The Engineer may allow divisible overweight loads on pavement structures within the work locations not open to the traveling public. Obtain written approval before hauling the overweight loads. Include calculations to demonstrate that there will be no damage or overstress to the pavement structure.

16. CONTRACTOR'S RESPONSIBILITY FOR WORK

Until final acceptance of the Contract, take every precaution against injury or damage to any part of the work by the action of the elements or by any other cause, whether arising from the execution or from the nonexecution of the work. Protect all materials to be used in the work at all times, including periods of suspension.

When any roadway or portion of the roadway is in suitable condition for travel, it may be opened to traffic as directed. Opening of the roadway to traffic does not constitute final acceptance.

Repair damage to all work until final acceptance. Repair damage to existing facilities in accordance with the Contract or as directed by the City Engineer. Repair damage to existing facilities or work caused by Contractor operations at the Contractor's expense. Repair work for damage that was not due to the Contractor's operations will not be paid for except as provided below.

16.1. **Reimbursable Repair**. Except for damage to appurtenances listed in Section 7.16.2.1., "Unreimbursed Repair," the Contractor will be reimbursed for repair of

damage caused by:

- motor vehicle, watercraft, aircraft, or railroad-train incident;
- vandalism; or
- Acts of God, such as earthquake, tidal wave, tornado, hurricane, or other cataclysmic phenomena of nature.

16.2. **Appurtenances**.

16.2.1. **Unreimbursed Repair**. Except for destruction (not reusable) due to hurricanes, reimbursement will not be made for repair of damage to the following temporary appurtenances, regardless of cause:

- signs,
- barricades,
- changeable message signs, and
- other work zone traffic control devices.

Crash cushion attenuators and guardrail end treatments are the exception to the above listing and are to be reimbursed in accordance with Section 7.16.2.2., "Reimbursed Repair."

For the devices listed in this Section, reimbursement may be made for damage due to hurricanes. Where the Contractor retains replaced appurtenances after completion of the project, UC will limit the reimbursement to the cost that is above the salvage value at the end of the project.

16.2.2. **Reimbursed Repair**. Reimbursement will be made for repair of damage due to the causes listed in Section 7.16.1., "Reimbursable Repair," to appurtenances (including temporary and permanent crash cushion attenuators and guardrail end treatments).

16.3. **Roadways and Structures**. Until final acceptance, the Contractor is responsible for all work constructed under the Contract. UC will not reimburse the Contractor for repair work to new construction, unless the failure or damage is due to one of the causes listed in Section 7.16.1., "Reimbursable Repair."

UC will be responsible for the cost for repair of damage to existing roadways and structures not caused by the Contractor's operations.

16.4. **Detours**. The Contractor will be responsible for the cost of maintenance of detours constructed under the Contract, unless the failure or damage is due to one of the causes listed in Section 7.16.1., "Reimbursable Repair." The City Engineer may consider failures beyond the Contractor's control when determining reimbursement for repairs to detours constructed. UC will be responsible for the cost of maintenance of existing streets and roadways used for detours or handling traffic.

16.5. **Relief from Maintenance**. The City Engineer may relieve the Contractor from responsibility of maintenance as outlined in this Section. This relief does not release the Contractor from responsibility for defective materials or work or constitute final acceptance.

16.5.1. **Isolated Work Locations**. For isolated work locations, when all work is completed, including work for Article 5.11., "Final Cleanup," the City Engineer may relieve the Contractor from responsibility for maintenance.

16.5.2. **Work Except for Vegetative Establishment and Test Periods**. When all work for all or isolated work locations has been completed, including work for Article 5.11., "Final Cleanup," with the exception of vegetative establishment and maintenance

periods and test and performance periods, the City Engineer may relieve the Contractor from responsibility for maintenance of completed portions of work.

16.5.3. **Work Suspension**. When all work is suspended for an extended period of time, the City Engineer may relieve the Contractor from responsibility for maintenance of completed portions of work during the period of suspension.

16.5.4. **When Directed by the City Engineer**. The City Engineer may relieve the Contractor from the responsibility for maintenance when directed.

16.6. **Basis of Payment**. When reimbursement for repair work is allowed and performed, payment will be made in accordance with pertinent Items or Article 4.3., "Changes in the Work."

17. ELECTRICAL REQUIREMENTS

17.1. **Definitions**.

17.1.1. **Electrical Work.** Electrical work is work performed for the following TxDOT Items:

- Item 610, "Roadway Illumination Assemblies,"
- Item 614, "High Mast Illumination Assemblies,"
- Item 616, "Performance Testing of Lighting Systems,"
- Item 617, "Temporary Roadway Illumination,"
- Item 618, "Conduit,"
- Item 620, "Electrical Conductors,"
- Item 621, "Tray Cable,"
- Item 622, "Duct Cable,"
- Item 628, "Electrical Services,"
- Item 680, "Highway Traffic Signals,"
- Item 681, "Temporary Traffic Signals,"
- Item 684, "Traffic Signal Cables,"
- Item 685, "Roadside Flashing Beacon Assemblies,"
- other Items that involve either the distribution of electrical power greater than 50 volts or the installation of conduit and duct banks,
- the installation of conduit and wiring associated with Item 624, "Ground Boxes" and Item 656, "Foundations for Traffic Control Devices," and
- the installation of the conduit system for communication and fiber optic cable.

Electrical work does not include the installation of communications or fiber optic cable, or the connections for low voltage and inherently power limited circuits such as electronic or communications equipment. Assembly and placement of poles, structures, cabinets, enclosures, manholes, or other hardware will not be considered electrical work as long as no wiring, wiring connections, or conduit work is done at the time of assembly and placement.

17.1.2. **Specialized Electrical Work**. Specialized electrical work is work that includes the electrical service and feeders, sub-feeders, branch circuits, controls, raceways, and enclosures for the following:

- pump stations,
- facilities required under TxDOT Item 504, "Field Office and Laboratory,"
- electrical services larger than 200 amps,
- electrical services with main or branch circuit breaker sizes not shown in the Contract, and
- any 3-phase electrical power.

17.1.3. **Certified Person**. A certified person is a person who has passed the test from the TxDOT's course TRF450, "TxDOT Roadway Illumination and Electrical Installations," or other courses as approved by the Traffic Operations Division. Submit a current and valid TRF certification upon request. Texas A&M Engineering Extension Service (TEEX) certifications for "TxDOT Electrical Systems" course will not be accepted.

17.1.4. **Licensed Electrician**. A licensed electrician is a person with a current and valid unrestricted master electrical license, or unrestricted journeyman electrical license that is supervised or directed by an unrestricted master electrician. An unrestricted master electrician need not be on the work locations at all times electrical work is being done, but the unrestricted master electrician must approve work performed by the unrestricted journeyman.

The unrestricted journeyman and unrestricted master electrical licenses must be issued by the Texas Department of Licensing and Regulation or by a city in Texas with a population of 50,000 or greater that issues licenses based on passing a written test and demonstrating experience.

The City Engineer may accept other states' electrical licenses. Submit documentation of the requirements for obtaining that license. Acceptance of the license will be based on sufficient evidence that the license was issued based on:

- passing a test based on the NEC similar to that used by Texas licensing officials, and
- sufficient electrical experience commensurate with general standards for an unrestricted master and unrestricted journeyman electrician in the State of Texas.

17.2. **Work Requirements**. The qualifications required to perform electrical work and specialized electrical work are listed in Table 2.

Table 2
Work Requirements

Type of Work	Qualifications to Perform Work
Electrical work with plans	Licensed electrician, certified person, or workers directly supervised by a licensed electrician or certified person
Electrical work without plans	Licensed electrician or workers directly supervised by a licensed electrician
Specialized electrical work	Licensed electrician or workers directly supervised by a licensed electrician
Replace lamps, starting aids, and changing fixtures	Licensed electrician, certified person, or workers directly supervised by a licensed electrician or certified person
Conduit in precast section with approved working drawings	Inspection by licensed electrician or certified person
Conduit in cast-in-place section	Inspection by licensed electrician or certified person
All other electrical work (troubleshooting, repairs, component replacement, etc.)	Licensed electrician or workers directly supervised by a licensed electrician

A licensed electrician must be physically present during all electrical work when Table 2 states that workers are to be directly supervised by a licensed electrician or certified person.

A non-certified person may install conduit in cast-in-place concrete sections if the work is verified by a certified person before concrete placement. If the plans specify IMSA certification or the completion of other electrical installation courses for traffic signal installation and maintenance, a licensed electrician or certified person will be required only for the installation of the conduit, ground boxes, electrical services, pole grounding, and electrical conductors installed under Item 620, “Electrical Conductors.”

Item 8
Prosecution and Progress

1. PROSECUTION OF WORK

Unless otherwise shown in the Contract, begin work within 30 calendar days (7 calendar days for routine maintenance Contracts) after the authorization date to begin work as shown on the notice to proceed. Prosecute the work continuously to completion within the working days specified. Unless otherwise shown on the plans, work may be prosecuted in concurrent phases if no changes are required in the traffic control plan or if a revised traffic control plan is approved. Notify the City Engineer at least 24 hr. before beginning work or before beginning any new operation. Do not start new operations to the detriment of work already begun. Minimize interference to traffic.

When callout work is required, begin work in the right of way within the specified time and continuously prosecute the work until completion.

2. COMPUTATION OF CONTRACT TIME FOR COMPLETION

Upon request, the Engineer will provide the conceptual time determination schedule to the Contractor for informational purposes only. The schedules assume generic resources, production rates, sequences of construction and average weather conditions based on historic data. UC will not adjust the number of working days and milestones, if any, due to differences in opinion regarding any assumptions made in the preparation of the schedule or for errors, omissions, or discrepancies found in UC's conceptual time schedule.

The number of working days is established by the Contract. Working day charges will begin 30 calendar days (7 calendar days for routine maintenance Contracts) after the date of the written authorization to begin work. Working day charges will continue in accordance with the Contract. The City Engineer may consider increasing the number of working days under extraordinary circumstances.

2.1. **Working Day Charges**. Working days will be charged in accordance with Section 8.2.1.4., "Standard Workweek," unless otherwise shown on the plans. For multiple work order Contracts, working days will be established in each work order. Working days will be computed and charged in accordance with one of the following:

2.1.1. **Five-Day Workweek**. Working days will be charged Monday through Friday, excluding city, state, and national holidays, regardless of weather conditions or material availability. The Contractor has the option of working on Saturdays. Provide sufficient advance notice to UC when scheduling work on Saturdays. Work on Sundays and holidays will not be permitted without written permission from UC. If work requiring an Inspector to be present is performed on a Saturday, Sunday, or a holiday, and weather and other conditions permit the performance of work for 4 hr. between 7:00 A.M. and 10:00 P.M., a working day will be charged.

2.1.2. **Six-Day Workweek**. Working days will be charged Monday through Saturday, excluding city, state, and national holidays, regardless of weather conditions or material availability. Work on Sundays and holidays will not be permitted without written permission from UC. If work requiring an Inspector to be present is performed on a Sunday or a holiday, and weather or other conditions permit the performance of work for 4 hr. between 7:00 A.M. and 10:00 P.M., a working day will be charged.

2.1.3. **Seven-Day Workweek**. Working days will be charged Monday through Sunday, excluding city, state, and national holidays, regardless of weather conditions or material availability. Work on holidays will not be permitted without written permission from UC. If work is performed on any of these holidays requiring an Inspector to be present, and weather or other conditions permit the performance of work for 4 hr. between 7:00 A.M. and 10:00 P.M., a working day will be charged.

2.1.4. **Standard Workweek**. Working days will be charged Monday through Friday, excluding city, state, and national holidays, if weather or other conditions permit the performance of the principal unit of work underway, as determined by UC, for a continuous period of at least 4 hr. between 7:00 A.M. and 10:00 P.M., unless otherwise shown in the Contract. The Contractor has the option of working on Saturdays or holidays. Provide sufficient advance notice to UC when scheduling work on Saturdays. Work on Sundays and holidays will not be permitted without written permission from UC. If work requiring an Inspector to be present is performed on a Saturday, Sunday, or a holiday, and weather or other conditions permit the performance of work for 4 hr. between 7:00 A.M. and 10:00 P.M., a working day will be charged.

2.1.5. **Calendar Day**. Working days will be charged Sunday through Saturday, including all holidays, regardless of weather conditions, material availability, or other conditions not under the control of the Contractor.

2.1.6. **Other**. Working days will be charged as shown on the plans.

2.2. **Restricted Work Hours**. Restrictions on Contractor work hours and the related definition for working day charges are as prescribed in this Article unless otherwise shown on the plans.

2.3. **Nighttime Work**. Nighttime work is allowed only when shown on the plans or directed or allowed by UC. Nighttime work is defined as work performed from 30 min. after sunset to 30 min. before sunrise.

2.3.1. **Five-, Six-, and Seven-Day Workweeks**. Nighttime work that extends past midnight will be assigned to the following day for the purposes of approval for allowing work on Sundays or national holidays.

2.3.2. **Standard Workweek**.

2.3.2.1. **Nighttime Work Only**. When nighttime work is allowed or required and daytime work is not allowed, working day charges will be made when weather and other conditions permit the performance of the principal unit of work underway, as determined by the Engineer, for a continuous period of at least 4 hr. for the nighttime period, as defined in Section 8.3.3., “Nighttime Work,” unless otherwise shown in the Contract.

2.3.2.2. **Nighttime Work and Daytime Work Requiring Inspector**. When nighttime work is performed or required and daytime work is allowed, working day charges will be made when weather and other conditions permit the performance of the principal unit of work underway, as determined by UC, for a continuous period of at least 4 hr. for the nighttime period, as defined in Section 8.2.3., “Nighttime Work,” or for a continuous period of at least 4 hr. for the alternative daytime period unless otherwise shown in the Contract. Only one day will be charged for each 24-hr. time period. When UC agrees to restrict work hours to the nighttime period only, working day charges will be in accordance with Section 8.2.3.2.1., “Nighttime Work Only.”

2.4. **Time Statements**. The Engineer will furnish the Contractor a monthly time statement.

Review the monthly time statement for correctness. Report protests in writing, no later than 30 calendar days after receipt of the time statement, providing a detailed explanation for each day protested. Not filing a protest within 30 calendar days will indicate acceptance of the working day charges and future consideration of that statement will not be permitted.

3. TEMPORARY SUSPENSION OF WORK OR WORKING DAY CHARGES

The City Engineer may suspend the work, wholly or in part, and will provide notice and reasons for the suspension in writing. Suspend and resume work only as directed in writing.

When part of the work is suspended, the City Engineer may suspend working day charges only when conditions not under the control of the Contractor prohibit the performance of critical activities. When all of the work is suspended for reasons not under the control of the Contractor, the City Engineer will suspend working day charges.

4. PROJECT SCHEDULES

Prepare, maintain, and submit project schedules. Project schedules are used to convey the Contractor's intended work plan to UC. Prepare project schedules with a level of effort sufficient for the work being performed. Project schedules will not be used as a basis to establish the amount of work performed or for the preparation of the progress payments. Schedule shall be resource and cost loaded. Contractor shall submit plotted and electronic pdf copies of schedule and updates in color as defined in this section unless otherwise directed.

4.1. **Project Scheduler**. Designate an individual who will develop and maintain the progress schedule. The Project Scheduler will be prepared to discuss, in detail, the proposed sequence of work and methods of operation, and how that information will be communicated through the Progress Schedule at the Preconstruction Meeting. This individual will also attend the project meetings and make site visits to prepare, develop, and maintain the progress schedules.

4.2. **Construction Details**. Before starting work, prepare and submit a progress schedule based on the sequence of work and traffic control plan shown in the Contract. At a minimum, prepare the progress schedule as a Bar Chart or Critical Path Method (CPM), as shown on the plans. Include all planned work activities and sequences and show Contract completion within the number of working days specified. Incorporate major material procurements, known utility relocations, and other activities that may affect the completion of the Contract in the progress schedule. Show a beginning date, ending date, and duration in whole working days for each activity. Do not use activities exceeding 20 working days, except for agreed upon activities. Show an estimated production rate per working day for each work activity.

4.3. **Schedule Format**. Format all project schedules according to the following:

- Begin the project schedule on the date of the start of Contract time or start of activities affecting work on the project;
- Show the sequence and interdependence of activities required for complete performance of the work. If using a CPM schedule, show a predecessor and a successor for each activity; and
- Ensure all work sequences are logical and show a coordinated plan of the work.

CPM schedules must also include:

- Clearly and accurately identify the critical path as the longest continuous path;

- Provide a legend for all abbreviations, run date, data date, project start date, and project completion date in the title block of each schedule submittal; and
- Through the use of calendars, incorporate seasonal weather conditions into the schedule for work (e.g., earthwork, concrete paving, structures, asphalt, drainage, etc.) that may be influenced by temperature or precipitation. Also, incorporate non-work periods such as holidays, weekends, or other non-work days as identified in the Contract.

4.4. **Activity Format**. For each activity on the project schedule provide:

- A concise description of the work represented by the activity;
- An activity duration in whole working days;
- Code activities so that organized plots of the schedule may be produced.

CPM schedules must also include the quantity of work and estimated production rate for major items of work. Provide enough information for review of the work being performed.

4.5. **Schedule Types**.

4.5.1. **Bar Chart**. Seven calendar days before the preconstruction meeting, prepare and submit a hard copy of the schedule using the bar chart method.

4.5.1.1. **Progress Schedule Reviews**. Update the project schedule and submit a hard copy when changes to the schedule occur or when requested.

4.5.2. **Critical Path Method**. Prepare and submit the schedule using the CPM.

4.5.2.1. **Preliminary Schedule**. Seven calendar days before the preconstruction meeting, submit both the plotted and electronic pdf copies of the project schedule showing work to be performed within the first 90 calendar days of the project.

4.5.2.2. **Baseline Schedule**. The baseline schedule will be considered the Contractor's plan to successfully construct the project within the timeframe and construction sequencing indicated in the Contract. Submit both plotted and electronic pdf copies of the baseline schedule. Submit 2 plots of the schedule: one organized with the activities logically grouped using the activity coding; and the other plot showing only the critical path determined by the longest path, not based on critical float.

Develop and submit the baseline schedule for review within the first 45 calendar days of the project unless the time for submission is extended by the City Engineer.

4.5.2.2.1. **Review**. Within 15 calendar days of receipt of the schedule, the Engineer will evaluate, and inform the Contractor if the schedule has been accepted. If the schedule is not accepted, the Engineer will provide comments to the Contractor for incorporation. Provide a revised schedule based on the Engineer's comments, or reasons for not doing so within 10 calendar days. The Engineer's review and acceptance of the project schedule is for conformance to the requirements of the Contract documents only and does not relieve the Contractor of any responsibility for meeting the interim milestone dates (if specified) or the Contract completion date. Review and acceptance does not expressly or by implication warrant, acknowledge, or admit the reasonableness of the logic or durations of the project schedule. If the Contractor fails to define any element of work, activity, or logic and the Engineer's review does not detect this omission or error, the Contractor is responsible for correcting the error or omission.

Submit an acceptable baseline schedule before the 90th calendar day of the project unless the time for submission is extended by the City Engineer.

4.5.2.3. **Progress Schedule**. Maintain the project schedule for use by both the Contractor and the City Engineer. Submit both the plotted and electronic pdf copy as it will become an as-built record of the daily progress achieved on the project. If continuous progress of an activity is interrupted for any reason except non-work periods (such as holidays, weekend, or interference from temperature or precipitation), then the activity will show the actual finish date as that date of the start of the interruption and the activity will be broken into a subsequent activity (or activities, based on the number of interruptions) similarly numbered with successive alpha character as necessary. The original duration of the subsequent activity will be that of the remaining duration of the original activity. Relationships of the subsequent activity will match those of the original activity so that the integrity of the project schedule logic is maintained. Once established, the original durations and actual dates of all activities must remain unchanged. Revisions to the schedule may be made as necessary.

The project schedule must be revised when changes in construction phasing and sequencing occur or other changes that cause deviation from the original project schedule occur. Any revisions to the schedule must be listed in the monthly update narrative with the purpose of the revision and description of the impact on the project schedule's critical path and project completion date. Create the schedule revision using the latest update before the start of the revision.

Monthly updating of the project schedule will include updating of:

- The actual start dates for activities started;
- The actual finish dates for activities completed;
- The percentage of work completed and remaining duration for each activity started but not yet completed; and
- The calendars to show days actual work was performed on the various work activities.

The cut-off day for recording monthly progress will be the last day of each month. Submit the updated project schedule no later than the 20th calendar day of the following month. The Engineer will evaluate the updated schedule within 5 calendar days of receipt and inform the Contractor if it has or has not been accepted. If the schedule is not accepted, the Engineer will provide comments to the Contractor for incorporation. Provide a revised schedule based on the Engineer's comments, or reasons for not doing so within 5 calendar days.

Provide a brief narrative in a bulleted statement format for major items that have impacted the schedule. Notify the Engineer if resource-leveling is being used.

4.5.2.3.1. **Project Schedule Summary Report (PSSR)**. When shown on the plans, provide the PSSR instead of the narrative required in Section 8.4.5.2.3., "Progress Schedule." The PSSR includes a listing of major items that have impacted the schedule as well as a summary of progress in days ahead or behind schedule. Include an explanation of the project progress for the period represented on the form provided by UC.

4.5.3. **Notice of Potential Time Impact**. Submit a "Notice of Potential Time Impact" when a Contract time extension or adjustment of milestone dates may be justified or when directed.

Failure to provide this notice in the timeframes outlined above will compromise UC's ability to mitigate the impacts and the Contractor forfeits the right to request a time extension or adjustment of milestone dates unless the circumstances are such that the Contractor could not reasonably have had knowledge of the impact at the time.

4.5.4. **Time Impact Analysis**. When directed, provide a time impact analysis. A time impact analysis is an evaluation of the effects of impacts on the project. A time impact

analysis consists of the following steps:

- **Step 1**. Establish the status of the project immediately before the impact.
- **Step 2**. Predict the effect of the impact on the schedule update used in Step 1.
- **Step 3**. Track the effects of the impact on the schedule during its occurrence.
- **Step 4**. Establish the status of the project after the impact's effect has ended and provide details identifying any mitigating actions or circumstances used to keep the project ongoing during the impact period.

Determine the time impact by comparing the status of the work before the impact (Step 1) to the prediction of the effect of the impact (Step 2), if requested, and to actual effects of the impact once it is complete (Step 4). Unless otherwise approved by the City Engineer, steps 1, 3, and 4, must be completed before consideration of a Contract time extension or adjustment of a milestone date will be provided. Time extensions will only be considered when delays that affect milestone dates or the Contract completion date are beyond the Contractor's control. Submit Step 4 no later than 15 calendar days after the impact's effects have ended or when all the information on the effect has been realized. Submit one electronic backup copy of the complete time impact analysis and a copy of the full project schedule incorporating the time impact analysis. If the project schedule is revised after the submittal of a time impact analysis, but before its approval, indicate in writing the need for any modification to the time impact analysis.

The City Engineer will review the time impact analysis upon completion of step 4. If this review detects revisions or changes to the schedule that had not been performed and identified in a narrative, the City Engineer may reject the time impact analysis. If the City Engineer is in agreement with the time impact analysis, a change order may be issued to grant additional working days, or to adjust interim milestones. Once a change order has been executed, incorporate the time impact analysis into the project schedule. The time impact analysis may also be used to support the settlement of disputes and claims. Compensation related to the time impact analysis may be provided at the completion of the analysis or the completion of the project to determine the true role the impact played on the final completion.

The work performed under this Article will not be measured or paid for directly but will be subsidiary to pertinent Items.

5. FAILURE TO COMPLETE WORK ON TIME

The time established for the completion of the work is an essential element of the Contract. If the Contractor fails to complete the work within the number of working days specified, working days will continue to be charged. Failure to complete the Contract, a separate work order, or callout work within the number of working days specified, including any approved additional working days, will result in liquidated damages for each working day charged over the number of working days specified in the Contract. The dollar amount specified in the Contract will be deducted from any money due or to become due the Contractor for each working day the Contract, work order, or callout work remains incomplete. This amount will be assessed not as a penalty but as liquidated damages. The amount assessed for non-site-specific Contracts will be based on the estimated amount for each work order unless otherwise shown in the Contract. The amount assessed for each callout will be as specified in the Contract.

6. DEFAULT OF THE CONTRACT

6.1. The City Engineer may declare the Contractor to be in default of the Contract if the Contractor:

- fails to begin the work within the number of days specified,

- fails to prosecute the work to assure completion within the number of days specified,
- is uncooperative, disruptive or threatening,
- fails to perform the work in accordance with the Contract requirements,
- neglects or refuses to remove and replace rejected materials or unacceptable work,
- discontinues the prosecution of the work without the City Engineer's approval,
- makes an unauthorized assignment,
- fails to resume work that has been discontinued within a reasonable number of days after notice to do so,
- fails to conduct the work in an acceptable manner, or
- commits fraud or other unfixable conduct as determined by UC,

If any of these conditions occur, the City Engineer will give notice in writing to the Contractor and the Surety of the intent to declare the Contractor in default. If the Contractor does not proceed as directed within 10 days after the notice, UC will provide written notice to the Contractor and the Surety to declare the Contractor to be in default of the Contract. UC will also provide written notice of default to the Surety. If the Contractor provides UC written notice of voluntary default of the Contract, UC may waive the 10 day notice of intent to declare the Contractor in default and immediately provide written notice of default to the Contractor and the Surety. Working day charges will continue until completion of the Contract. UC may suspend work in accordance with Section 8.3., "Temporary Suspension of Work or Working Day Charges," to investigate apparent fraud or other unfixable conduct before defaulting the Contractor. The Contractor may be subject to sanctions under the TAC.

UC will determine the method used for the completion of the remaining work as follows:

- **Contracts without Performance Bonds**. UC will determine the most expeditious and efficient way to complete the work, and recover damages from the Contractor.
- **Contracts with Performance Bonds**. UC will, without violating the Contract, demand that the Contractor's Surety complete the remaining work in accordance with the terms of the original Contract. A completing Contractor will be considered a subcontractor of the Surety. UC reserves the right to approve or reject proposed subcontractors. Work may resume after UC receives and approves Certificates of Insurance as required in Section 3.3.3., "Insurance." Certificates of Insurance may be issued in the name of the completing Contractor. The Surety is responsible for making every effort to expedite the resumption of work and completion of the Contract. UC may complete the work using any or all materials at the work locations that it deems suitable and acceptable. Any costs incurred by UC for the completion of the work under the Contract will be the responsibility of the Surety.

From the time of notification of the default until work resumes (either by the Surety or UC), UC will maintain traffic control devices and will do any other work it deems necessary, unless otherwise agreed upon by UC and the Surety. All costs associated with this work will be deducted from money due to the Surety.

UC will hold all money earned but not disbursed by the date of default. Upon resumption of the work after the default, all payments will be made to the Surety. All costs and charges incurred by UC as a result of the default, including the cost of completing the work under the Contract, costs of maintaining traffic control devices, costs for other work deemed necessary, and any applicable liquidated damages or disincentives will be deducted from money due the Contractor for completed work. If these costs exceed the sum that would have been payable under the Contract, the Surety will be liable and pay UC the balance of these costs in excess of the Contract price. In case the costs incurred by UC are less than the amount that would have been payable under the Contract if the work had been completed by the Contractor, UC will be entitled to retain the difference.

6.2 UC will determine if the Contractor has been wrongfully defaulted, and will proceed with the following:

In the event that UC determines the default is proper, the default will remain. If the Contractor is in disagreement, the Contractor may file a claim in accordance with Article 4.6., "Dispute or Claims Procedure."

In the event that UC determines it was a wrongful default, UC will terminate the Contract for convenience, in accordance with Article 8.7., "Termination of the Contract."

7. TERMINATION OF THE CONTRACT

UC may terminate the Contract in whole or in part whenever:

- the Contractor is prevented from proceeding with the work as a direct result of an executive order of the President of the United States or the Governor of the State;
- the Contractor is prevented from proceeding with the work due to a national emergency, or when the work to be performed under the Contract is stopped, directly or indirectly, because of the freezing or diversion of materials, equipment or labor as the result of an order or a proclamation of the President of the United States;
- the Contractor is prevented from proceeding with the work due to an order of any federal authority;
- the Contractor is prevented from proceeding with the work by reason of a preliminary, special, or permanent restraining court order where the issuance of the restraining order is primarily caused by acts or omissions of persons or agencies other than the Contractor; or
- UC determines that termination of the Contract is in the best interest of the State or the public. This includes but is not limited to the discovery of significant hazardous material problems, right of way acquisition problems, or utility conflicts that would cause substantial delays or expense to the Contract.

7.1. **Procedures and Submittals**. The City Engineer will provide written notice to the Contractor of termination specifying the extent of the termination and the effective date. Upon notice, immediately proceed in accordance with the following:

- stop work as specified in the notice;
- place no further subcontracts or orders for materials, services, or facilities, except as necessary to complete a critical portion of the Contract, as approved by the City Engineer;
- terminate all subcontracts to the extent they relate to the work terminated;
- complete performance of the work not terminated;
- settle all outstanding liabilities and termination settlement bids resulting from the termination for public convenience of the Contract;
- create an inventory report, including all acceptable materials and products obtained for the Contract that have not been incorporated in the work that was terminated (include in the inventory report a description, quantity, location, source, cost, and payment status for each of the acceptable materials and products); and
- take any action necessary, or that the City Engineer may direct, for the protection and preservation of the materials and products related to the Contract that are in the possession of the Contractor and in which UC has or may acquire an interest.

7.2. **Settlement Provisions**. Within 60 calendar days of the date of the notice of termination, submit a final termination settlement bid, unless otherwise approved. The City Engineer will prepare a change order that reduces the affected quantities of work and adds acceptable costs for termination. No claim for loss of anticipated profits will be considered. UC will pay reasonable and verifiable termination costs including:

- all work completed at the unit bid price and partial payment for incomplete work;
- the percentage of TxDOT Item 500, “Mobilization,” equivalent to the percentage of work complete or actual cost that can be supported by cost records, whichever is greater;
- expenses necessary for the preparation of termination settlement bids and support data;
- the termination and settlement of subcontracts;
- storage, transportation, restocking, and other costs incurred necessary for the preservation, protection, or disposition of the termination inventory; and other expenses acceptable to UC.

Item 9
Measurement and Payment

1. MEASUREMENT OF QUANTITIES

The Engineer will measure all completed work using United States standard measures, unless otherwise specified.

1.1. **Linear Measurement**. Unless otherwise specified, all longitudinal measurements for surface areas will be made along the actual surface of the roadway and not horizontally. No deduction will be made for structures in the roadway having an area of 9 sq. ft. or less. For all transverse measurements for areas of base courses, surface courses, and pavements, the dimensions to be used in calculating the pay areas will be the neat dimensions and will not exceed those shown on the plans, unless otherwise directed.

1.2. **Volume Measurement**. Transport materials measured for payment by volume in approved hauling vehicles. Display a unique identification mark on each vehicle. Furnish information necessary to calculate the volume capacity of each vehicle. The Engineer may require verification of volume through weight measurement. Use body shapes that allow the capacity to be verified. Load and level the load to the equipment's approved capacity. Loads not hauled in approved vehicles may be rejected.

1.3. **Weight Measurement**. Transport materials measured for payment by weight or truck measure in approved hauling vehicles. Furnish certified measurements, tare weights, and legal gross weight calculations for all haul units. Affix a permanent, legible number on the truck and on the trailer to correspond with the certified information. Furnish certified weights of loaded haul units transporting material if requested.

The material will be measured at the point of delivery. The cost of supplying these volume and weight capacities is subsidiary to the pertinent Item. For measurement by the ton, in the field, provide measurements in accordance with TxDOT Item 520, "Weighing and Measuring Equipment," except for Items where ton measurements are measured by standard tables.

The Engineer may reject loads and suspend hauling operations for overloading.

1.3.1. **Hauling on Routes Accessible to the Traveling Public**. For payment purposes on haul routes accessible to the traveling public, the net weight of the load will be calculated as follows:

- If the gross vehicle weight is less than the maximum allowed by state law, including applicable yearly weight tolerance permit, the net weight of the load will be determined by deducting the tare weight of the vehicle from the gross weight.
- If the gross vehicle weight is more than the maximum allowed by state law, including applicable yearly weight tolerance permit, the net weight of the load will be determined by deducting the tare weight of the vehicle from the maximum gross weight allowed.

1.3.2. **Hauling on Routes Not Accessible to the Traveling Public**. For payment purposes on haul routes that are not accessible to the traveling public where advance permission is obtained in writing from the City Engineer.

- If the gross vehicle weight is less than the maximum allowed by the Engineer, including applicable yearly weight tolerance permit, the net weight of the load will be determined by deducting the tare weight of the vehicle from the gross weight.

- If the gross vehicle weight is more than the maximum allowed by the Engineer, the net weight of the load will be determined by deducting the tare weight of the vehicle from the maximum gross weight allowed.

2. PLANS QUANTITY MEASUREMENT

Plans quantities may or may not represent the exact quantity of work performed or material moved, handled, or placed during the execution of the Contract. The estimated bid quantities are designated as final payment quantities, unless revised by the governing specifications or this Article.

If the quantity measured as outlined under "Measurement" varies by more than 5% (or as stipulated under "Measurement" for specific Items) from the total estimated quantity for an individual Item originally shown in the Contract, an adjustment may be made to the quantity of authorized work done for payment purposes.

When quantities are revised by a change in design approved by UC, by change order, or to correct an error on the plans, the plans quantity will be increased or decreased by the amount involved in the change, and the 5% variance will apply to the new plans quantity.

If the total Contract quantity multiplied by the unit bid price for an individual Item is less than $250 and the Item is not originally a plans quantity Item, then the Item may be paid as a plans quantity Item if the City Engineer and Contractor agree in writing to fix the final quantity as a plans quantity.

For callout work Contracts, plans quantity measurement requirements are not applicable.

3. ADJUSTMENT OF QUANTITIES

The party to the Contract requesting the adjustment will provide field measurements and calculations showing the revised quantity. When approved, this revised quantity will constitute the final quantity for which payment will be made. Payment for revised quantity will be made at the unit price bid for that Item, except as provided for in Article 4.3. "Changes in the Work."

4. SCOPE OF PAYMENT

Payment of the Contract unit price is full compensation for all materials, equipment, labor, tools, and supplies necessary to complete the Item of work under the Contract. Until final acceptance in accordance with Article 5.12., "Final Acceptance," assume liability for completing the work according to the plans and specifications and any loss or damage arising from the performance of the work or from the action of the elements, infringement of patent, trademark, or copyright, except as provided elsewhere in the Contract.

UC will only pay for material incorporated into the work in accordance with the Contract. Payment of progress estimates will in no way affect the Contractor's obligation under the Contract to repair or replace any defective parts in the construction or to replace any defective materials used in the construction and to be responsible for all damages due to defects if the defects and damages are discovered on or before final inspection and acceptance of the work.

5. PROGRESS PAYMENTS

The Engineer will prepare a monthly estimate of the amount of work performed, including materials in place. Incomplete items of work may be paid at an agreed upon percentage approved by the City Engineer. Payment of the monthly estimate is determined at the Contract Item prices less any withholdings or deductions in accordance with the Contract. Progress payments may be withheld for failure to comply with the Contract.

6. RETAINAGE

UC will withhold retainage on the Contractor. The Contractor may withhold retainage on subcontractors in accordance with state and federal regulations.

For contracts totaling four hundred thousand ($400,000.00) dollars or less, the withhold retainage amount by UC will be ten percent (10%) of the total contract amount. Where the contract exceeds four hundred thousand ($400,000.00) dollars, the withhold retainage amount by UC will be five percent (5%) of the total contract amount. The percent retained shall be held by UC until the final payment.

7. PAYMENT PROVISIONS FOR SUBCONTRACTORS

For the purposes of this Article only, the term subcontractor includes suppliers and the term work includes materials provided by suppliers at a location approved by UC.

These requirements apply to all tiers of subcontractors. Incorporate the provisions of this Article into all subcontract or material purchase agreements.

Pay subcontractors for work performed within 10 days after receiving payment for the work performed by the subcontractor. Also, pay any retainage on a subcontractor's work within 10 days after satisfactory completion of all of the subcontractor's work. Completed subcontractor work includes vegetative establishment, test, maintenance, performance, and other similar periods that are the responsibility of the subcontractor.

For the purpose of this Section, satisfactory completion is accomplished when:

- the subcontractor has fulfilled the Contract requirements of both (UC) and the subcontract for the subcontracted work, including the submittal of all information required by the specifications and UC; and
- the work done by the subcontractor has been inspected, approved, and paid by (UC).

Provide a certification of prompt payment in accordance with the TxDOT's prompt payment procedure to certify that all subcontractors and suppliers were paid from the previous months payments and retainage was released for those whose work is complete. Submit the completed form each month and the month following the month when final acceptance occurred at the end of the project.

The inspection and approval of a subcontractor's work does not eliminate the Contractor's responsibilities for all the work as defined in Article 7.16., "Contractor's Responsibility for Work."

(UC) may pursue actions against the Contractor, including withholding of estimates and suspending the work, for noncompliance with the subcontract requirements of this Section upon receipt of written notice with sufficient details showing the subcontractor has complied with contractual obligations.

8. FINAL PAYMENT

When the Contract has been completed, all work has been approved, final acceptance has been made in accordance with Article 5.12., “Final Acceptance,” and Contractor submittals have been received, the Engineer will prepare a final estimate for payment showing the total quantity of work completed and the money owed the Contractor. The final payment will reflect the entire sum due, less any sums previously paid.

This page is intentionally left blank

100 Items

This page is intentionally left blank

SPECIAL PROVISION
100
MOBILIZATION

For this project refer to TxDOT Item 500, "Mobilization," of the most current Standard Specifications. Hereby amend Item 100 with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Article 100.3. PAYMENTS. This section is voided and replaced by the following:

Partial payments of the "Lump Sum" bid for mobilization will be as follows: (The adjusted contract amount for construction items, as used below, is defined as the total contract amount less the lump sum bid for Mobilization and Preparing Right-Of-Way).

1. When 1% of the adjusted contract amount for construction items is earned, 50% of the "Lump Sum" bid or 5% of the total contract, whichever is less, will be paid.

2. When 5% of the adjusted contract amount for construction items is earned, 75% of the "Lump Sum" bid or 10% of the total contract amount, whichever is less, will be deducted from the above amount.

3. When 10% of the adjusted contract amount for construction items is earned, 90% of the "Lump Sum" bid or 15% of the total contract amount, whichever is less, will be paid. Previous payments under this item will be deducted from the above amount.

Upon completion of all work under this contract, payment for the remainder of the "Lump Sum" bid for Mobilization will be made.

NOTES: Cost for Insurance and Bond is inclusive to cost of Mobilization Item.

New Article 100.4 BID ITEMS. Add the following:

Item 00100 – Mobilization – Lump Sum

Item 00100.01 – Insurance and Bond – Lump Sum (3%)

SPECIAL PROVISION

101

PREPARING RIGHT OF WAY

For this project refer to TxDOT Item 100, "Preparing Right of Way," from the most current Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Article 101.1. DESCRIPTION. Add the following:

Such obstructions shall be considered to include, but not be limited to, remains of houses not completely removed by others, foundations, floor slabs, concrete, brick, lumber, plaster, cisterns, septic tanks, basements, abandoned utility pipes or conduits, equipment or other foundations, fences, retaining walls, outhouses, shacks, and all other debris, as well as buried concrete slabs, curbs, driveways and sidewalks.

This item shall also include the removal of trees, stumps, bushes, shrubs, brush, roots, vegetation, logs, rubbish, paved parking areas, miscellaneous stone, brick, drainage structures, manholes, inlets, abandoned railroad tracks, scrap iron and all debris, whether above or below ground, except live utility facilities.

This item shall not govern the demolition of buildings by the use of explosives. Such demolition work shall be governed by the use of a special specification controlling the work.

It is the intent of this specification to provide for the removal and disposal of all obstructions to the new construction, together with other objectionable materials, not specifically provided for elsewhere by the plans and specifications.

Unless shown otherwise on the plans, all fences along the right-of-way which are damaged or removed temporarily by the Contractor shall be replaced by the Contractor to an equal or better condition at no additional cost to the City.

Article 101.2 CONSTRUCTION. The following is edited:

4th Paragraph, 3rd sentence, delete and with:

All other areas, 2 feet below natural ground.

Add the following to the end:

Where a conduit is shown to be replaced, it shall be removed in its entirety, and all connections to the existing conduit shall be extended to the new line. Where an existing conduit is to be cut and plugged, the line shall be cut back not less than 2 feet, and a

plug of concrete not less than 2 feet long shall be placed and held in the end of the pipe. The plug may also be accomplished by using a precast stopper grouted into place.

Material to be removed will be designated as “salvageable” or “non-salvageable” on the plans prior to bidding by the Contractor. All “salvageable” material will remain the property of the City and will be stored at the site as directed by the Inspector. All “non-salvageable” materials and debris removed shall become the property of the Contractor and shall be removed from the site and shall be disposed of properly.

All asphaltic material shall be disposed of or recycled at the facility authorized to accept the asphalt for such purposes and applicable to appropriate guidelines and regulations.

Article 101.3 MEASUREMENT. Delete and replace with the following:

Preparing Right-Of-Way for new construction will be measured by the “Lump Sum”.

Article 101.4 PAYMENT. Delete and replace with the following:

This item will be paid for at the contract “Lump Sum” price bid for Preparing Right of Way, which price shall be full compensation for work herein specified, including the furnishing of all materials, equipment, tools, labor, and incidentals necessary to complete the work. 10% of the payment will be withheld until final construction payment. The remainder will be paid on the estimate after the final acceptance under Article 5.12, “Final Acceptance”.

102

RESTORING RIGHT OF WAY

1. DESCRIPTION

Restore the right of way and designated easements for construction operations to equal or better conditions as specified herein. Restoration includes but is not limited to pavement, esplanades, sidewalks, driveways, medians, fences, lawns, and landscaping.

2. MATERIALS

Items related to restoration not shown on the plans to be subsidiary to pertinent items shall be considered subsidiary to restoring right of way when specified as a pay item.

3. CONSTRUCTION

3.1. Preparation Work. Cleanup and restoration crews shall work closely behind utility installation and roadway reconstruction, and when necessary, during testing, service restoration, abandonment, backfill and surface restoration. When testing has been completed, passed, and is accepted by the owner, abandonment of main, if applicable, and right of way restoration may begin unless otherwise directed.

3.2. Cleaning. Remove construction debris and trash to maintain a clean and orderly site.

3.3. Seeding and Sodding. Restore to grade and provide topsoil so that grass surfaces match existing grass level and preconstruction drainage patterns are maintained. Level with embankment that meets the intended use, when necessary.

3.4. Trees, Shrubs, and Plants. Remove and replant trees, shrubs, and plants. Preserve and protect existing trees, shrubs, and plants from foliage, branch, trunk, or root damage that results from construction operations. When trees other than those designated for removal are destroyed or damaged as result of construction operations, remove and replace with same size, species, and variety.

3.5. Fences. Reinstall fence to equal or better existing condition. Install in accordance with applicable TXDOT Items unless otherwise indicated. Metal fencing material not damaged may be reused.

3.6. Maintenance. Maintain seeded or sodded areas, trees, shrubs, and plants until established and as directed. Replace any that fail to become established.

4. MEASUREMENTS

Restoring Right Of Way will not be measured for payment directly but will be subsidiary to pertinent items when part of a roadway reconstruction or proposed

roadway project unless otherwise indicated. When measured for payment it will be by the “Lump Sum”.

5. PAYMENT

When specified as a pay item, this item will be paid for at the contract “Lump Sum” price bid for Restoring Right of Way, which price shall be full compensation for work herein specified, including the furnishing of all materials, equipment, tools, labor, and incidentals necessary to complete the work. 10% of the payment will be withheld until final construction payment. The remainder will be paid on the estimate after the final acceptance under Article 5.12, “Final Acceptance”.

This page is intentionally left blank

200 Items

This page is intentionally left blank

SPECIAL PROVISION
200
FLEXIBLE BASE

For this project refer to TxDOT Item 247, "Flexible Base," from the most current Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Article 247.4. CONSTRUCTION. Edit the following:

247.4.2., 1st Paragraph, after the 2nd sentence, add the following:

> Place the flexible base material on the approved subgrade in courses not to exceed six (6) inches compacted depth.

Article 247.5 MEASUREMENT. Edit the following:

1st Paragraph, Delete the 2nd (Roadway Delivery) and 3rd (Stockpile Delivery) measurement options

2nd Paragraph, 1st sentence, Delete "…cubic yard in final position and.."

Delete sections: 5.1, 5.2, 5.4, 5.5, and the last paragraph of this section.

Article 247.6 PAYMENT. Delete and replace with the following:

2nd paragraph with "Sprinkling, rolling, and proof rolling will not be paid for directly but will be subsidiary to this item.

SPECIAL PROVISION

201

PRIME COAT

For this project refer to TxDOT Item 310, "Prime Coat," from the most current Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Article 310.4.1. CONSTRUCTION. Add the following:

310.4.1, new 3rd paragraph.

Apply the asphaltic material on the clean surface utilizing an approved self-propelled pressure distributor as to distribute the prime coat at a rate not to exceed 0.20 gallon per square yard of surface, evenly, smoothly, and under a pressure necessary for proper distribution. Take care during the application of prime coat to prevent splattering of adjacent pavement, curb and gutters or structures.

SPECIAL PROVISION

203

HOT MIX ASPHALTIC CONCRETE PAVEMENT

For this project refer to TxDOT Item 340, "Dense-Graded Hot-Mix Asphalt (Small Quantity)," from the most current Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Article 340.2 MATERIALS. Edit the following:

Add to the end of 340.2, the 1st paragraph.

> Recycled Asphalt Shingles (RAS) and Recycled Asphalt Pavement (RAP) will not be allowed in any HMA or Warm Mix Asphaltic Concrete (WMAC).

Delete the 5th sentence from 340.2.1

Delete the 4th sentence from 340.2.1.1.1.

Delete "…RAP, RAS…" from the 3rd footnote for Table 1.

Delete the following:

> 340.2.7, 340.2.7.1, 340.2.7.2, and 340.2.8, including Table 5.

Article 340.4 CONSTRUCTION. Edit the following:

Add the following as the second (2nd) sentence of the current third (3rd) paragraph:

> Operate the equipment at a uniform speed consistent with the plant's production rate, hauling capability, placement rate, and compaction capacity to result in a continuous operation. The speed of the operation shall be such that minimal stoppage of the placement and compaction equipment is required. If the inspector determines that the placement rate is not sufficiently met, the City of UC may require placement operations to cease until an acceptable plan has been presented.

Section 340.4.6.1 Weather Conditions, first sentence, replace "…60ºF…" with "…50 ºF…".

Section 340.4.6.3.2 Hauling Equipment, add the following as a second paragraph:

> Dispatch the trucks such that all material delivered is placed and compacted during daylight hours unless otherwise shown on the plans. Covering and insulating trucks will be required in cool weather and long haul distances.

Section 340.4.7 Compaction, fifth paragraph, replace all "…160ºF…" with "…175 ºF…".

Article 340.5 MEASUREMENT. Delete and replace with the following:

Hot mix will be measured by the square yard, which includes asphalt, aggregate, and additives, complete in place, and at the thickness specified on the plans. Limits of payment will be from face of curb to face of curb at the station limits shown on the plans.

Article 340.6 PAYMENT. Delete the third (3rd) paragraph and replace with the following:

Prime Coat, when required will be paid under the provisions of Item 201.

SPECIAL PROVISION

204

CUTTING AND PATCHING PAVEMENT

For this project refer to TxDOT Item 351, "Flexible Pavement Structure Repair," from the most current Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Article 351.1. DESCRIPTION. Edit the following:

Add to the end of the sentence of 351.1.

"and as directed".

Article 351.2 MATERIALS. The following is edited:

Replace "Item 247, "Flexible Base" with "Item 200, Flexible Base".
Add "Item 300, Asphalts, Oils, and Emulsions".
Replace "Item 340, "Dense Graded Hot-Mix Asphalt (Small Quantity)" with "Item 203, Hot Mix Asphaltic Concrete Pavement".

Article 351.4 WORK METHODS. The following is edited:

Section 351.4.3.1 Flexible Base, replace "Item 247, "Flexible Base" with "Item 200, Flexible Base".
Sections 351.4.3.4 Asphalt-Stabilized Base and 351.4.5.3 Asphalt Concrete Pavement, replace "Item 340, "Dense Graded Hot-Mix Asphalt (Small Quantity)" with "Item 203, Hot Mix Asphaltic Concrete Pavement".
Section 351.4.5.1 Prime Coat, remove and replace the second (2nd) sentence with "Apply the prime coat at a rate shown on the plans or at the rate of 0.20 gallons per square yard if not shown in the plans. Tack coat will be applied at a rate of 0.10 gallons per square yard."
Section 351.4.5 Surfacing, add the following sentence "The pavement's surface after compaction will not deviate by more than one-fourth (1/4) inch of the original surface line and grade."

Article 101.4 PAYMENT. Replace "…"Flexible Pavement Structure Repair…" in the first (1st) sentence with "…Cutting and Patching Pavement…".

205

MASTIC SURFACE TREATMENT – PARKING LOT

1. DESCRIPTION

Apply an emulsified asphalt and water mixture as an aggregate loss preventative or surface seal for parking lot pavements.

2. MATERIALS

Provide asphalt materials that meet the stated requirements when tested in accordance with the referenced AASHTO and ASTM test methods.

2.1. Emulsified Asphalt. Provide emulsified asphalt that is homogeneous, does not separate after thorough mixing, and meets the requirements for the specified type and grade in Table 1.

TABLE 1 – EMULSIFIED ASPHALT			
CRITERION	**STANDARD**	**MIN**	**MAX**
Viscosity, Saybolt Furol At 77˚ F, Seconds	**AASHTO T 59 ASTM D244**	**15**	**100**
Particle Charge Test	**AASHTO T 59 ASTM D244**	**Positive[2]**	
Sieve Test, %	**AASHTO T 59**	**0**	**0.1[3]**
Residue By Distillation, %	**AASHTO T 59**	**57**	**---**
Penetration At 77˚ F, 100g, 5 Seconds (Test On Residue From Distillation)	**AASHTO T 49 ASTM D5**	**15**	**150**

1. The storage stability test may be waived provided the asphalt emulsion storage tank at the mixing site has adequate provisions for circulating the entire contents of the tank, and provided satisfactory field results are obtained.
2. If the particle charge test is inconclusive, material having a maximum pH value of 6.0 will be acceptable.
3. The sieve test may be waived if material applies without clogging nozzles and satisfactory field results are obtained.

2.2. Aggregate. Provide composite aggregate blend that is free of cemented or conglomerated material, does not have any detrimental material, and meets the requirements in Table 2.

TABLE 2 – AGGREGATE			
PHYSICAL PROPERTIES[1]			
CRITERION	STANDARD	MIN	MAX
Water Absorption, %	AASHTO T 84	---	10
Micro-Deval[2], %	ASTM D7428	---	20
GRADATION[3]			
SIEVE	STANDARD	PERCENT PASSING	
No. 8	ASTM C136	100	---
No. 16		75 - 100	---
No. 30		65 - 100	---
No. 60		50 – 90	---
No. 100		40 – 85	---
No. 200		40 - 80	---

1. Perform physical property tests on aggregates that are received before blending into sealer.
2. Micro-Deval on aggregate larger than No. 60 sieve U.S.
3. Includes all mineral components.

2.3. **Water.** The manufacturer shall use water that is potable and free of harmful soluble salts.

2.4. **Additives.** Any other material added to the mixture or to any of the component materials to provide the required properties shall be applied by the manufacturer.

3. JOB MIX FORMULA (JMF)

3.1. **Mix Design.** The manufacturer shall develop the JMF and shall present certified test results for approval prior to use. Acceptance will is subject to satisfactory field performance. Mixture shall contain a minimum of 30% aggregate by weight of mixture following ignition oven and shall meet the following requirements.

TABLE 3 – ASPHALTIC MASTIC			
MIX DESIGN			
TEST	STANDARD	MIN	MAX
Wet-Track Abrasion Loss (3 day soak)[1], g/m^2	ISSA TB 100 ASTM D3910	---	80
Asphalt Content By Ignition Method, %	AASHTO T 308	30	---

1. Use modified method to account for realistic application depth and fine emulsion mixture.
2. Establish base friction value using prepared laboratory compacted slab of approved mix as surface to be tested. The Dynamic Friction Test (DFT) number ratio should indicate that after application of the mastic seal, the surface retains required minimum percentage DFT number of the original pavement surface.

3.2. **Manufacture and Field Sample.** Manufacture and field samples shall meet the following requirements.

TABLE 4 – ASPHALTIC MASTIC			
MANUFACTURE AND FIELD SAMPLES			
TEST	STANDARD	MIN	MAX
Solids Content By Evaporation[1], %	AASHTO T 59	44	---
Asphalt Content By Ignition Method[2], %	AASHTO T 308	30	---
Rotational Viscosity @ 20 RPM/RV spindle (cPs) @ 25˚ C	ASTM D2196	800	4000

1. T 59 sample shall be dried to a state where measurements taken 20 minutes apart do not indicate change. Samples shall be tested within 7 days.
2. Sample size shall be reduced to achieve asphalt quantity. Test should be performed on a completely dry sample.

4. EQUIPMENT

4.1. **Mixing Equipment.** The mixture shall be mixed thru a central mixing plant. Aggregate, asphalt emulsion, water, and additives shall be proportioned by volume or weight (mass) utilizing the approved mix design. The tank shall be equipped with a full sweep agitator capable of producing a homogeneous mastic surface treatment mix.

Individual volume or weight (mass) controls for proportioning each item to be added to the mix shall be provided. Each material control device shall be calibrated and properly marked. Each device shall be accessible for ready calibration and placed such that the UC representative may determine the amount of each material used at the time.

4.2. **Mobile Distribution Unit (MDU).** The MDU shall be fully self-contained and shall have a storage tank with full sweep agitation, hydraulic system, operator controls, pumping system with multiple piston pumps, material filters and spray bar capable of applying a full lane width. The equipment shall have sufficient available power to operate the full spray system and the agitation system at the same time

4.2.1. As material is delivered to the job site and applied, the proportion of the mixture shall be maintained as it was manufactured per the mix design.

4.2.2. The storage tank shall have an internal full sweep mixing system and have sufficient mixing capability to assure proper suspension of fine aggregates in the surfacing mix.

4.2.3. The MDU shall be equipped with a system allowing the measurement and calculation of application rates. This system shall include a tank scale to determine weight of material and a GPS to determine distance and area.

4.2.4. The spray system shall have low shearing piston driven pumps regulated by the hydraulic control system. The pumps shall provide operation resulting in high volume and low potential for cavitation and engineered to allow the system to handle fine aggregate filled materials.

4.2.5. The spray system's pumps shall be equipped with a primary filter prior to the pumps and a secondary filter system for fine post pump filtration of the material. The MDU shall have an air driven clean out system for each nozzle to eliminate clogging. An

operator shall be able to monitor the spray system insuring even distribution of material and be able to control the clean out system of each nozzle during application. The MDU shall have a safe area on the back of the MDU for an operator to monitor and control clean out of the spray system.

4.2.6. The applicator spray bar shall be sized with volumetric capacity to dampen any possible pressure ripples by providing even pressure to all spray tips. Attachments such as a spray shield and wind deflector shall be available.

5. CONSTRUCTION

5.1. **Surface Preparation.** The surface shall be thoroughly cleaned of all vegetation, loose material, dirt, mud and other objectionable material immediately prior to application of the mixture.

5.2. **Weather Limitations.** Mixture shall not be placed when either the air temperature or the temperature of the surface on which the mixture is to be placed is below 60˚ F, when it is raining, when there is a chance of temperatures below 32˚ F (0˚ C) within 24 hours after placement, or as directed.

5.3. **Dilution.** Contractor shall not dilute mixture in the field with water or any other additive except as approved by the manufacturer

5.4. **Placement.** The exact rate will be as shown on the plans or as directed. The minimum application shall be 0.10 gallons per square yard (gal/yd^2) per pass. Placement of the mix shall be performed in two passes with a minimum total coverage of 0.25 gal/yd^2.

5.4.1. The mixture shall be uniform and homogeneous after applying on the existing surfacing and shall not show separation of the emulsion and aggregate after setting.

5.4.2. Placement of the material may be permitted in multiple passes at the election of the contractor. Contractor shall provide a mat ensuring total coverage and especially free of voids and pit holes.

5.4.3. After application, the roadway shall remain closed until the surface is tack-free and capable of being open to traffic without tracking.

6. MEASUREMENT

This item will be measured by the square yard.

7. PAYMENT

The work performed and the materials furnished in accordance with this item and measured as provided under “Measurement” will be paid for at the unit price bid for “Mastic Surface Treatment – Parking Lot” as specified. This price is full compensation for materials, equipment, labor, tools, and incidentals.

206

MASTIC SURFACE TREATMENT - ROADWAY

1. DESCRIPTION

Apply an emulsified asphalt and water mixture as an aggregate loss preventative or surface seal for roadway pavements.

2. MATERIALS

Provide asphalt materials that meet the stated requirements when tested in accordance with the referenced AASHTO and ASTM test methods.

2.1. Emulsified Asphalt. Provide emulsified asphalt that is homogeneous, does not separate after thorough mixing, and meets the requirements for the specified type and grade in Table 1.

TABLE 1 – EMULSIFIED ASPHALT			
CRITERION	**STANDARD**	**MIN**	**MAX**
Viscosity, Saybolt Furol At 77˚ F, Seconds	**AASHTO T 59 ASTM D244**	**15**	**100**
Particle Charge Test	**AASHTO T 59 ASTM D244**	**Positive[2]**	
Sieve Test, %	**AASHTO T 59**	**0**	**0.1[3]**
Residue By Distillation, %	**AASHTO T 59**	**57**	**---**
Penetration At 77˚ F, 100g, 5 Seconds (Test On Residue From Distillation)	**AASHTO T 49 ASTM D5**	**15**	**150**

1. The storage stability test may be waived provided the asphalt emulsion storage tank at the mixing site has adequate provisions for circulating the entire contents of the tank, and provided satisfactory field results are obtained.
2. If the particle charge test is inconclusive, material having a maximum pH value of 6.0 will be acceptable.
3. The sieve test may be waived if material applies without clogging nozzles and satisfactory field results are obtained.

2.2. Aggregate. Provide composite aggregate blend that is free of cemented or conglomerated material, does not have any detrimental material, and meets the requirements in Table 2.

TABLE 2 – AGGREGATE			
PHYSICAL PROPERTIES[1]			
CRITERION	STANDARD	MIN	MAX
Water Absorption, %	AASHTO T 84	---	4
Micro-Deval[2], %	ASTM D7428	---	20

GRADATION[3]			
SIEVE	STANDARD	PERCENT PASSING	TOLERANCE
No. 8	ASTM C136	100	
No. 16		80 - 100	
No. 30		75 - 100	+/- 5
No. 60		50 - 85	+/- 5
No. 100		40 - 65	+/- 5
No. 200		25 - 65	+/- 5

1. Perform physical property tests on aggregates that are received before blending into sealer.
2. Micro-Deval on aggregate larger than No. 60 sieve U.S.
3. Includes all mineral components.

2.3. **Water.** The manufacturer shall use water that is potable and free of harmful soluble salts.

2.4. **Additives.** Any other material added to the mixture or to any of the component materials to provide the required properties shall be applied by the manufacturer.

3. JOB MIX FORMULA (JMF)

3.1. **Mix Design.** The manufacturer shall develop the JMF and shall present certified test results for approval prior to use. Acceptance will is subject to satisfactory field performance. Mixture shall contain a minimum of 30% aggregate by weight of mixture following ignition oven and shall meet the following requirements.

TABLE 3 – ASPHALTIC MASTIC			
MIX DESIGN			
TEST	STANDARD	MIN	MAX
Wet-Track Abrasion Loss (3 day soak)[1], g/m^2	ISSA TB 100 ASTM D3910	---	80
Asphalt Content By Ignition Method, %	AASHTO T 308	30	---
Dynamic Friction Test Number @ 20kph[2], ratio	ASTM E1911	0.90	---

1. Use modified method to account for realistic application depth and fine emulsion mixture.
2. Establish base friction value using prepared laboratory compacted slab of approved mix as surface to be tested. The Dynamic Friction Test (DFT) number ratio should indicate that after application of the mastic seal, the surface retains required minimum percentage DFT number of the original pavement surface.

3.2. **Manufacture and Field Sample.** Manufacture and field samples shall meet the following requirements.

TABLE 4 – ASPHALTIC MASTIC			
MANUFACTURE AND FIELD SAMPLES			
TEST	STANDARD	MIN	MAX
Solids Content By Evaporation[1], %	AASHTO T 59	48	---
Asphalt Content By Ignition Method[2], %	AASHTO T 308	30	---
Rotational Viscosity @ 20 RPM/RV spindle (cPs) @ 25˚ C	ASTM D2196	800	4000

1. T 59 sample shall be dried to a state where measurements taken 20 minutes apart do not indicate change. Samples shall be tested within 7 days.
2. Sample size shall be reduced to achieve asphalt quantity. Test should be performed on a completely dry sample.

4. EQUIPMENT

4.1. **Mixing Equipment.** The mixture shall be mixed thru a central mixing plant. Aggregate, asphalt emulsion, water, and additives shall be proportioned by volume or weight (mass) utilizing the approved mix design. The tank shall be equipped with a full sweep agitator capable of producing a homogeneous mastic surface treatment mix.

Individual volume or weight (mass) controls for proportioning each item to be added to the mix shall be provided. Each material control device shall be calibrated and properly marked. Each device shall be accessible for ready calibration and placed such that the UC representative may determine the amount of each material used at the time.

4.2. **Mobile Distribution Unit (MDU).** The MDU shall be fully self-contained and shall have a storage tank with full sweep agitation, hydraulic system, operator controls, pumping system with multiple piston pumps, material filters and spray bar capable of applying a full lane width. The equipment shall have sufficient available power to operate the full spray system and the agitation system at the same time

4.2.1. As material is delivered to the job site and applied, the proportion of the mixture shall be maintained as it was manufactured per the mix design.

4.2.2. The storage tank shall have an internal full sweep mixing system and have sufficient mixing capability to assure proper suspension of fine aggregates in the surfacing mix.

4.2.3. The MDU shall be equipped with a system allowing the measurement and calculation of application rates. This system shall include a tank scale to determine weight of material and a GPS to determine distance and area.

4.2.4. The spray system shall have low shearing piston driven pumps regulated by the hydraulic control system. The pumps shall provide operation resulting in high volume and low potential for cavitation and engineered to allow the system to handle fine aggregate filled materials.

4.2.5. The spray system's pumps shall be equipped with a primary filter prior to the pumps and a secondary filter system for fine post pump filtration of the material. The MDU shall have an air driven clean out system for each nozzle to eliminate clogging. An

operator shall be able to monitor the spray system insuring even distribution of material and be able to control the clean out system of each nozzle during application. The MDU shall have a safe area on the back of the MDU for an operator to monitor and control clean out of the spray system.

4.2.6. The applicator spray bar shall be sized with volumetric capacity to dampen any possible pressure ripples by providing even pressure to all spray tips. Attachments such as a spray shield and wind deflector shall be available.

5. CONSTRUCTION

5.1. **Surface Preparation.** The surface shall be thoroughly cleaned of all vegetation, loose material, dirt, mud and other objectionable material immediately prior to application of the mixture.

5.2. **Weather Limitations.** Mixture shall not be placed when either the air temperature or the temperature of the surface on which the mixture is to be placed is below 60˚ F, when it is raining, when there is a chance of temperatures below 32˚ F (0˚ C) within 24 hours after placement, or as directed.

5.3. **Dilution.** Contractor shall not dilute mixture in the field with water or any other additive except as approved by the manufacturer

5.4. **Placement.** The exact rate will be as shown on the plans or as directed. The minimum application shall be 0.10 gallons per square yard (gal/yd²) per pass. Placement of the mix shall be performed in two passes with a minimum total coverage of 0.25 gal/yd².

5.4.1. The mixture shall be uniform and homogeneous after applying on the existing surfacing and shall not show separation of the emulsion and aggregate after setting.

5.4.2. Placement of the material may be permitted in multiple passes at the election of the contractor. Contractor shall provide a mat ensuring total coverage and especially free of voids and pit holes.

5.4.3. After application, the roadway shall remain closed until the surface is tack-free and capable of being open to traffic without tracking.

6. MEASUREMENT

This item will be measured by the square yard.

7. PAYMENT

The work performed and the materials furnished in accordance with this item and measured as provided under “Measurement” will be paid for at the unit price bid for “Mastic Surface Treatment – Roadway” as specified. This price is full compensation for materials, equipment, labor, tools, and incidentals.

207

SURFACE SEALING TREATMENT – TIRE RUBBER MODIFIED SURFACE SEALER (TRMSS)

1. DESCRIPTION

Apply an emulsified asphalt and water mixture as an aggregate loss preventative or surface seal.

2. MATERIALS

2.1. Emulsified Asphalt. Provide emulsified asphalt that is homogeneous, does not separate after thorough mixing, and meets the requirements for the specified type and grade in Table 1. Use a quantity of emulsified asphalt in the mixture, expressed as a percentage of total volume, which meets the percentage shown on the plans or directed.

TABLE 1 – TRMSS			
CRITERION	**STANDARD**	**MIN**	**MAX**
Tire Rubber Content, %		**10**	**---**
Viscosity, Krebs Unit, 77˚F, Krebs Units	**ASTM D562**	**35**	**85**
Softening Point, ˚F	**ASTM D36**	**130**	**---**
Uniformity (Wet Film Continuity)	**ASTM D2939**	**Pass[2]**	
Resistance To Heat	**ASTM D2939**	**Pass[3]**	
Resistance To Water	**ASTM D2939**	**Pass[4]**	
Wet Flow, mm	**ASTM D2939**	**Pass[5]**	
Resistance To Kerosene (Optional)[6]	**ASTM D2939**	**Pass[7]**	
Ultraviolet Exposure, UVA-340, 0.77 W/m², 50˚C, 8 HR UV Light, 5 Min Spray, 3HR 55Min Condensation, 1000 HR Total Exposure	**ASTM G154**	**Pass[8]**	
Abrasion Loss, 1.6mm Thickness, TRMSS Liquid Only, %	**ISSA TB-100**	**---**	**1.5**
Residue By Evaporation, % By Weight	**ASTM D2939**	**33**	**---**
Test On Residue By Evaporation:			
Penetration, 77˚F, 100 g, 5 Sec	**ASTM D5**	**12**	**30**
Flash Point, Cleveland Open Cup, ˚F	**ASTM D93**	**550**	**---**
Test On Base Asphalt Before Emulsification: Solubility In Trichloroethylene, %	**ASTM D2042**	**98.5**	**---**

1. Cure the TRMSS emulsion in the softening point ring in a 200˚F +/- 5˚F forced draft oven for 120 minutes.
2. Product shall be homogenous and show no separation or coagulation that cannot be overcome by moderate stirring.
3. No sagging or slippage of film beyond the initial reference line.
4. No blistering or re-emulsification.
5. No flow beyond initial reference line.
6. Recommend for airport applications or where fuel resistance is desired.
7. No absorption of Kerosene into the clay tile past the sealer film. Note sealer surface condition and loss of adhesion.
8. No cracking, chipping, surface distortion or loss of adhesion. No color fading or lightening.

3. EQUIPMENT

Provide applicable equipment in accordance with TXDOT article 316.3.,"Equipment." Furnish the necessary facilities and equipment for determining the temperature of the mixture, regulating the application rate, and securing uniformity at the junction of 2 distributor loads.

4. CONSTRUCTION

Store material in a suitable container to prevent leakage and protect from freezing.

Apply the mixture when the air temperature is at or above 50°F unless otherwise approved. Measure the air temperature in the shade away from artificial heat. Do not apply mixture when the air temperature is below 50°F unless otherwise approved. Suitable weather will be determined by the Engineer.

Distribute material at the rate shown on the plans or as directed.

Furnish and uniformly distribute clean, fine sand on the surface to blot the excess when an excessive quantity of asphalt is applied. Maintain ingress and egress as directed by applying sand to freshly sealed areas. Open the treated surface to traffic when directed.

5. MEASUREMENT

Measure by the square yard.

6. PAYMENT

The work performed and the materials furnished in accordance with this item and measured as provided under “Measurement” will be paid for at the unit price bid for “Surface Sealing Treatment – TRMSS” as specified. This price is full compensation for materials, equipment, labor, tools, and incidentals.

This page is intentionally left blank

300 Items

This page is intentionally left blank

SPECIAL PROVISION

300

CONCRETE (NATURAL AGGREGATE)

For this project refers to TxDOT Item 421, “Hydraulic Cement Concrete” for the material quality and storage, design requirements, mixing and delivering, and testing of the concrete. This specification is from the most current Standard Specifications.

SPECIAL PROVISION
301
REINFORCING STEEL

For this project refer to TxDOT Item 440, "Reinforcement for Concrete," from the most current Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this item are waived or changed hereby.

Article 440.2 MATERIALS. Edit the following:

Section 440.2.1 Approved Mills, add the following to the end of the first (1st) paragraph and delete the second (2nd) paragraph:

Reinforcing steel produced outside of the US is not acceptable.

SPECIAL PROVISION

302

CONCRETE STRUCTURES

For this project refers to TxDOT Item 420, "Concrete Substructures" is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Article 420.1 MATERIALS. Delete and replace with the following:

> Construct concrete substructures including footings, columns, caps, abutments, piers, culverts, other bridge substructure elements, box culverts, headwalls, wingwalls, box transitions, approach slabs, retaining walls, inlets, storm and sanitary sewer structures, and other concrete structures as indicated. Construct all concrete structures in accordance with specifications herein outlined and in conformity with the required lines, grades, sections, and details shown on the plans or as directed.

Article 420.2 MATERIALS. Edit the following:

Section 420.2.1 Concrete, in the first (1st) sentence, replace "…Item 421, "Hydraulic Cement Concrete." with "…Item 300, Concrete (Natural Aggregates)."

Section 420.2.4 Reinforcing Steel, delete the first (1st) sentence and replace with the following:

> Provide materials in accordance with Item 303 "Expansion Joint Materials" and with DMS-6310, "Joint Sealants and Fillers."

Add the following as Section 420.2.9:

> 2.9 Cast Iron Castings. Provide all cast iron castings in conformance with Item 405 "Cast Iron Castings."

Article 420.4 CONSTRUCTION. Edit the following:

Section 420.4.6 Placing Reinforcement and Post-tensioning, in the first (1st) sentence, replace "…Item 440, "Reinforcement for Concrete." With "…Item 301, Reinforcing Steel."

Section 420.2.7, Placing Concrete, add the following as the sixth (6th) paragraph:

> The base slabs of inlets, junction boxes, headwalls, culverts and other structures shall be placed and allowed to set before the remainder of the structure is constructed. Suitable provisions shall be made for bonding the sidewalls to the base slab by means of longitudinal keys so constructed as to prevent the percolation of water through the construction joints. Before concrete is placed in the walls, the keyed-edge joints shall be thoroughly cleaned of all shavings, sticks, trash or other extraneous materials. The top

slabs of culverts and like structures may be poured monolithic with the walls, provided the walls are poured and allowed to set a minimum of 1 hour, no more than 2 hours, shall elapse between the placing of the concrete in the wall and that in the top slab; such interval is to allow for shrinkage of the concrete in the wall. Under adverse weather conditions, the minimum time will be increased by the Inspector.

Section 420.4.7.2 Transporting Time, in the first (1st) sentence, replace "…Item 421, "Hydraulic Cement Concrete." With "…Item 300, Concrete (Natural Aggregates)."

Section 420.4.7.9 Consolidation, add the following as the third (3rd) paragraph:

Maintain a minimum vibratory speed of 6,000 impulses per minute, when submerged in concrete. An adequate number of vibratory units to properly consolidate all concrete will be made available. Form or surface vibrators will not be allowed. The duration of vibration shall be limited to properly consolidate the concrete without causing objectionable segregation of aggregates. Insertion of vibrators into lower courses that have commenced initial set, or the disturbance or reinforcement in concrete beginning to set, will be avoided.

Section 420.4.7.12 Placing Concrete in Hot Weather, add the following as the second (2nd) paragraph:

When concrete is placed in air temperatures above 85° F, an approved retarding agent, meeting the requirements of ASTM C494, Type B, will be required in all concrete used in superstructures and top slabs of culverts unless directed otherwise by the Inspector.

Section 420.4.13 Ordinary Surface Finish, add the following as the second (2nd), third (3rd), fourth (4th), and fifth (5th) paragraphs:

Floor finish shall be given to the floors of all inlets, culverts and other structures, and shall be struck off true to the required grade as shown on the drawings and floated to a smooth, even finish by manual or mechanical methods. No coarse aggregate shall be visible after finishing.

All exposed surfaces of retaining walls, wingwalls, headwalls and other structures, after patching and painting has been completed and the surface has been wetted, shall be given a first rubbing with a No. 16 Carborundum Stone. After the first rubbing is completed and the ground material has been evenly spread, the material shall be allowed to take a rest. After sufficient aging, the surface shall be wetted and given a finish rubbing with a No. 30 Carborundum Stone, after which the surface shall be neatly stripped with a brush and allowed to take a rest. On the inside surfaces of all culvert walls an area from the top slab, on a line 30 degrees from the vertical, to the bottom slab shall be rubbed as specified above,

Sidewalk surfaces shall be given a wood float finish, a light broom finish, or may be stripped with a brush as directed by the Inspector or specified in the plans.

Roadway slabs shall be given a broom finish after completion of the floating or straight-edging operation, but before the disappearance of the moisture sheen. The grooves of the finish shall be parallel to the centerline of the roadway. The average texture depth of the grooves shall be a minimum of 0.035 inches.

Article 420.5 MEASUREMENT AND 4206 PAYMENT. Delete and replace with the following:

No direct measurement or payment will be made for the work performed or the equipment used under this item and will be considered subsidiary to the particular items of work for which unit prices are required in the proposal.

303

EXPANSION JOINT MATERIALS

1. DESCRIPTION

Provide and install all longitudinal, transverse contraction, and expansion joint material in concrete work as herein specified in the various items of these specifications as indicated or as directed by the Engineer or designated representative. This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

2. SUBMITTALS

Submittal requirements include:

2.1. Type and manufacturer of all joint materials proposed for use.

2.2. Technical data indicating that proposed products meet the requirements specified herein.

3. MATERIALS

Specific Cross Reference Material:

American Society for Testing and Materials (ASTM)

Designation	Description
D 994	Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
D 1751	Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
D 1752	Specification for Preformed Sponge Rubber and Cork Expansion and recycled PVC Joint Fillers for Concrete Paving and Structural Construction
D 2240	Standard Test Method for Rubber Property-Durameter Hardness

Texas Department of Transportation: Manual of Testing Procedures

Designation	Description
Tex-525-C	Tests for Asphalt and Concrete Joint Sealers
DMS 6310	Joint Sealants and Fillers

3.1. Preformed Asphalt Board

3.1.1. Manufactured from cane or other suitable fibers of a cellular nature securely bound together, uniformly impregnated with a suitable asphaltic binder, and meeting the requirements of ASTM D 994, Standard Specifications for Preformed Expansion Joint Filler for Concrete (Bituminous Type).

3.2. Preformed Non-bituminous Fiber Material

3.2.1. Preformed non-bituminous fiber material meeting the requirements of ASTM D 1751, Standard Specifications for the Preformed Expansion Joint Filler for Concrete Paving and Structural Construction, voiding the requirements pertaining to bitumen content, density, and water absorption.

3.3. Boards

3.3.1. Boards obtained from Redwood timber, of sound heartwood, free from sapwood, knots, clustered “birdseye”, checks, and splits. Occasional sound or hollow “birdseye”, when not in clusters, will be permitted provided the board is free from any other defects that will impair its usefulness as joint filler.

3.4. Joint Sealer (Concrete Pavement)

3.4.1. This material shall be a one part low modulus silicone especially designed to cure at ambient temperatures by reacting with moisture in the air and shall have the following properties:

As Supplied	
Color	Gray
Flow, MIL-2-8802D Sec. 4.8.4	0.2 maximum
Working Time, minutes	10
Tack-Free Time at 77°F 2F (25°C 1.66°C) Min. MIL-2-8802D Sec.4.8.7	60
Cure time, at 77°F (25°C), days	7-14
Full Adhesion, days	14-21
As Cured---after 7 days at 77°F (25°C) and 40% RH	
Elongation, percent minimum	1200
Durometer Hardness, Shore A, points ASTM 2240	15
Joint Movement Capability, percent	+100 to -50
Tensile Strength, maximum elongation, psi (kPa)	100 (689)
Peel Strength, psi (kPa)	25 (172)

The joint sealer shall adhere to the sides of the concrete joint or crack and shall be an effective seal against infiltration of water and incompressibles. The material shall not crack or break when exposed to

low temperature.

3.5. Backer Rod

3.5.1. Backer Rod shall be expanded closed cell polyethylene foam compatible with sealant. No bond or reaction shall occur between rod and sealant. Backer Rod shall be of sufficient width to be in compression after placement and shall be used with joint sealer.

3.6. Joint Sealing Material

3.6.1. Joint Sealing Material for other than pavement use may be a two-component, synthetic polymer or cold-pourable, self-leveling type meeting the following requirements:

The material shall adhere to the sides of the concrete joint or crack and shall form an effective seal against infiltration of water and incompressibles. The material shall not crack or break when exposed to low temperatures. Curing is to be by polymerization and not by evaporation of solvent or fluxing of harder particles and shall cure sufficiently at an average temperature of 77°F 3°F (25°C 1.66°C) so as not to pick up under wheels of traffic in a maximum of three (3) hours.

3.6.2. Performance Requirements:

When tested in accordance with TxDOT Test Method Tex-525-C, meet the above curing requirements and as follows:

Be consistent such that it can be mixed and poured or mixed and extruded into joints at temperatures above 60°F (1.66°C).

Penetration 77°F (25°C), 150 gm. Cone, 5 sec., max.-cm	0.90
Bond and Extension 75%, 0F, 5 cycles:	
Dry Concrete Blocks	Pass
Wet Concrete Blocks	Pass
Steel Blocks (Primed if specified by manufacturer)	Pass
Flow at 200 °F (93°C)	None
Water content % by weight, max.	5.0
Resilience:	
Original sample min. % (cured)	50
Oven-aged at 158°F (70°C) min. %	50
For Class 1-a material only, Cold Flow (10 minute)	None

3.7. Rebonded Recycled Tire Rubber

3.7.1. Material consists of granular particles of rubber, made by grinding automobile and truck tires, securely bound together by a synthetic resin or plastic binder. Filler shall be molded into sheets of the required dimensions meeting the testing requirements of both ASTM D 1751 and ASTM D 1752 voiding the requirements for asphalt content and expansion. Minimum density of the material shall be 30 lb/ft ^{3} (440kg/m^3).

4. CONSTRUCTION

Install the expansion joint materials to function as a compatible system. Joint sealer shall not be placed where a bond breaker is present.

Extend the asphalt, redwood board, or other materials the full depth of the concrete and perpendicular to the exposed face. Shape joints to conform to the contour of the finished installed section. Provide a material a minimum of one-half (½) inch (12.5 mm) thick or as indicated. Anchor wood materials to the adjacent concrete to permanently hold them in place. Install joint sealer in accordance with the manufacturer's recommendations.

Use material meeting 2.4 Boards for side walk expansion joints, unless otherwise indicated.

Use material conforming to 2. Materials for curb and gutter expansion joints filler, except when placed adjacent to concrete pavement the joint material shall match the pavement joint material.

5. MEASUREMENTS AND PAYMENT

No additional compensation will be made for materials, equipment or labor required by this item, but shall be included in the unit price bid for the item of construction in which this item is used.

This page is intentionally left blank

400 Items

This page is intentionally left blank

SPECIAL PROVISION

400

EXCAVATION, TRENCHING, AND BACKFILLING

For this project refer to TxDOT Item 400, "Excavation and Backfill for Structures," from the most current Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Article 400.1. DESCRIPTION, Add the following paragraphs:

Excavate and place storm drainage box culverts, whether cast-in-place or precast, within the limits shown on the plans, regardless of the type of material encountered. Remove and satisfactorily dispose all unused excavated materials. Construct, shape, backfill, and finish all earthwork in conformance with the required lines, grades and cross sections in accordance with the plans and specification requirements contained herein.

This item shall govern the excavation, trenching and backfilling for storm drainage pipe, and pipe culverts, unless otherwise noted on the plans, details and the specifications. The work includes all necessary pumping or bailing, sheeting, drainage and the construction and removal of any required cofferdams. Protect all existing utilities from damage during the excavation and backfilling of trenches, and if damaged, replaced or repaired by the Contractor at their expense. Unless otherwise shown on the plans and bid proposal, all excavation shall be unclassified and shall include all materials encountered regardless of their nature or the manner in which they are removed.

Article 400.2. MATERIALS, Add the following materials to the list:

- **Flexible Base.** Item 200, "Flexible Base."
- **Subgrade Filler.** Item 406, "Subgrade Filler."
- **Cement Stabilized Sand.** Item 407, "Granular Fill Material."
- **Flowable Fill.** Item 408, "Flowable Backfill."
- **Filter Fabric.** TxDOT DMS 6200, "Filter Fabric," Type 1

Article 400.3 CONSTRUCTION. Edit the following:

Section 400.3.1.1 Excavation, General, The following is added to the end of the 1st Paragraph:

Excess excavated material not utilized as backfill becomes the Contractor's property and disposal of the material is their responsibility and is not to be hauled to any limits project's right-of-way, public thoroughfares, or water courses. Disposal of the material as directed or per pertinent City ordinances.

Unless otherwise indicated, excavations are open cut.

If hazardous substances, industrial waste, environmental damage, underground storage tanks, or conditions conductive to environmental damage is encountered, stop work immediately in the area affected and report the condition to the Owner's representative in writing. Do not conduct any investigation, site monitoring, containment, cleanup, removal, restoration or other remedial work of any kind or nature (the "remedial work") under any applicable level, state or federal law, regulation or ordinance, or any judicial order. Only if written agreements are prepared and signed can work commence and/or some or all of the remedial work, all costs and expenses, to include any extension of the contract time, of such remedial work will be paid by Owner to Contractor as additional compensation.

Section 400.3.1.1.3 Excavation, Utilities, The following is added to the end:

Trench walls shall be vertical and the practice of undercutting at the bottom or flaring at the top will not be permitted unless as directed. In special cases where trench flaring is permitted and directed, the trench walls shall remain vertical to a depth of at least one (1) foot above the top of the pipe. Grade trench bottoms to provide uniform bearing and support for each section of pipe on the undisturbed soil at every point along its entire length, except for the portions of pipe sections where bells are necessary and to properly seal pipe joints. Excavate bell holes and depressions for joints after grading the trench bottom so the full length of the pipe may rest upon the prepared bottom. If over-excavation occurs, restore the under-cut trench to grade, to the satisfaction of the Inspector, by replacement and compacting the excavated material as specified.

When wet or otherwise unstable soil does not properly supporting the structure or pipe, as determined, such soil shall be removed to the depth shown on the plans or as determined and backfill to the proper grade with a subgrade filler as specified in Item No. 407, "Gravel Subgrade Filler". Also, where water, silt, muck, trash, debris or rock in ledge, boulder or coarse gravel particle size larger than one and three quarters (1 ¾) inch is encountered at the bearing level, as directed, the Contractor shall under-excavate and remove such materials to a depth not less than four (4) inches below the bottom of the pipe and replace with a material as specified in Item 407, "Gravel Subgrade Filler".

As furnished by the Consultant, the depth of cut indicated on cut sheets is from the offset or cut hub elevation to the invert of the pipe. The width of the trench shall be at least the outside diameter of the pipe plus six (6) inches on each side of the pipe for sizes less than forty-two (42) inches in diameter. It shall be understood that the depth of cut as indicated on the cut sheet may be more or less than the actual excavated depth due to ground conditions existing at the site. For this reason the Consultant shall determine the depth for pay purposes based on the surface elevation prior to the Contractor's operation and the invert of the sewer line. The Consultant's decision shall be final.

The maximum working room for pipe forty-two (42) inches in diameter and under shall not exceed ½ of the outside diameter of the pipe or twelve (12) inches whichever is greater, from the edge of the pipe to the face of the trench walls, or inside face of the shoring protection. For pipe over forty-two (42) inches in diameter, the maximum width of the trench shall be such that the working space from the pipe to the trench wall, or shoring protection as the case may be, will be a minimum of twelve (12) inches, and a maximum of twenty-four (24) inches. If allowable trench widths are exceeded through over-excavation of rock or caving of earth trenches, the Contractor shall provide corrective measures or alternative designs as determined.

Section 400.3.3.1 Backfill, General, add the following to the end of the 1st paragraph:

Only backfill the trench when the constructed structures or appurtenances as installed conforms to the requirements specified. Carefully backfill the trench with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, flexible base material, sand and gravel, soft shale or other approved materials, free from large clods of earth or stones.

Section 400.3.3.1 Backfill, General, replace the 2nd paragraph with the following:

Place backfill in layers no greater than 9 in. deep (loose measurement) in all areas. Compact each layer to not be less than ninety-five percent (95%) of the maximum dry density at + or - 2% optimum moisture content as determined by tests on samples as outlined in TXDOT Testing Method TEX 113-E, unless otherwise shown on the plans or directed.

Section 400.3.3.1 Backfill, General, add the following paragraph to the end:

Care shall be taken not to damage pipe specially coated to protection against corrosion. Excavate to the depth required where use of improper backfill or areas where settlement occurs, meeting specified grades and compaction. Sand backfill will not be allowed.

Section 400.3.3.3 Backfill, Pipe, replace the first sentence of the first paragraph with:

Bring backfill material to the proper moisture condition after installing bedding and pipe as required and place it equally along both sides of the pipe in uniform layers no greater than 9 in. deep (loose measurement).

Section 400.3.3.3 Backfill, Pipe, add the following paragraph to the end:

Initial backfill begins at the top of the pipe's exterior to a point twelve (12) inches above the top of the pipe's exterior. Backfill materials are as follows:

- Material for initial backfill may be selected fine compactable soil material as approved. Compact as specified in Section 400.3.3.3 in layers not to exceed six (6) inches in compacted thickness. Each layer shall be compacted to the required density by approved hand or mechanical tamping equipment. Thoroughly compact the backfill under the haunches of the pipe insuring the backfill soil is in intimate contact with the sides of the pipe. Keep the backfill material at the same elevation on both sides of pipe.

- A clean gravel or gravel approved by the Engineer, conforming to the requirements of Item No. 407, "Gravel Subgrade Filler", may be used for backfill material. Place the gravel in the trench, lightly tamped to consolidate, and seal the mass against the conduit and earthen surfaces. Keep backfill material at the same elevation on both sides of pipe. Place a filter fabric between the top of the gravel backfill and the secondary backfill for the entire length and width of the trench. Use filter fabric conforming to the requirements of Texas Department of Transportation Material Specification 6200, Type1.

- Cement Stabilized Backfill conforming to “Class D” Concrete as defined in Item No. 300 “Concrete” of these specifications. Place the Cement Stabilized Backfill within one (1) hour after mixing and rodded in such a manner as to completely fill the backfill area. Before placing Cement Stabilized Backfill, clean the trench of any extraneous material and thoroughly wet. Remove all surplus excavated material from the ditch from the site.

Begin secondary backfill at a point above twelve (12) inches above the top of the pipe exterior to the top of the trench or proposed subgrade elevation. Use appropriate rolling equipment to obtain the specified compaction effect. Place material in uniform layers not more than nine (9) inches in depth (loose measurement) and compacted to the density specified herein. If the material is dry, uniformly wet each layer of backfill material prior to placement in the trench to the moisture content required to obtain the specified density, and compact to the required density by means of appropriate rolling equipment or other suitable mechanical method. No rolling equipment shall be used which may damage the pipe.

Add Section 400.3.3.6 Backfill, Quality Control, to the end of 400.3:

All City of UC Capital Improvement projects’ in-place density tests are to be performed by the City of UC’s on-call construction materials testing firm and at the City’s expense. The developer or utility agency conducting the installation of a utility line for a private development is responsible for the project costs associated with in-place density tests.

The following table details the frequency and location of testing:

Secondary Backfill Depth	Number of Tests per 400 Linear Feet
(Ft.)	
0 - 6	3
6 – 12	5
>12	7 or as directed

The number of tests shown above is minimums. Additional testing may be required as directed. All failed test require the Contractor to remove and replace or rework as required the layer of backfill to points halfway to the next test location at no additional cost. All retests of these areas are at the Contractor’s expense. The Contractor shall provide access to the test area, associated trench excavation safety protection, and backfilling of the test areas at the Contractor’s expense.

Article 400.4. MEASUREMENT, Delete and replace with the following:

Excavation, Trenching, and Backfill will not be measured for payment.

Article 400.5. PAYMENT, Delete and replace with the following:

No direct payment shall be made for excavation, trenching, and backfilling for pipe culverts and pipe storm sewers, the installation of filter fabric, and all costs associated therewith shall be subsidiary to the contract price for the item to which the work pertains.

Excavation for reinforced concrete box culverts will be measured and paid for at the contract unit price bid per cubic yard under Item No. 102, “Box Culvert Excavation and Backfill”. Subgrade filler will be measured and paid for at the contract unit price as provided for in Item No. 407, “Gravel Subgrade Filler”.

SPECIAL PROVISION
401
STORM DRAINAGE PIPE

For this project refer to TxDOT Item 464, "Reinforced Concrete Pipe," and to TxDOT Special Specification 4122, "Thermoplastic Pipe" from the most current Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Item 464, "REINFORCED CONCRETE PIPE"

Article 464.1 DESCRIPTION. Add the following:

> Install pipe to the line and grades shown on the plans, and of sizes and dimensions shown thereon. Installation includes all joints or connections to new or existing pipes, manholes, headwalls, or other appurtenances as required.

Article 464.2 MATERIALS. The following is edited:

Section 464.2.2.1 Design, General, the 1st sentence in the 1st paragraph is replaced with:

> Reinforced concrete pipe shall conform to ASTM C76 or C655, the class and D-load equivalents are shown in Table 1.

Section 464.2.2.2 Design, Jacking, Boring, or Tunneling, the following is added after the 1st paragraph:

> In addition to conforming to pertinent ASTM standards, the pipe shall have circular reinforcement. For 30 in. or larger diameter pipes, an additional layer of class III reinforcement, 12 in. long, extending to both the tongue and groove within 3/4 in. of the ends is required. The minimum wall thickness and concrete strength shall be as determined by the engineer.
>
> For 24 in. through 60 in. diameter pipes, variations in laying length of opposite sides shall not exceed 3/8 in., and 3/4 in. for 66 in. and larger diameters. Joint taper shall not exceed 7 degrees for tongue and groove pipe and 2 degrees for O-ring gasket pipe.
>
> Pipes manufactured for jacking and boring shall be identified and marked.

Add Section 464.2.8. Connections, to the end of section 464.2:

> Concrete collar on all storm drain pipe to concrete structure connections shall be Class "C," 3,600 psi minimum in conformance with UC Item 300, "Concrete (Natural Aggregate)." For bond between fresh concrete to cured concrete, use epoxy Type V or Type VII meeting TXDOT DMS-6110 specification. Reinforcing shall conform to UC Item 301, "Reinforcing Steel."

Article 464.3 CONSTRUCTION. The following is edited:

Section 464.3.1 Excavation, Shaping, Bedding, and Backfill, the 1st and 2nd sentence in the 1st paragraph is replaced with:

> Excavate, shape, bed, and backfill in accordance with UC Item 400, "Excavation, Trenching and Backfilling," except where jacking, boring or tunneling methods are permitted. Jack, bore, or tunnel the pipe in accordance with UC Item 403, "Jacking, Boring, and Tunneling."

Section 464.3.2 Laying Pipe, the following is added after the 1st paragraph:

> Pipe over 30 in. diameter may have lifting holes as recommended and provided by pipe manufacturer. Holes shall be filled with grout plugs supplied by the manufacturer before backfilling. Apply plastic gasket material or grout patch over the plug as a seal.

Section 464.3.4 Connections and Stub Ends, add to the end of the 1st paragraph the following:

> For storm drain pipe to concrete structure connections, concrete collar is required as shown on DET-402-23 and in conformance with section 464.2.8., "Connections," unless otherwise shown on the plans. Concrete collar is subsidiary unless otherwise specified.

Article 464.4 MEASUREMENT. The 4th sentence in the 1st paragraph is replaced with:

> Pipe that will be jacked, bored, tunneled will be measured in accordance with UC Item 403, "Jacking, Boring or Tunneling."

Article 464.5 PAYMENT. The 2nd paragraph is replaced with:

> Protection methods for excavations greater than 5 ft. deep will be measured and paid for as required under UC Item 550, "Trench Excavation Safety Protection," or Item 403, "Temporary Special Shoring." Excavation, shaping, bedding, and backfill will be paid for in accordance with UC Item 400, "Excavation, Trenching, and Backfilling." When jacking, boring, or tunneling is used at the Contractor's option, payment will be made under this Item. When jacking, boring or tunneling is required, payment will be made under UC Item 403, "Jacking, Boring and Tunneling."

SPECIAL SPECIFICATION 4122, "THERMOPLASTIC PIPES"

Article 4122.1 DESCRIPTION. Add the following.

> Install pipe to the line and grades shown on the plans, and of sizes and dimensions shown thereon. Installation includes all joints or connections to new or existing pipes, manholes, headwalls, or other appurtenances as required.

Article 4122.2 MATERIALS. The following is edited:

Section 4122.2.1 High Density Polyethylene (HDPE) Pipe and Section 4122.2.2 Polyvinyl Chloride (PVC) Pipe are removed in its entirety.

Section 4122.2.3.3 Designation Type. The paragraph is replaced with:

For polypropylene pipe used in gravity flow drainage applications use Type S (outer corrugated wall with smooth inner liner).

Article 4122.4 CONSTRUCTION. The following is edited:

Section 4122.4.1 Excavation. Delete and replace section with the following:

Excavate, shape, bed, and backfill in accordance with UC Item 400, "Excavation, Trenching and Backfilling".

Table 2
Minimum Trench Width

Nominal Pipe Diameter (in.)	Minimum Trench Width (in.)
12	30
15	36
18	42
24	48
30	56
36	64
42	72
48	78
60	96

Section 4122.4.5 Laying Pipe. The last sentence of the 1st paragraph is replaced with:

Remove and re-lay pipe that is not in alignment or that shows excessive settlement after laying, at no expense to the City of Universal City.

Section 4122.4.5 Laying Pipe. Table 3 is replaced with:

Table 3
Minimum Clear Distance Between Pipes

Nominal Pipe Diameter (in.)	Min. Clear Distance Between Pipes (in.)
12	12
15	12
18	12
24	12
30	15
36	18
42	21
48	24
60	30

Section 4122.4.6 Reusing Existing Appurtenances. The second 2nd sentence in the 2nd paragraph is replaced with:

> Restore any headwall and any aprons or pipes attached to the headwall that are damaged during moving operations, to their original condition, at no expense to the City of Universal City.

Article 4122.6 PAYMENT. Paragraphs 2-4 are replaced with:

> Protection methods for excavations greater than 5 ft. deep will be measured and paid for as required under UC Item 550, “Trench Excavation Safety Protection,” or Item 403, “Temporary Special Shoring.” Excavation, shaping, bedding, and backfill will be paid for in accordance with UC Item 400, “Excavation, Trenching, and Backfilling.”

SPECIAL PROVISION
402
STORM SEWER MANHOLES AND INLETS

For this project refer to TxDOT Item 465, "Junction Boxes, Manholes, and Inlets," from the most current Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Article 465.2 MATERIALS. The following is edited:

Section 465.2 Materials, Replace the bullet items as listed with:

- UC Item 300, "Concrete (Natural Aggregate)"
- UC Item 301, "Reinforcing Steel"
- UC Item 302, "Concrete Structures"
- UC Item 401, "Storm Drainage Pipe"
- UC Item 405, "Cast Iron Castings"

Add Section 465.2.5 Materials, Throat Rings, to the end of 465.2:

> Throat Rings. Provide rings with 2 in. maximum thickness and 5 in. minimum width. Internal diameter of rings shall be no less than 30 in. as required to complete manhole ring and cover. Concrete shall conform to UC Item 300, "Concrete (Natural Aggregate)."

Article 465.3 CONSTRUCTION. Add the following paragraph in front of the 1st paragraph:

> Label the manholes and junction boxes as designated on the plans to indicate the type and location. Construct each in accordance with the details and to the depth required by the profiles and schedules given. For precast units label the box prior to being delivered to project site.

SPECIAL PROVISION
403
JACKING, BORING AND TUNNELING

For this project refer to TxDOT Item 476, "Jacking, Boring, or Tunneling Pipe or Box," from the most current Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Article 476.2 MATERIALS. The following is edited:

Replace the second bullet with:

- reinforced concrete pipe meeting the special requirements for jacking, boring, or tunneling of UC Item 401, "Storm Drainage Pipe," of the size, strength, and dimension shown on the plans;

Add the following bullets to the list:

- pvc pipe fully restraint conforming to UC Item 818, "PVC (C-905 and C-909) Pipe Installation," of the size, type, and dimension shown on the plans;
- pvc pipe conforming to UC Item 848, "Sanitary Sewers," of the size, type, and dimension shown on the plans;

Add the following paragraph after the bullet list:

> If casing is required for water or sewer utility, the casing shall be (1.) RCP, (2.) Steel, or (3.) Liner Plate.

Article 476.3 CONSTRUCTION. The following is edited:

Section 476.3 Construction, the last sentence of the 1st paragraph is replaced with:

> Protect excavations as specified in UC Item 550, "Trench Excavation Safety Protection," or Item 403, "Temporary Special Shoring."

Section 476.3.4 Construction, Joints, the 2nd sentence is replaced with:

> Make the joints in accordance with UC Item 401, "Storm Drainage Pipe," if reinforced concrete pipe is used.

Section 476.3.4 Construction, Joints, the following is added to the end of the paragraph:

> Make the joints in accordance with UC Item 848, "Sanitary Sewers," if pvc pipe is used.

Article 476.4 MEASUREMENT. The following paragraph is added to the end:

Casings or liners, where required by the plans, of the size and material required shall be measured by the linear foot actually installed in accordance with the plans.

Article 476.5 PAYMENT. The 3rd paragraph is replaced with:

Protection methods will be measured and paid for as required under UC Item 550, “Trench Excavation Safety Protection,” or Item 403, “Temporary Special Shoring.” Casings or liners shall be paid for at the contract unit price bid for "Casing or Liner" per linear foot of casing or liner installed and measured as prescribed above.

SPECIAL PROVISION
405
CAST IRON CASTINGS

For this project refer to TxDOT Item 471, "Frames, Grates, Rings, and Covers," from the most current Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Article 471.2 MATERIALS. The following is edited:

Section 471.2.3 Documentation, the sentence is added to the end of the paragraph:

> Also furnish the mill test reports or manufacturer's certification for each lot or shipment of steel and iron materials.

Article 471.4 MEASUREMENT. The 1st sentence is replaced with:

> Frames, grates, rings, and covers, when part of the complete manhole or inlet, will not be measured for payment but will be considered subsidiary to UC Item 402, "Storm Sewer Manholes and Inlets."

406

SUBGRADE FILLER

1. DESCRIPTION

Furnish and install materials for stabilizing subgrade in trenches, channels, under conduits, cast in-place concrete box culverts, bedding for pre-cast box culverts, or unstable material such as quicksand or muck.

2. MATERIALS

2.1. Provide the following subgrade filler materials:

2.1.1. **Concrete.** Concrete subgrade filler composed of concrete conforming to the provisions of Item No. 300, "Concrete (Natural Aggregate)," Class B.

2.1.2. **Gravel.** Gravel subgrade filler composed of well graded, crushed stone or gravel, approved by the Engineer and meeting the gradation requirements of Table 1. Wear must not be more than 40% when tested in accordance with TxDOT standard laboratory test procedure Tex-406-A.

Table 1
Gradation Requirements

Sieve Size	% Passing
2 inch	100
1 – 3/4 inch	95
1/4 inch	90

3. CONSTRUCTION

Remove unstable material, such as quicksand or muck, within the bottom of the channel, box culverts, box conduits, storm sewers, or other structures at established footing or pipe bearing grade, as directed and replace with the specified materials:

3.1. **Concrete Subgrade Filler.** When saturated subgrade material is encountered but determined stable and when the construction operations would disturb the subgrade surface, establish a working surface with the material. As directed, remove and replace with the concrete filler material to a depth below the established footing or bearing elevation, compact, and grade the surface to allow forming a subgrade surface of accuracy equivalent to that obtained for normal fine grading of subgrade.

3.2. **Gravel Subgrade Filler.** When wet subgrade or other unstable materials is encountered which is unsatisfactory for support of the structure involved, as directed remove and replace with gravel subgrade material to a depth below the established footing or bearing elevation. Place the material in uniform layers of suitable depth, as

directed and grade the surface to allow forming a subgrade surface of accuracy equivalent to that obtained for normal fine grading of subgrade.

4. MEASUREMENT

Measure Subgrade Filler by the cubic yard its final position and using the average end area method. Compute the volume between the original ground surface or the surface upon which the embankment is to be constructed and the lines, grades, and slopes of the embankment.

5. PAYMENT

Pay for the work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” at the unit price bid for “Subgrade Filler (Concrete),” or “Subgrade Filler (Gravel),” of the compaction method and type specified. This price is full compensation for furnishing fill material; hauling; placing, compacting, finishing, and reworking; disposal of waste material; and equipment, labor, tools, and incidentals.

407

GRANULAR FILL MATERIAL

1. DESCRIPTION

Granular fill materials specified in this Section are for use as bedding pipe, replacement of unsuitable material, gravel cushion in ledge excavation, pavement foundation, and foundation support and similar uses are specified in detail elsewhere.

2. MATERIALS

2.1. Provide the following granular filler materials:

2.1.1. **Common Fill.** Consisting of sandy clay material free of organic material, loam, wood, trash, and other objectionable material which may be compressible, or which cannot be compacted properly. Common fill shall not contain stones larger than 6-inches in any dimension, broken concrete, masonry, rubble, asphalt pavement, or other similar materials. It shall have physical properties, as approved by the Engineer, such that it can be readily spread and compacted.

2.1.2. **Select Common Fill.** As specified above for common fill except that the material shall contain no stones larger than two (2) inches in its largest dimension.

2.1.3. **Gravel Backfill.** Consisting of hard, durable particles of proper size and gradation, free from sand, loam, clay, excess fines and deleterious materials. The size of the particles shall be uniformly graded as shown in Table 1.

Table 1
Gradation Requirements

Sieve Size	% Passing
1/2 inch	100
3/8 inch	98 - 100
No. 4	15 - 60
No. 10	0 - 5

2.1.4. **Crushed Stone Base**. Consisting of sound, durable stone, free of any foreign materials, angular in shape, free from structural defects, and comparatively free of chemical decay. This material shall comply with TxDOT Item 247, Type A, Grade 3. The stone shall have a maximum size of seven eights (7/8) inch.

2.1.5. **Bedding Sand.** Consisting of a clean, coarse-grained, cohesionless material uniformly graded as shown in Table 2.

Table 2
Gradation Requirements

Sieve Size	% Passing
1/4 inch	100
No. 60[1.]	0 - 25
No. 100	0 - 5

1. All material passing No. 60 sieve shall have a PI less than or equal to 4.

2.1.6. **Bedding Gravel.** Consisting of a clean, coarse-grained, crushed stone or gravel, cohesionless material uniformly graded as shown in Table 3. Wear shall not be more than 40% when tested in accordance with TxDOT standard laboratory test procedure TEX410-A.

Table 3
Gradation Requirements

Sieve Size	% Passing
2 inch	100
1-3/4 inch	95
1/4 inch	10

2.1.7. **Cement Stabilization Sand Backfill.** Consisting of a mixture of ASTM C33 fine aggregate and Type I cement. Proportion the mix with two sacks of cement per cubic yard and fifty one (51) gallons of water per cubic yard of cement stabilized sand.

3. MEASUREMENT

The material used as backfill is subsidiary to various items and does not require measurement.

4. PAYMENT

Pay for the work performed and materials furnished in accordance with this Item are subsidiary to various pay items.

SPECIAL PROVISION

408

FLOWABLE BACKFILL

For this project refer to TxDOT Item 401, “Flowable Backfill,” for the material quality and storage, design requirements, mixing and delivering, and testing of the flowable. This specification is from the most current Standard Specifications.

SPECIAL PROVISION

409

RIPRAP

For this project refer to TxDOT Item 432, “Riprap,” for the material quality and storage, design requirements, mixing and delivering, and testing of the riprap. This specification is from the most current Standard Specifications.

This page is intentionally left blank

500 Items

This page is intentionally left blank

SPECIAL PROVISION

500

TEMPORARY EROSION, SEDIMENTATION, AND WATER POLLUTION PREVENTION CONTROL

For this project refer to TxDOT Item 506, "Temporary Erosion, Sedimentation, and Environmental Controls," from the most current Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Article 506.2. MATERIALS. Add the following to the end of the section:

2.11. Curb Inlet Gravel Filter.

2.11.1. Gravel Filter Bags. Provide gravel filter bags with the same characteristics of Sandbags as described in section 506.2.8.Sandbags with the exception of filling bags with 3/4" gravel in lieu of sand.

2.11.2. Concrete Masonry Units (CMU's). Hollow, non-load-bearing concrete blocks of 1500-2000 psi, 28 day compressive strength concrete shall be used with the following dimensions: 8"X6"X16" width, height, and length, respectively.

2.11.3. Wood Blocks. Wolmanized treated 2"X4" lumber, length as per inlet size.

Article 506.4. CONSTRUCTION. Add the following after section 4.4.10:

4.4.11. Curb Inlet Gravel Filter. Place the 2"X4" treated lumber in front of and parallel with the opening of the inlet. Place the CMU's around the inlet, to be protected, in front of the 2"X4" lumber, with opening of the CMU's facing the inlet. Surround CMU's with gavel bags, making certain that there are no gaps evident between the gravel bags.

Article 506.5. MEASUREMENT. Add the following after section 5.10:

5.11. Curb Inlet Gravel Filter. Installation or removal of the curb inlet gravel filter will be measured by the foot along the centerline of the top of the gravel bags.

Article 506.6. PAYMENT. Add the following after section 6.10:

6.11. Curb Inlet Gravel Filter. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid as follows:

6.11.1. Installation. Installation will be paid for as "Curb Inlet Gravel Filter (Install)" of the size specified. This price is full compensation for furnishing all materials, labor, tools, equipment and incidentals.

6.11.2. **Removal.** Removal will be paid for as “Curb Inlet Gravel Filter (Remove).” This price is full compensation for furnishing all materials, labor, tools, equipment and incidentals.

550

TRENCH EXCAVATION SAFETY PROTECTION

1. DESCRIPTION

Provide trench excavation safety protection required for the construction of all trench excavation in the project and including all additional excavation and backfill necessitated by the protection system.

2. CONSTRUCTION

Provide vertical or sloped cuts, benches, shields, support systems, or other systems providing the necessary protection in accordance with the most recent provisions of OSHA Standards and Interpretations, 29 CFR 1926, Subpart P, “Excavations.” Utilize Subpart P, Appendix F, “Selection of Protective Systems” to make decisions regarding whether trench excavation protective systems are to be used for certain trench depths and soil conditions.

3. MEASUREMENT

This item will be measured by the linear foot along the long axis of a trench that requires safety excavation per OSHA and will be entered by personnel. This measurement includes all required trench protection, including trench ends.

4. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Trench Excavation Safety Protection.” The price is full compensation for excavation and backfill required for excavation protection; for any retention by contractor of structural design/geotechnical/safety/equipment consultant; furnishing, placing, and removing shoring, sheeting, or bracing; dewatering or diversion of water; jacking and jack removal; and equipment, labor, materials, tools, and incidentals.

This page is intentionally left blank

800 Items

This page is intentionally left blank

804

EXCAVATION, TRENCHING, AND BACKFILL

1. DESCRIPTION

This section shall govern the excavation, trenching, and backfilling for water, sanitary sewer, and recycle mains construction, unless otherwise noted on the plan details and the specifications. The work shall include all necessary drainage, dewatering, pumping, bailing, sheeting, shoring and incidental construction. All existing utilities shall be protected from damage during the excavation and backfilling of trenches and, if damaged, shall be replaced by the Contractor at his expense. Unless otherwise shown on the plans, proposal, or contract documents, all excavation shall be unclassified and shall include all materials encountered regardless of their nature or the manner in which they are removed, to include but not limited to rock, stone, sand, organic material, or whatever material is encountered. The Contractor shall at all times conform to the latest applicable provision of subpart “P” entitled “Excavation, Trenching, and Shoring of OSHA Safety and Health Regulations for Construction”, or most applicable approved equal provision. An excavation plan submittal signed and sealed by a Texas licensed professional engineer shall be submitted, if applicable, one week prior to start of actual construction activities where the planned excavation is 20 feet or greater.

2. EXCAVATION

The Contractor shall perform all excavation of every description and of whatever substances, including rock, encountered to the lines and grades shown on the plans or determined by the Engineer. During excavation, material suitable for backfilling shall be stockpiled in orderly manner a sufficient distance from banks of the trench to avoid overloading and to prevent slides or cave-ins. All excavated materials not required or suitable for backfill shall be removed and properly disposed of by the Contractor or as directed by the Engineer. Grading shall be done as may be necessary to prevent surface water from flowing into trenches or other excavations, and any water accumulating therein shall be removed by pumping or by other approved methods.

Sheeting and shoring shall be installed in accordance with safety requirements for the protection of the work, adjoining property, and for the safety of the personnel. Unless otherwise indicated, excavation shall be by open cut, whether by hand, backhoe, ram-hoe, rock saw, or whatever method as necessary. Short sections of a trench may be tunneled, if in the opinion of the Engineer representing the Owner, the pipe or structure can be safely and properly installed or constructed, and backfill can be properly compacted in such tunnel sections.

2.1. **Archaeological.** “Unidentified Archaeological Sites”: If the Contractor should encounter a section of an acequia (early Spanish irrigation ditch) or any other archaeological deposits during construction operations, the Contractor must stop

excavation immediately and contact the City of Universal City Inspector. The Contractor cannot begin excavation again without written permission from the City of Universal City. If more than three days are required for investigation (not including holidays and weekends) and also the Contractor cannot work on other areas, the Contractor will be permitted to negotiate for additional construction time. The Contractor shall submit a request in writing within ten days after date of the first notice. If the time required for investigation does not exceed three days for each event, contract duration will not be extended.

2.2. **Safety Devices.** The Contractor shall provide and maintain barricades, flags, torches, and other safety devices as required by local, state, and federal codes and ordinances and conduct work to create a minimum inconvenience to the public. Temporary suspension of work does not relieve responsibility for the above requirements.

2.3. **Safety and Health Regulations.** The Contractor shall at all times conform to all applicable regulations of Subpart "P" entitled "Excavation, Trenching, and Shoring of OSHA Safety and Health Regulations for Construction"; and all applicable state and local rules and regulations.

3. TRENCHING

3.1. Trench walls shall be vertical. The practice of undercutting at the bottom or flaring at the top will not be permitted except where it is justified for safety or at the Engineer's and/or Inspector's direction. In special cases, where trench flaring is required, the trench walls shall remain vertical to a depth of at least 1 foot above the top of the pipe.

The trench bottom shall be square or slightly curved to the shape of the trenching machine cutters. The trench shall be accurately graded along its entire length to provide uniform bearing and support for each section of pipe installed upon the bedding material. Bell holes and depressions for joints shall be dug after the trench bottom has been graded and bedding installed. The pipe shall rest upon the new bedding material for its full length.

Where over-excavation occurs, the under-cut trench shall be restored to grade at no cost to the Owner by replacement with a material conforming to the requirements of the bedding material or a material approved by the Engineer.

The depth of cut indicated on cut sheets, as furnished by the Engineer, is from the off-set or cut hub elevation to the invert.

3.1.1. **Minimum Width of Trench.** The minimum width of pipe trenches, measured at the crown of the pipe, shall be not less than 12 inches greater than the exterior diameter of the pipe, exclusive of bells. The minimum base width of such trench shall be not less than 12 inches greater than the exterior diameter of the pipe, exclusive of special structures or connections. Such minimum width shall be exclusive of trench supports and not greater than the width at the top of the trench.

3.1.2. **Maximum Width of Trench.** The maximum allowable width of trench for pipelines measured at the top of the pipe shall be the outside diameter of the pipe (exclusive of bells or collars) plus 24 inches. A trench wider than the outside diameter plus 24 inches may be used without special bedding if the Contractor, at his expense, furnishes pipe of the required strength to carry additional trench load. Such modifications shall be submitted to the Owner and approved in writing. Whenever such maximum allowable width of trench is exceeded, except as provided for on the drawings, or in the specifications, or by the written approval of the Owner, the Contractor, at his expense, shall encase the pipe in concrete from trench wall to trench wall, or other pipe bedding material approved by the Owner. Any excavation wider than this maximum width or subsequent Surface or Paving work, will be done at the Contractor's expense.

The depth of cut as indicated on the cut sheet for pay purposes may be more or less than the actual excavated depth. The variation is based on the surface elevation prior to the Contractor's operation and the invert of the sewer line.

3.2. When unsuitable bearing materials such as water, silt, muck, trash, debris or rock in ledge, boulder or coarse gravel (particle size larger than 1- 3/4 inch) is encountered at the bearing level, the Contractor shall over excavate and remove such materials to a depth no less than 6 inches below the bottom of the pipe and replace it with a material conforming to the requirements of Paragraph 804.4.2.1, 804.5, or as approved by the Engineer and/or Inspector.

3.3. **Dewatering.** Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding project site and surrounding area.

3.3.1. The Contractor shall not allow water to accumulate in excavations or at subgrade level. Remove water to prevent softening of foundation bottoms and soil changes detrimental to stability of subgrades and foundations. Provide and maintain dewatering system components necessary to convey water from excavations.

3.3.2. Convey water removed from excavation and rainwater to collecting or runoff areas away from buildings and other structures. Establish and maintain temporary drainage ditches and other diversions outside excavation limits. Do not use trench excavations as temporary drainage ditches.

3.3.3. Dewatering devices shall be provided by the Contractor with filters to prevent the removal of fines from the soil. Should the pumping system draw fines from the soil, the Owner shall order immediate shutdown, and remedial measures will be the responsibility of the Contractor.

3.3.4. Upon completion of the dewatering work, the Contractor shall remove all equipment and leave the construction area in a neat, clean, condition that is acceptable to the Owner.

3.3.5. The Contractor shall maintain ground water table at least 12 inches below the finished excavation subgrade.

3.3.6. **Dewatering Performances.** Performances of the dewatering system for lowering ground water shall be measured by observation wells on piezometers installed in conjunction with the dewatering system, and these shall be documented at least daily. The Contractor shall maintain a log of these readings and submit them to the Owner.

No direct payment shall be made for costs associated with dewatering. All costs in connection therewith shall be included in the applicable contract price for the item to which the work pertains.

4. Backfilling Sanitary Sewer Trenches

4.1. **General.** Trenches shall not be backfilled until the construction structures or appurtenances, as installed, conform to the requirements specified. Where specified, only the secondary backfilling may incorporate excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel, soft shale or other approved materials, free from large clods of earth or stones. Where pipe is specially coated for protection against corrosion, care shall be taken not to damage the coating.

Where a trench has been improperly backfilled, or where settlement occurs, the identified section shall be excavated to a depth and length 50' beyond the failed area, then refilled and compacted to the grade and compaction required. The use of sand backfill shall not be allowed. All compaction within the secondary backfill zone shall be such that the apparent dry density of each layer shall be not less than 98% within 2 feet of top pavement. These top 2 feet shall not be less than 98% for pavement areas of the maximum dry density at + or – 2% optimum moisture content as determined by tests on samples as outlined in TXDOT Testing Method Tex 113-E, unless otherwise shown on the plans. At the time of compaction, the water content shall be at optimum moisture content, + or - 2% points. See Table 3 at the end of this specification for an outline of the bedding and initial backfill requirements for various pipe types.

4.2. **Sanitary Sewer Backfilling.** Backfilling for sanitary sewers is divided into three (3) separate zones: (4.2.1) bedding: the material in trench bottom in direct contact with the bottom of the pipe; (4.2.2) initial backfill: the backfill zone extending from the surface of the bedding to a point 1 foot above the top of the pipe; and (4.2.3) secondary backfill: the backfill zone extending from the initial backfill surface to the top of the trench. Materials and placement for each of the zones shall be as described herein.

4.2.1. Bedding.

4.2.1.1. **Stable Material.** Existing stable material present during excavation include: Trench bottom free of water, muck, debris; Rock in boulder, ledge or coarse gravel (particle size not larger than 1- 3/4 inch) formations; Coarse sand and gravels with maximum particle size of 1- 3/4 inch, various graded sands and gravels containing small percentages of fines, generally granular and non-cohesive either wet or dry; and Fine sands and clayey gravels; fine sand, sand-clay mixtures, clay and gravel-clay mixtures.

4.2.1.2. **Unstable Material.** Existing unstable materials are: Silt, muck, trash or debris in the trench bottom bearing level; rock, in ledge or boulder, or coarse gravel (minimum particle size larger than 1- 3/4 inch) formations.

4.2.1.3. **Bedding Material.** The existing material at the bearing level shall be removed and replaced to a minimum depth of 6 inches or 1/8 inch of the outside diameter of the pipe, whichever is greater, with bedding material. The bedding material shall extend up the sides of the pipe sufficient to embed the lower quadrant of the pipe. The bedding material shall be composed of well-graded, crushed stone or gravel conforming to the following requirements unless modified by the Engineer.

Table 1
Gradation Requirements

Sieve Size	% Passing
1 inch	100
3/4 inch	90 – 100
3/8 inch	20 – 55
No. 4	0 - 10
No. 8	0 - 5

Payment for additional excavation must be approved by the Inspector.

4.2.1.4. **Over Excavation.** Where the trench bottom has been over excavated beyond the limits as defined in Item No.848, “Sanitary Sewers,” due to removal or unstable material, the pipe shall be concrete encased. Encasement shall extend from the trench wall to trench wall and be a minimum of 6 inches above the top of pipe. No separate pay item. (See Item No. 858.)

4.2.1.5. **Reduced Excavation.** Where the trench bottom is not excavated in accordance with the specification due to rock or other hard under lying materials, then the pipe shall be concrete encased as defined in Item No. 858, “Concrete Encasement.”

4.2.1.6. **Consolidating Backfill Material.** The Initial Bedding material shall be consolidated to assure it is incorporated from the bottom of the trench up to the pipe centerline.

4.2.2. **Initial Backfill.** Initial backfill is defined as backfill having a thickness in its compacted state from the surface of the bedding to a point 1 foot above the top of the pipe.

Initial backfill shall consist of gravel which conforms to the requirements of Item No. 804.4.2.1.3.

For sewer lines up to 24 inches in diameter initial backfill material shall be placed in two lifts above the bedding material the pipe is set on. The first lift shall be spread uniformly and simultaneously on each side and under the bottom quadrant of the pipe to the midpoint or spring line of the pipe.

Consolidate the Initial Backfill material as per section 804.4.2.1.6.

Placement of the first lift of initial backfill shall be subject to inspection and approval prior to placement of second lift, which shall extend from the spring line of the pipe to a minimum of 1 foot above the top of the pipe. The second lift shall be evenly spread in a similar manner as the first lift.

For diameters 24 inches and larger, initial backfill material shall be evenly and simultaneously spread alongside, under the lower quadrant the pipe and over the pipe in 6 inch lifts to a point sufficient to a minimum of 1 foot above the top of the pipe.

Consolidate the Initial Backfill material as per section 804.4.2.1.6.

4.2.3. **Secondary Backfill.** Secondary backfill is defined as backfill from 1 foot above the top of the pipe to the top of the trench.

Secondary backfill shall be constructed in accordance with details shown on the plans and these specifications.

Secondary backfill shall generally consist of materials removed from the trench and shall be free of brush, debris and trash. Rock or stones having a dimension larger than 6 inches at the largest dimension shall be sifted out and removed before the material is used in the secondary backfilling zone. Secondary backfill material shall be primarily composed of compactable soil materials. The secondary backfill material shall be placed in maximum 9 inch loose lifts or as directed by the Design Engineer and/or Inspector. The moisture content for the secondary backfill shall be as per section 804.4.1.General.

When work only involves utility improvements or repair, and is not part of a roadway reconstruction or proposed roadway project, flowable fill is required as secondary backfill.

4.2.4. **Trench Surface Restoration.** The surface of the backfilled trench shall be restored to match the previous existing conditions. This shall include final grading, placement of topsoil and seeding, placement of sod (such as at homes or businesses that had maintained lawns), or other unprepared and prepared surfaces.

Trenches in alleys shall be restored with sewer gravel and flowable as shown on the “Utility Trench Repair Detail for Roadway and Alley Crossings,” for the entire width of the trench.

Trenches in paved streets shall be covered with a temporary all weather surface to allow for vehicular traffic until the final asphalt/concrete paving is complete. This surface shall be a minimum of 12 inches compacted and rolled asphaltic black base, and hot-mix applied. It is the Contractor’s responsibility to maintain this surface until the final street restoration is complete. Temporary street striping may also be required. This surface must be removed prior to final asphalting. All street work shall be done in accordance with the latest City of Universal City Public Works’ requirements. Included in this requirement is replacement of any curbs or sidewalks damaged or removed during the construction.

No separate payment for the surface restoration is permitted. The cost for this work must be included in the appropriate bid item.

5. BACKFILLING POTABLE WATER TRENCHES

Mains and service line trenches shall be excavated in accordance with Item No. 804.2 and Item No. 804.3 for placement of potable water appurtenances.

5.1. Bedding/Initial Backfilling. The bedding and initial backfill materials for ductile iron pipe (DI), H.D.P.E. Pipe, and Polyvinyl Chloride Pipe (PVC) in all nominal diameters shall be composed of pit silica sand conforming to the following requirements unless modified by the Engineer.

Table 2
Gradation Requirements

Sieve Size	% Passing
3/8 inch	100
No. 4	95 - 100
No. 8	80 – 100
No. 16	50 – 85
No. 30	25 – 65
No. 50	10 – 35[1]
No. 100	0 – 10
No. 200	0 – 3[2]

1. 6 – 35 when sand equivalent value is greater than 85.
2. 0 – 6 for manufactured sand.

The quantity and thickness of materials lifts and compaction of initial backfill materials shall be in accordance with the provisions of Item No. 804.4.2.2 and Item No. 804.5.1.

Where services 3/4" – 2" copper are installed, initial backfill shall be "Pit Run" silica sand conforming to the following requirements: Natural sand. Larger services utilizing DI pipe or PVC (C-909) pipe shall be backfilled the same as mains.

5.2. Secondary Backfill. Secondary backfill materials for all types and sizes of pipe shall be as defined in Item No. 804.4.2.3, "Secondary Backfill." Secondary backfill materials shall be placed and compacted in accordance with the provisions of Item No. 804.4.2.3, "Secondary Backfill."

5.3. Trench Surface Restoration. Trench surface restoration shall be accomplished as defined in Item No. 804.4.2.4.

6. DISPOSAL OF EXCAVATED MATERIALS

Any excess excavated material, not utilized after all fill requirements have been met, shall become the responsibility of the Contractor. The Contractor shall haul away excess material for disposal at Contractor's expense.

7. QUALITY CONTROL

7.1. The Contractor shall procure, store, and place materials from either onsite or offsite sources which comply with the specified requirements.

7.2. **Quality Assurance Testing.** The Owner shall have such tests and inspections as he may desire performed by a City pre-approved, independent testing laboratory for his guidance and control of the work. Payment for such tests shall be the responsibility of the Owner, including the material proctor tests and density tests. The Contractor shall request testing work performed by the Owner by notifying the Owner of the areas available by Station Numbers or Dimensions and Lift Numbers. The Contractor shall provide access to the test area, associated trench excavation safety protection, and backfilling of the test areas. The frequency and location of testing shall be determined solely by the Owner. The Owner may test any lift of fill at any time, location, or elevation.

7.3. **Quality Control Testing.** The Contractor shall be responsible for compaction in accordance with the appropriate Specification. Compactions tests will be done at one location point randomly selected or as indicated by the Universal City Inspector/Test Administrator, per each 9 inch loose lift per 400 linear feet.

Note: Any failed test shall require the Contractor to remove and replace that layer of backfill to 50 feet from either side from the failed test location. The Contractor will also be required at no cost to Universal City to provide two additional tests at the replaced location where the initial test failed and at one location point, randomly selected or as indicated by the Universal City Inspector/Test Administrator.

Note: Sanitary Sewer Laterals will be subject to compaction tests at the discretion of the Universal City Inspector/Test Administrator within 400 linear foot segments. Any failed test shall require the Contractor to remove and replace failed backfill. The Contractor will also be required at no additional cost to Universal City to provide one test at the replaced location where the initial tests failed.

The Contractor shall be responsible for all costs associated with supplying material for the proctor and density tests. These tests shall be performed by a nationally-accredited, independent testing laboratory. The Owner shall provide access to the results of the material proctor tests to the Contractor prior to performing any backfill operations.

The Contractor shall provide access to the test area, associated trench excavation safety protection, and backfilling of the test areas at the Contractor's expense. The Owner will determine in-place density and moisture content by any one or combination of the following methods: ASTM D2922 (density of soil and soil aggregate in-place by nuclear methods – shallow depth), D1556 (density and unit weight of soil in-place by sand cone method), D2216 (lab density of water content of soil and rock), D3017 (water content of soil and rock – shallow depth in-place by nuclear methods).

8. MEASUREMENT

Excavation, Trenching and Backfill will not be measured for payment.

9. PAYMENT

No direct payment shall be made for incidental costs associated with quality control testing, excavation, trenching and backfilling for water mains and sanitary sewers, and all costs in connection therewith shall be included in the applicable contract price for the item to which the work pertains.

TABLE 3
BEDDING AND INITIAL BACKFILL REQUIREMENTS

	UNSTABLE		STABLE		ROCK	
	Bedding	**Initial Backfill**	**Bedding**	**Initial Backfill**	**Bedding**	**Initial Backfill**
WATER	6"	1.0' above pipe	6"	1.0' above pipe	6"	1.0' above pipe
DI	Pit Silica Sand					
PVC						
HDPE						
SEWER	6"	1.0' above pipe	6"	1.0' above pipe	6”	1.0’ above pipe
RIGID	Sewer Gravel					
FLEXIBLE						

HDPE = High Density Polyethylene Pipe.
Sewer Gravel --- See Item No. 804.4.2.1.3

812

WATER MAIN INSTALLATION

1. DESCRIPTION

This item shall consist of water main installation in accordance with these specifications and as directed by the Engineer.

2. MATERIALS

The materials for water main installation shall conform to the specifications contained within the latest revision of SAWS Material Specifications "Ductile Iron Pipe", Item No. 05-11, "PVC C-909 Water Pipe", Item No. 05-12, “PVC C-905 Water Pipe”, Item No. 819. The pressure rating for pipe materials shall be in accordance with Table HP, "High Pressure Levels," in Appendix A. Minimum pressure rating for all pipes in high pressure zones shall be 200 psi.

2.1. PVC water pipe shall be blue in color. PVC pipe markings shall include:

- PVC Manufacturer’s name or trademark;
- Standard to it conforms;
- Pipe size;
- Material designation code;
- Pressure rating;
- SDR number or schedule number;
- Potable water laboratory seal or mark attesting to suitability for potable water;
- A certifier’s mark may be added; and
- Manufactured date (installation shall not exceed one year from this date)

2.2. White-colored PVC pipe is acceptable if labeled in accordance with item 2.1.

3. CONSTRUCTION

3.1. **Start of Work.** The Contractor shall start his work at a tie-in or point designated by the Engineer. Pipe shall be laid with bell ends facing in the direction of pipe laying, unless otherwise authorized or directed by the Engineer. All valves and fire hydrants must be installed as soon as pipe laying reaches their established location. Pipe shall be installed to the required lines and grades with fittings, valves, and hydrants placed

at the required locations. Spigots shall be centered in bells or collars, all valves and hydrant stems shall be set plumb, and fire hydrant nozzles shall face as per City of Universal City standard details or as directed by the Engineer. No valve or other control on the existing system shall be operated for any purpose by the Contractor unless a representative of the City of Universal City is present.

3.2. **Crossing Other Underground Lines.** New water mains crossing any other utilities shall have a minimum of thirty (30") inches of cover over the top of the pipe unless otherwise waived or modified by the Engineer. Excavation around other utilities shall be done by hand for at least twelve (12") inches all around. Any damage to the protective wrap on gas lines or electrodes shall be reported immediately to the C. P. S. Energy, phone (210) 353-3333. Any damage to other utilities shall be reported to their proper governing entity. In both of these cases of utility damage, Contractor shall also promptly notify the Inspector.

3.3. **Pipe Separation – Parallel Lines.**

3.3.1. Where a new potable waterline parallels an existing non-pressure-rated wastewater main or lateral and the engineer is able to determine that the wastewater main or lateral is not leaking, the new potable water line shall be located at least two feet above the existing wastewater main or lateral, measured vertically, and at least four feet away, measured horizontally, from the existing wastewater main or lateral. Every effort shall be exerted not to disturb the bedding and backfill of the existing wastewater main or lateral.

3.3.2. Where a new potable waterline parallels an existing pressure-rated wastewater main or lateral and it cannot be determined by engineer if the existing line is leaking, the existing wastewater main or lateral shall be replaced with at least 150 psi pressure-rated pipe. The new potable water line shall be located at least two feet above the existing wastewater main or lateral, measured vertically, and at least four feet away, measured horizontally, from the existing wastewater main or lateral.

3.3.3. Where a new potable waterline parallels a new wastewater main or lateral, the new wastewater main or lateral shall be constructed of at least 150 psi pressure-rated pipe. The new potable water line shall be located at least two feet above the existing wastewater main or lateral, measured vertically, and at least four feet away, measured horizontally, from the existing wastewater main or lateral.

3.4. **Pipe Separation – Crossing Lines.**

3.4.1. Where a new potable waterline crosses an existing non-pressure-rated wastewater main or lateral, one segment of the waterline pipe shall be centered over the wastewater main or lateral such that the joints of the pipe are equidistant and at least nine feet horizontally from the center line of the wastewater main or lateral. The potable waterline shall be at least two feet above the wastewater main or lateral. Whenever possible, the crossing shall be centered between the joints of the wastewater main or lateral. If the existing water main or lateral shows signs of leaking, it shall be replaced for at least nine feet in both directions (18 feet total) with at least 150 psi pressure-rated pipe.

3.4.2. Where a new potable waterline crosses an existing pressure-rated wastewater main or lateral, one segment of the waterline pipe shall be centered over the wastewater main or lateral such that the joints of the pipe are equidistant and at least nine feet horizontally from the center line of the wastewater main or lateral. The potable waterline shall be at least six inches above the wastewater main or lateral. Whenever possible, the crossing shall be centered between the joints of the wastewater main or lateral. If the existing water main or lateral shows signs of leaking, it shall be replaced for at least nine feet in both directions (18 feet total) with at least 150 psi pressure-rated pipe.

3.4.3. Where a new potable waterline crosses a new non-pressure-rated wastewater main or lateral and the standard pipe segment length of the wastewater main or lateral is at least 18 feet, one segment of the waterline pipe shall be centered over the wastewater main or lateral such that the joints of the pipe are equidistant and at least nine feet horizontally from the center line of the wastewater main or lateral. The potable waterline shall be at least two above the wastewater main or lateral. Whenever possible, the crossing shall be centered between the joints of the wastewater main or lateral. The wastewater pipe shall have a minimum pipe stiffness of 115 psi at 5.0% deflection. The wastewater main or lateral shall be embedded in cement stabilized sand for the total length of one pipe segment plus 12 inches beyond the joint on each end.

3.4.4. Where a new potable waterline crosses a new non-pressure-rated wastewater main or lateral and a standard length of the wastewater pipe is less than 18 feet in length, the potable water pipe shall be centered over the wastewater line. The materials and method of installation shall conform to one of the following options.

3.4.4.1. Within nine feet horizontally of either side of the waterline, the wastewater pipe and joints shall be constructed with pipe material having a minimum pressure rating of at least 150 psi. An absolute minimum vertical separation distance of two feet shall be provided. The wastewater main shall be located below the waterline.

3.4.4.2. All sections of the wastewater main or lateral within nine feet horizontally of the waterline shall be encased in an 18-foot or longer section of pipe. Flexible encasing pipe shall have a minimum pipe stiffness of 115 psi at 5.0% deflection. The encasing pipe shall be centered on the waterline and shall be at least two nominal pipe diameters larger than the wastewater main or lateral. The space around the carrier pipe shall be supported at five-foot or less intervals with spacers or be filled to the springline with washed sand. Each end of the casing shall be sealed with watertight non-shrink cement grout or a manufactured water tight seal. An absolute minimum separation distance of six inches between the encasement pipe and the waterline shall be provided.

3.5. **Pipe Grade.** Water mains sixteen (16") inches or smaller shall have a minimum of forty eight (48”) inches of cover from the proposed final finish ground/street/elevation and sixty (60”) inches of cover when the main is installed in a parkway or under the pavement where there are no existing/proposed curb or existing drainage facilities. Water mains twenty (20") inches and above shall have a minimum of sixty (60”) inches of cover over the top of the pipe from the proposed final finish ground/street/elevation unless otherwise waived or modified by the Engineer. Pipe grades shall be as required by the plans or as directed by the Engineer. Grades shall

be met as specified by “Excavation, Trenching and Backfilling", Item No. 804. Precaution shall be taken to insure that the pipe barrel has uniform contact with the cushion material for its full length except at couplings. The couplings shall not be in contact with the original trench bottom prior to backfilling. Cushion material shall be placed under the coupling and compacted by hand prior to backfilling so as to provide an even bearing surface under the coupling and pipe. Changes in grade shall be made only at joints.

3.6. **Cushion and Cushion Materials.** Prior to placing pipe in a trench, the trench shall have been excavated to the proper depth as required in "Excavation, Trenching, and Backfilling", Item No. 804, of these specifications. Approved imported materials or Engineer approved materials selected from suitable fines derived from the excavation shall be smoothly worked across the entire width of the trench bottom to provide a supporting cushion.

3.7. **Structures to Support Pipe.** Where the bottom of a trench at subgrade consists of material that is notably unstable by the Engineer and cannot be removed and replaced with approved material which may be properly compacted in place to support the pipe. The Contractor shall also construct a foundation for the pipe consisting of piling, concrete beams, or other supports in accordance with plans prepared by the Engineer. Extra compensation will be allowed for the Contractor for the additional work done. All claims for extra compensation must first be agreed to by UC, prior to any such work occurring.

3.8. **Lowering Materials into Trench.** Proper implements, tools, and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient completion of work. All pipe, fittings, valves, and hydrants shall be carefully lowered into the trench piece by piece, by means of a derrick, ropes, or other suitable tools or equipment in such a manner as to prevent damage to water main materials and protective coatings and linings. Under no circumstances shall water main materials, pipes, fittings, etc, be dropped or dumped into the trench. Extreme care shall be taken to avoid damaging polywrap films. No chains or slings shall be allowed unless the entire sling is wrapped with a protective nylon web sock.

3.9. **Pipe Laying.** Every precaution shall be taken to prevent foreign material from entering the pipe during installation. Under adverse trenching conditions, work stoppage for an extended period of time and/or otherwise required by the Engineer, a manufactured cap/plug is to be used to prevent any foreign type material entering. The cap/plug shall be left in place until it is connection to an adjacent pipe. The interior of each pipe shall be inspected for defects, and the pipe shall be rejected if any defects are found.

After placing a length of pipe in the trench, the jointed end shall be centered on the pipe already in place, forced into place, brought to correct line and grade, and completed in accordance with the requirements of these Specifications. The pipe shall be secured in place with approved backfill material tamped around it. Pipe and fittings which do not allow a sufficient and uniform space for joints shall be rejected by the Engineer and shall be replaced with pipe and fittings of proper dimensions. Precautions shall be taken to prevent dirt or other foreign matter from entering the joint space.

At times when pipe laying is halted, the open end of pipe in the trench shall be closed by a watertight plug or other means approved by the Engineer. Pipe in the trench which cannot temporarily be jointed shall be capped or plugged at each end to make it watertight. This provision shall apply during all periods when pipe laying is not in progress. Should water enter the trench, the seal shall remain in place until the trench is pumped completely dry. The Contractor shall provide all plugs and caps of the various sizes required.

3.10. **Deviations in Line or Grade.** Wherever obstructions not shown on the plans are encountered during the progress of the work and interfere to an extent that an alteration in the plan is required, the Engineer shall have the authority to change the plans and direct a deviation from the line and grade or to arrange with the owners of the structures for the removal, relocation, or reconstruction of the obstructions. Any deviation from the line shall be accomplished by the use of appropriate bends unless such requirement is specifically waived by the Engineer.

Whenever it is necessary to deflect pipe from a straight line, the deflection shall be as directed by the Engineer and as described herein. In no case shall the amounts shown in Table 812-1, "Maximum Deflections of Ductile-Iron Pipe" for ductile-iron pipe, be exceeded.

3.11. **Cutting Pipe.** The cutting of pipe for inserting valves, fittings, or closure pieces shall be accomplished in a neat and workmanlike manner so as to produce a smooth end at right angles to the axis of the pipe. The recommendations of the pipe manufacturer shall be strictly followed by the Contractor. Only qualified and experienced workmen shall be used and, under no circumstances, shall a workman not equipped with proper safety goggles, helmet and all other required safety attire be permitted to engage in this work.

Asbestos-Cement (AC). No field cutting will be allowed on asbestos cement pipe. Repairs to AC pipe shall be accomplished by removing one full joint of AC pipe and replacing with appropriate PVC or Ductile Iron pipe and fittings. Information about handling AC pipe may be obtained through the SAWS homepage at http://www.saws.org.

All cuts made on ductile-iron pipe shall be done with a power saw. The cuts shall be made at right angles to the pipe axis and shall be smooth. The edges of the cut shall be finished smoothly with a hand or machine tool to remove all rough edges. The outside edge of pipe should be finished with a small taper at an angle of about thirty (30°) degrees.

To facilitate future repair work on water mains, no sections less than 3 feet in length between fittings shall be allowed.

3.12. **Joint Assembly.**

3.12.1. **Rubber Ring Joints.** The installation of pipe and the assembly of rubber ring joints for Ductile-Iron pipe shall conform to the pipe manufacturer's assembly instructions. The method of inserting spigot ends of pipe in bells or collars known as "stabbing" shall not be permitted with pipe larger than 6 inches in size. Spigot ends of pipe larger

than six (6”) inches in size must be properly inserted in the joint by means of suitable pushing/pulling devices or an approved manufactures’ method.

3.12.2. **Mechanical Couplings.** Mechanical couplings shall be assembled and installed according to the standards recommended by the manufacturer.

Mechanical coupling consists of a cylindrical steel middle ring, two steel follower rings, two rubber compound gaskets, and a set of steel bolts. The middle ring is flared at each end to receive the wedge-shaped gasket which is compressed between the middle ring flare and the outer surface of the pipe by pressure exerted on the follower rings through the bolt circle.

Prior to the installation of the mechanical coupling, the pipe ends shall be cleaned by wire brush or other acceptable method to provide a smooth bearing surface for the rubber compression gasket. The pipe shall be marked to align the end of the coupling which will center it over the joint. After positioning, the nuts shall be drawn up finger tight. Uniform pressure on the gaskets shall be applied by tightening alternate bolts on the opposite side of the circle in incremental amounts. Final tensioning shall be accomplished with a torque wrench and in a manner similar to the tightening procedure. The coupling shall then be left undisturbed for twenty four (24) hours to allow the gaskets to "pack in." Final torque check shall then be made prior to coating and wrapping the joint. Table 812-2, “Torque for Mechanical Couplings”, sets forth the proper torque for various sized mechanical couplings and is included for the convenience of the Contractor.

3.12.3. **Restraint Joints.** Restraint Joints shall be installed as shown on the plans or as directed by the Engineer. Installation shall conform to the manufactures’ recommendation.

3.13. **Abandonment of Old Mains.** The Contractor shall accomplish all cutting, capping, plugging, and blocking necessary to isolate those existing mains retained in service from those abandoned. The open ends of abandoned mains and all other openings or holes in such mains occasioned by cutting or removal of outlets shall be blocked off by manually forcing cement grout or concrete into and around the openings in sufficient quantity to provide a permanent substantially watertight seal. Abandonment of old, existing water mains will be considered subsidiary to the work required, and no direct payment will be made.

When specified or shown otherwise in the contract document, Contractor shall remove the main and all related appurtenances that are to be replaced, or will no longer be in service, and all effort to accomplish this requirement will be considered subsidiary to the work required, and no direct payment will be made.

3.14. **Abandoned Valves.** Valves abandoned in the execution of the work shall have the valve box and extension removed. The valve covers shall be salvaged and returned to the Owner.

3.15. **New/Existing Valves.** At no time during the project work shall any valves be covered or rendered inaccessible for operation due to any activities by the Contractor. Any

work during construction activities will be suspended until this requirement is met. No claims for cost or schedule delays will be accepted.

4. MEASUREMENT

Water main installed will be measured by the linear foot for each size and type as follows:

Measurements will be from the center line intersection of runs and branches of tees to the end of the valve of a dead end run.

Measurements will also be between the center line intersection of runs and branches of tees. Where the branch is plugged for future connection, the measurement will include the entire laying length of the branch or branches of the fitting.

The measurement of each line of pipe of each size will be continuous and shall include the full laying lengths of all fittings and valves installed between the ends of such line except that the laying length of reducers will be divided equally between the connected pipe sizes. Lines leading to a tapping connection with an existing main will be measured to the center of the main tapped.

5. PAYMENT

Payment for water main installed will be made at the unit price bid per linear foot of pipe of the various sizes installed by the open cut method. Such payment shall also include excavation, selected embedment material, backfill, compaction, polyethylene sleeve where required, hauling and disposition of surplus excavated material.

Removed AC pipe shall be manifested and disposed in accordance with standards that may be obtained through the SAWS homepage at http://www.saws.org. Payment for disposal of AC pipe will be made at the unit price bid.

TABLE 812-1

MAXIMUM DEFLECTIONS OF DUCTILE-IRON

Nominal Pipe Diameter	Maximum Deflection Angle	Maximum Deflection In Inches		Approximate Radius Of Curve In Inches	
		18 Ft.	20 Ft.	18 Ft.	20 Ft.
6”	4˚25’	16.7	18.5	234	260
8”	3˚51’	14.6	16.2	268	297
10”	3˚42’	14.0	15.5	279	310
12”	3˚08’	11.9	13.2	327	363
16”	2˚21’	8.8	9.7	440	488
20”	1˚55’	7.2	8.0	540	600
24”	1˚35’	6.0	6.7	648	720

TABLE 812-2		
TORQUE FOR MECHANICAL COUPLINGS		
Coupling Size	Bolt Diameter	Torque
2” to 24”	5/8”	75 ft-lb
2” to 24”	3/4”	90 ft-lb
30” to 36” (1/4” X 7” Middle Rings)	5/8”	65 ft-lb
30” to 36” (3/8” & Heavier Middle Rings)	5/8”	70 ft-lb
30” to 48”	3/4”	80 ft-lb
48” to 72”	3/4”	70 ft-lb

814

DUCTILE IRON PIPE

1. DESCRIPTION

This item shall consist of Ductile Iron Pipe installation in accordance with these specifications and as directed by the Engineer.

2. MATERIALS

The materials for Ductile-Iron pipe shall conform to the specifications contained within the latest revision of SAWS Material Specification "Ductile-Iron Pipe", Item No. 05-11, "Gray-Iron and Ductile-Iron Fittings", Item No. 10-10, and "Ductile-Iron Couplings", Item 100-34.

3. CONSTRUCTION

3.1. Excavations at Bells and Collars. Ductile Iron pipe shall be installed as specified within "Water Main Installation", Item No. 812, of these specifications. Bell holes of sufficient size shall be provided at each joint to permit the joints to be made properly. For mechanical type joints, the minimum clearance between the bell and natural ground shall be 6 inches in all directions. Subject to the above provisions, the length of excavation for bell holes below grade of the trench bottom shall be kept to a minimum.

3.2. Corrosion Protection for Ferrous Pipe, Fittings, and Valves. Except as otherwise shown on the plans or as directed by the Engineer, anti-corrosion embedment shall be provided for all ductile-iron pipe, fittings, and valves and at all valves, fittings, or outlets for nonferrous or reinforced concrete steel cylinder pipe. The embedding material shall be pit run silica sand which conforms to the requirements as set forth in the Item No. 804, Paragraph 804.5.1.

The preparation of the trench shall be in accordance with applicable provisions of "Excavation, Trenching and Backfilling", Item No. 804. After the subgrade has been prepared, the pipe shall be laid to grade in accordance with "Excavation, Trenching and Backfilling", Item No. 804. The pipe, fitting, or valve shall be firmly embedded in and surrounded by an insulating blanket of the embedding material. The minimum thickness of this blanket shall be 6 inches in every direction.

3.3. Coating and Wrapping of Underground Pipe.

3.3.1. Ductile-Iron Pipe In Casing. Where ductile-iron pipe is to be installed in a bore, the pipe shall be thoroughly cleaned down to the coal-tar enamel pipe coating by approved methods. Where damaged, a prime coat compatible to the polyvinyl tape to be used shall then be applied to the pipe. Following the application of the prime coat,

the pipe shall be wrapped with Trantex VID10 polyvinyl tape, or an approved equal. The tape shall not be applied until the prime coat is completely dry.

The tape shall be spirally and tightly wrapped on each section of the pipe with a 50% lap. The wrap shall be made to the bell on the bell end and to a point 6 inches from the spigot end. The joint shall be protected with tape 6 inches in width on pipe 12” or less in size and with tape 8 inches in width on pipe greater than 12” in size.

3.3.2. **Open Trench.** Ductile-iron pipe to be installed in a trench shall be protected in the following manner. Each pipe joint shall be covered with a 4 mil thick polyethylene sleeve that is 2 feet longer than the pipe joint. The sleeve shall cover the full length of the pipe joint, lap over 1 foot on each end of the adjoining pipe joints, and be secured with a minimum of two circumferential turns of pressure sensitive polyvinyl tape. Excess material should be neatly drawn up around the pipe barrel, folded into an overlap on top of the pipe, and held in place by means of pieces of pressure sensitive tape at approximately 5 foot intervals. After assembling the joint, the polywrap tube from the previously installed pipe shall be pulled over the joint and secured by the Contractor. The polywrap tube from the new joint shall be pulled over the first tube and secured by the Contractor to provide a double seal.

Cast-iron and Ductile-iron fittings and valves shall be completely wrapped in 8 mil thick polyethylene film with a minimum of one 1 foot overlap on each end and appropriately taped. Laps shall cover joints with adjoining pipe joints or fittings when installed. Fire Hydrant barrel from the surface to the valve shall be wrapped as specified herein.

Any damaged areas in the polyethylene film shall be repaired by covering the area with a sheet of polyethylene film large enough to lap over the damaged area 1 foot minimum in any direction and appropriately taped. Extreme care shall be taken at service tap locations to insure that the tape extends beyond the corporation and onto the service line pipe 1 foot.

Prior to placing pipe in the trench, a cushion of approved materials shall be placed in the trench as required by "Excavation, Trenching and Backfill", Item No. 804. Backfill material shall be carefully placed on the pipe so as to avoid any damage to the polyethylene sleeve.

The Contractor shall use care to protect and preserve the polyethylene wrap around ductile iron water mains when installing service corporations. The required method is to wrap pipe tape around the pipe over the polywrap in the area to be tapped. The tap is to be made through the tape and polywrap. It is not necessary to remove and replace poly wrap. All exposed pipe, the corporation, and the first 3 feet of the service shall be wrapped and taped to achieve a complete seal. In addition, a sand envelope shall extend over and around the connection to a depth of eight inches above the main.

3.3.3. **Protective Coating on Joints.** All bolts and nuts destined for underground service on valves, fire hydrants, cast-iron mechanical joint fittings, pipe joints, and other ferrous metal appurtenances shall be packed in an approved protective coating material after installation. After the joint has been made and the bolts drawn to the proper tension, the joint including glands, flanges, bolt heads, and nuts shall be

covered with an approved SAWS coating. Such protective coating shall be supplemental to anti-corrosive sand embedment as set forth in Item No. 804, “Excavation, Trenching, and Backfill.” Coating and wrapping of joints will be considered incidental to the installation, and no separate payment will be made for this item. Asphaltic material such as Talcote shall not be used.

3.4. **Cutting Ductile-Iron Pipe.** All cuts made on ductile-iron pipe shall be done with a power saw or approved mechanical cutter. The cuts shall be made at right angles to the pipe axis and shall be smooth. The edges of the cut shall be finished smoothly with a hand or machine tool to remove all rough edges.

The outside edge of pipe should be finished with a small taper at an angle of about 30 degrees.

4. MEASUREMENT

Ductile Iron Pipe will be measured as established under "Water Main Installation”, Item No. 812 of these Specifications.

5. PAYMENT

Payment for Ductile Iron Pipe will be made as outlined in "Water Main Installation" Item No. 812 of these Specifications.

818

PVC (C-905 AND C-909) PIPE INSTALLATION

1. DESCRIPTION

This item shall consist of PVC (C-905 and C-909) pipe installation in accordance with these specifications and as directed by the Engineer. Deflection of PVC (C-905 and C-909) pipe shall not be allowed.

2. MATERIALS

The materials for PVC pipe installation shall conform to the specifications contained within the latest revision of SAWS Material Specification "Polyvinyl Chloride (PVC) Pressure Pipe", Item No. 05-13 and "Polyvinyl Chloride (PVC) Water Transmission Pipe", Item No. 819-01. PVC pipe C-900 is not allowed.

3. CONSTRUCTION

PVC (C-905 and C-909) pipe shall be installed as specified within "Water Main Installation", Item No. 812 of these specifications. PVC (C-905 and C-909) mains shall be laid to the depth and grades shown on the construction plans. The pipe shall be laid by inserting the spigot end into the bell flush with the insertion line or as recommended by the manufacturer. At no time shall the bell end be allowed to go past the "insertion line". A gap between the end of the spigot, and the adjoining pipe is necessary to allow for expansion and contraction.

3.1. **Joint Restraints.** For all mains consisting of PVC (C-905 and C-909) joint restraints as specified in the SAWS Material Specifications, “Pipe Joint Restraint Systems", Item No. 95-10, shall be installed in accordance with manufacturer’s recommendations. Joint restraints shall be non-directional and installed to fully restrain the system.

PVC (C-905 and C-909) shall be field cut using a power saw with a steel blade or abrasive disc depending on the size of pipe. If a bevel is needed after field cutting, it should be in accordance with Uni-Bell recommendations.

3.2. **Tracer Wire.** Tracer wire shall be utilized for location purposes and taped directly to the pipe. Tracer wire shall be of solid core (14 gauge insulated), and shall be taped to the main in minimum of 10 foot increments. Wire shall also come up to the top of valve extensions and fire hydrant stems, as directed by the Inspector.

4. MEASUREMENT

PVC (C-905 and C-909) pipe installed will be measured as outlined in "Water Main Installation", Item No. 812 of these Specifications.

5. PAYMENT

Payment for PVC (C-905 and C-909) water main installed will be made as outlined in "Water Main Installation", Item No. 812 of these Specifications.

824

SERVICE SUPPLY LINES (WATER)

1. DESCRIPTION

This item shall consist of water service supply lines adjustment and installation in accordance with these specifications and as directed by the Engineer.

2. MATERIALS

The materials for water service supply lines installation and adjustment shall conform to the specifications contained within the latest revision of SAWS Material Specification "Brass Goods", No. 15-40, "Copper Tubing", No. 15-01 and "Service Saddles", Item No. 100-30.

3. CONSTRUCTION

3.1. General. Service supply lines and fittings, meter boxes and appurtenances shall conform to the Material Specifications and shall be installed by the Contractor as specified herein, or as directed by the Engineer and in accordance with the Standard Drawings.

3.2. Designation of Service Supply Lines. A service supply line located between the water main and the inlet side of the water meter is designated as a "water service line". A service supply line located between the outlet side of the water meter to the point of connection within the limits of the Customers lot or property is designated as "Customer's yard piping" and is covered under Item No. 822 of these Specifications. Services 2” and smaller are designated "small services"; services 4” and larger are designated "large services".

3.3. Service Relays. New transfer main(s) to which services are to be relayed and are on the same side of the streets as the Customer's meter are defined as "short relays". New transfer main(s) to which services are to be relayed and are on the opposite side of the street from the Customer's meter are defined as "long relays".

3.4. Service Reconnects. New transfer main(s) to which services are to be reconnected and on the same side of the street as the old main are defined as "service reconnects". Existing services on the opposite side of the street to the new main shall be defined as a "long relay".

3.5. Service Relocates. Service Relocates are defined as services that are relocated from an alley or street to a side or front street. New transfer main(s) to which services are to be relocated and are on the same side of the street as the Customer's new meter box location, are designated as "short relocates". New transfer main(s) to

which services are to be relocated and are on the opposite side of the street from the Customer's new meter box location, are designated as "long relocates".

3.6. **New Services.** If a new main is required to be extended to provide water service for new Customers, the service lines laid to the new main shall be designated as "new services." New laid main(s) to which new services are on the same side of the street as the Customer's new meter box location, are designated as "new short services." New laid main(s) to which new services on the opposite side of the street from the Customer's new meter box location, are designated as "new long services."

3.7. **Tap Holes.** Tap holes are defined as excavations at existing mains, which are required in association with replacements of water service lines by pulling, boring or jacking operations.

All backfill material shall be as specified for main and service line trench excavation. For service lines and tap holes, payment for bedding, initial backfill and secondary backfill shall be included in the various sizes of each service placed.

3.8. **Service Line Installation.** Unless otherwise notified, service relays, service reconnects, service relocates and new services shall be installed as described herein, and in standard drawing. Unless otherwise indicated, existing meter and meter box relocation shall be included in the service line installation. All service line installation shall include a dielectric union to be installed within the meter box on the outlet side of the meter, as shown in Standard Drawing.

Cutting, excavation, backfill and replacement of pavement shall be done as specified herein and in accordance with applicable sections of the City of Universal City Specifications for Utility Trench Excavation, Backfill, Surfacing, and Barricading. The minimum trench width for small service lines shall be 8 inches, while the minimum trench width for large service lines shall be the nominal pipe diameter plus 16 inches, except when specified otherwise by the Engineer. For 3/4” to 2" Service lines, minimum bury depth shall be 3 feet. For services greater than 2”, minimum depth of bury shall be 4 feet.

All service lines shall be installed in accordance with the City of Universal City Standard Drawing DET-824 Series, SAWS Standard Material Specification Item No. 100-30.

The Contractor shall use precaution to protect and preserve the polyethylene wrap around Ductile-Iron (DI) water mains when installing service corporations. The required method is, wrap pipe tape around the pipe, over the polywrap, in the area to be tapped. The tap shall be made through the tape and polywrap. It is not necessary to remove and replace polywrap. All exposed pipe, corporation and the first three feet of the service, shall be wrapped and taped to achieve a complete seal. In addition, a sand envelope shall extend over and around the connection to a depth of 8 inches above the main.

Small service lines shall be embedded in sand in accordance with "Excavation, Trenching and Backfill", Item No. 804.

Where approved by the City Inspector, the Contractor may lay the new service line from the corporation stop to the curb stop or angle valve. Upon completion, the Contractor shall isolate the new service line by closing the curb stop or angle valve until the meter box is set.

3.9. **Splicing.** A long service line single slice may be permitted by means of a 3-part compression coupling only when approved in advance by the City Inspector, provided the location of the splice is not under pavement or concrete. The segment added is required to be the same material as the existing service line, unless otherwise directed by the Engineer. Splicing short service lines will not be permitted.

3.10. **Boring or Jacking Service Lines.** Service lines which cross paved streets may be installed at the Contractor's option by boring or jacking operations. Where it becomes necessary to widen the main trench section to accommodate a bore pit, such widening shall not extend more than one additional foot into the traffic side of the street.

3.11. **Tapping Asbestos Cement (AC) Water Mains.** All necessary service line tapping of AC pipe shall be completed during the period immediately before hydrostatic pressure testing operations so that subsequent flushing will maximize the elimination of contaminants associated with the tapping process.

Tapping of AC pipe must be done in accordance with manufacturers' recommendation and done only with tap machine having a built in flush valve and the flush valve must be open during the entire procedure.

3.12. **Abandonment of Service Lines.** The Contractor shall accomplish all cutting, capping, and plugging necessary to isolate new service lines transferred to new and existing mains from those abandoned, including service lines designated on the plans as "tap plug" and "tap kill." The corporation stop for an abandoned service line tapped on a ferrous main shall be removed, and the tap at the main shall be plugged with an appropriately sized brass plug. For a non-ferrous main, the corporation stop shall not be removed from the main. Instead, the corporation stop shall be closed and the compression nut shall be removed from the corporation top. After the appropriately sized copper disc is inserted inside the compression nut, replace the flared nut on the corporation stop. The Contractor shall salvage copper service line tubing, brass fittings, and other materials as directed by the City Inspector and return them to the Owner.

3.13. **Tapping PVC (C-909).** Tapping of PVC must be done in accordance with Uni-Bell procedures. Direct Tapping will not be allowed. All drill cutting tools must be the "shell type" with internal teeth or double slots which will retain the coupon. The shell cutters must be designed for C-909 pipe, thus having sufficient root depth to handle the heavier walled pipe.

3.14. **Small Service Lines.** Copper tubing shall be used for 3/4" through 2" service lines. Brass fittings for 3/4" and 1" service lines shall be of the compression type for the use with Type 'K' soft annealed copper tubing. Brass fittings for 1-1/2" and 2" lines shall be of the compression type for use with type 'K' soft annealed copper tubing, except as modified by "Splicing", Item No. 824.3.9.

Copper tubing shall be cut squarely by using an approved cutting tool and by avoiding excessive pressure on the cutting wheels which might bend or flatten the pipe walls.

Pipe adjacent to the fittings shall be straight for at least 10 inches. Bending of tubing shall be accomplished by using an appropriate sized bending tool. No kinks, dents, flats, or crimps will be permitted, and should such occur, the damaged section shall be cut out and replaced. When compression fittings are used, the copper tubing shall be cut squarely prior to insertion into the fitting. Final assembly shall be in accordance with the manufacturer's recommendations.

3.15. **Small Service Lines on New Mains.** Installation of new copper service lines shall consist of all excavation through miscellaneous material encountered; trench excavation protection; drilling and tapping the new main with an approved tapping machine; setting the curb stop or angle valve at the meter; laying the new copper service line at the specified depth between the main and the meter and its tie-in at the corporation and the curb stop or the angle valve; relocating the existing meter and installing a new meter box where required in accordance with "Meter and Meter Box Installation", Item No. 833, herein; backfilling the trench with approved selected material and disposal of surplus excavated material; capping the tap hole with asphalt treated base, including the outer limits of the main trench line with service line trench; cutting and replacing pavements, curbing and sidewalks of all types over the limits of the main line trench and the completed service line trench.

3.16. **Reconnecting Service Lines.** Both old and new water mains at existing service line connections as shown on the plans shall be exposed. The old main shall be exposed for the purpose of gaining access to the existing service corporation stop and the new main for the purpose of installing the new corporation stop. The new main shall be exposed for the purpose of being drilled and tapped with an approved tapping machine, a new corporation stop installed under pressure, and the trench extended laterally to expose a sufficient length of the existing service line to provide slack to bend it into position for tying to the new corporation stop. After suitable notification to the Customer, the Contractor shall "kill" the existing service by closing the corporation stop, removing the existing compression nut, inserting inside the existing compression nut an appropriately-sized copper disc and replacing the existing compression nut on the corporation stop if the main is non-ferrous, or plugging the existing service line at the main if the main is ferrous. The Contractor shall then immediately open the stop and restore water service to the Customer. Where it is not possible to obtain sufficient length in the existing service to tie directly to the new main, at the direction of the Engineer, the Contractor shall splice the necessary length of new tubing and tie it to the existing service by means of a compression coupling at a point as close as practicable to the new main.

Cutting and bending of the tubing, introduction of slack to compensate for soil movement, and completion of the installation shall be as specified in "Relaying Service Lines", Item No. 824.3.17.

Where old and new mains are on opposite sides of the street, service lines may be installed under the street pavement by boring rather than trenching.

3.17. **Relaying Service Lines.** The existing or new mains shown on plans shall be exposed opposite location stakes placed on site at the direction of the Engineer. The

existing or new main shall; be drilled and tapped with an approved tapping machine, a new corporation stop installed, and the trench extended laterally to the location specified for the meter box. The existing meter shall be reset and the meter box and base shall be installed at its staked location and perpendicular to the corporation stop in the water main. The meter box location shall not vary more than 24 inches in any direction from its staked location. The service line shall be installed with sufficient slack to compensate for soil movement. Where the location of the existing meter is not changed, the new service line shall be extended from the main to the existing meter, a new curb stop installed at the end of the service line, and connected to the inlet side of the meter. If disturbed, the existing meter box shall be reset to correct grade. Long service relays may be placed under the street pavement by boring or jacking rather than trenching. All Long service relay must be installed in a minimum 3" schedule 40 conduit.

3.18. **Single Service Line - Dual Meters.** The single service line - dual meter installation shall consist of a 1" copper service line reducing to two 1" copper service lines at a tee which shall be set in line with the front edge of meter boxes for 3/4" meters. A single service line with dual meters shall be installed in those new residential developments where new 3/4" meters are required and in main replacement work where it is necessary to change the location of existing 3/4" meters. Single service line - dual meter materials and installation requirements shall conform to requirements established herein.

3.19. **Small Service Lines on Existing Mains.** The work involved in the installation of new copper service lines on existing mains shall consist of jacking, boring, tunneling, and, where authorized, open trench operations; all excavation through whatever material encountered; trench excavation protection; using the existing corporation when approved by the Construction Observer/Inspector; tapping the existing main and installing the new corporation and setting the curb stop or angle valve at the meter; relocating the existing meter and installing a new meter box where required in accordance with "Meter and Meter Box Installation", Item No. 833, herein; abandoning the existing corporation stop, removing the existing compression nut, and replacing the compression nut on the corporation stop if the main is non-ferrous, or plugging the existing service line at the main if the main is ferrous; installing the new service line at the same grade as the existing service line or at the specified grade between the main and the existing meter and its tie-in at the corporation and the curb stop; disposal of surplus excavated material; capping the tap hole with asphalt treated base including the outer limits of the main line trench and the service line trench; cutting and replacing all surfaces of whatever type encountered over the completed service line trench; restoration of the site.

3.20. **Large Service Lines.** DI pipe and cast-iron fittings used for metered service lines and metered fire service lines larger than 2" shall be installed in accordance with the applicable provisions of "Water Main Installation", Item No. 812, except where otherwise approved by the Engineer.

3.21. **Large Service Lines on New Mains.** Work involved in the installation of a new metered service lines and metered fire service lines shall consist of all excavation through whatever material encountered; trench excavation protection, installing tees, pipe and fittings of various sizes including main line and service line valves, valve boxes, DI pipe, fittings, in accordance with Item 824 "Service Standards" and reaction

block required; backfilling with approved selected material; cutting and replacing pavements, curbing, and sidewalks of all types over the limits of the main line trench and the completed DI service line.

3.22. **Large Service Lines on Existing Mains.** The work involved in the installation of the new metered service lines and metered fire service lines shall consist of all excavation through whatever material encountered, trench excavation protection, cutting-in tees and installing tapping sleeves and valves, pipe and fittings of various sizes including main line and service valves; valves boxes, DI pipe, fittings and reaction block required; backfilling with approved selected material; cutting and replacing pavements, curbing, and sidewalks of all types over the limits of the main line trench and the completed DI service line.

4. MEASUREMENT

4.1. Reconnect Short Service will be measured by the unit of the various types and sizes of each service line reconnected.

4.2. Relay Short Service will be measured by the unit of the various types and sizes of each service line relayed.

4.3. Relay Long Service will be measured by the unit of the various types and sizes of each service line relayed.

4.4. Relocate Short Service will be measured by the unit of the various types and sizes of each service line relocated.

4.5. Relocate Long Service will be measured by the unit of the various types and sizes of each service line relocated.

4.6. New Short Service will be measured by the unit of the various types and sizes of each new service line installed.

4.7. New Long Service will be measured by the unit of the various types and sizes of each new service line installed.

5. PAYMENT

Payment for a Reconnect will be made at the unit price for each service line of the various sizes reconnected. Such payment shall also include excavation, trench excavation protection, hauling and disposition of surplus excavated materials, sand backfill, cutting pavement and surface structures of whatever type encountered and replacement with whatever type specified, and copper tubing and fittings of the various sizes used in the service line reconnection.

Payment for a Relay Short and Long Service will be made at the unit price for each service line of the various sizes relayed. Payment shall include reconnection of new service to the existing meter and the adjustment of the meter, meter box, and Customer valve. Such payment shall also include excavation, trench excavation protection, hauling and disposition of surplus excavated materials, sand backfill, cutting pavement and surface structures of whatever type encountered and

replacement with whatever type specified, and copper tubing and fittings of the various sizes used in the service line relay, to include conduit sleeves.

Payment for a Relocate Short and Long Service will be made at the unit price bid for each service line of the various sizes relocated. Such payment shall also include excavation, trench excavation protection, hauling and disposition of surplus excavated materials, sand backfill, meter box relocation, cutting pavement and surface structures of whatever type encountered and replacement with whatever type specified, and copper tubing and fittings of the various sizes used in the service line relocation, to include conduit sleeves.

Payment for a New Short and Long Service will be made at the unit price bid for each new service line of the various sizes installed. Such payment shall also include excavated materials, trench excavation protection, sand backfill, cutting pavement and surface structures of whatever type encountered and replacement with whatever type specified, meter box, meter template, copper tubing and fittings of the various sizes used in the new service line installation, to include conduit sleeves.

828

GATE VALVES

1. DESCRIPTION

This item shall consist of gate valves installed in accordance with these specifications and as directed by the Engineer.

2. MATERIALS

All gate valves shall be most current AWWA approved resilient seat valves, as manufactured by East Jordan Iron Works, Mueller, American Darling, or Clow Valve. All valves shall open left.

The materials for all gate valves shall conform to the specifications contained within the latest revision of SAWS Material Specification Item No. 21-02, “Resilient Seated Gate Valves and Tapping Valves.”

3. CONSTRUCTION

The gate valve installation shall include; valve, reaction blocking when required conforming to Standard Drawing, cast iron boot, valve box extension (Ductile Iron Riser Pipe), valve box, concrete collar where subjected to vehicular traffic, and valve box lid. Gate Valves constructed in terrace shall be constructed with No. 4 bars all around.

The valve box shall be placed in such a manner to prevent shock or stress being transmitted to the valve. All valves located 6 feet and deeper shall include valve key extensions inside the valve box. The Contractor has the option to install fully adjustable valve box and valve key extension systems, on all valves located between 6 feet and 13 feet. Adjustable valve box and valve key extension systems shall be centered over the valve’s operating nut with the box cover flush with the finished pavement surface or located at another level as directed by the Engineer. Valve boxes located in streets or other area subject to vehicular traffic shall be provided with concrete collars as shown in the Standard Drawings. Collars around such valve boxes shall be formed and finished off neatly and in a workmanlike manner.

Valve pits shall be located so that the valve operating nut is readily accessible for operation through the opening in the valve box. The valve box shall be set flush with the finished pavement surface or at other finish elevations as may be specified. Pits shall be constructed in such a manner to permit minor valve repairs and provide protection to the valve and pipe from impact where penetrating through pit walls.

4. MEASUREMENT

Gate valves and valve boxes will be measured by the unit of each such assembly of the various sizes of gate valves and valve boxes installed to the finished grade.

5. PAYMENT

Payment for gate valves, complete with valve box, will be made at the unit price bid for each assembly of the various sizes of gate valves and valve boxes installed. Payment shall also include; excavation, selected embedment material, anti-corrosion embedment when specified, hauling, and disposition of excavated surplus material, backfill, concrete collar at the valve box where subjected to vehicular traffic, riser pipe, cast iron boot, packing, tar paper, concrete grout, concrete reaction blocking, protective coating material for bolts, nuts, and ferrous surfaces, and polyethylene sleeve where required.

830

BUTTERFLY VALVES

1. DESCRIPTION

This item shall consist of butterfly valves installed in accordance with these specifications and as directed by the Engineer.

2. MATERIALS

All butterfly valves shall be most current AWWA approved rubber-seated valves, as manufactured by East Jordan Iron Works, Mueller, American Darling, or Clow Valve. All valves shall open left.

The materials for all butterfly valves shall conform to the specifications contained within the latest revision of SAWS Material Specification Item No. 21-05 “Hand – Operated Butterfly Valves,” and “Rubber-Seated Butterfly Valves 3 inches Through 72 inches.”

3. CONSTRUCTION

Butterfly valve installation shall include; butterfly valve, coated and wrapped steel pipe nipple with reaction stop ring, concrete reaction blocking, cast-iron boot, valve box extension (ductile iron riser pipe), valve box and lid, concrete collar where subjected to vehicular traffic, all couplings and all coupling adapters required to complete the connection. The entire valve except for the operating nut shall be coated with an approved City of Universal City sewer structural coating, and wrapped with Polywrap. Butterfly Valves constructed in terrace shall be constructed with No. 3 bars all around.

The valve box shall be placed in such a manner to prevent shock or stress being transmitted to the valve. All valves located 6 feet and deeper shall include valve key extensions inside the valve box. The Contractor has the option to install fully adjustable valve box and valve key extension systems on all valves located between 6 feet and 13 feet. Adjustable valve box and valve key extension systems shall be centered over the valve’s operating nut with the box cover flush with the finished pavement surface or located at another level as directed by the Engineer. Valve boxes located in streets or other areas subject to vehicular traffic shall be provided with concrete collars as shown in the Standard Drawings. Collars around such valve boxes shall be formed and finished off neatly and in a workmanlike manner.

4. MEASUREMENT

Butterfly valves and boxes will be measured by the unit of each such assembly of the various sizes of butterfly valves and boxes installed.

5. PAYMENT

Payment for butterfly valves, complete with box, will be made at the unit price bid for each assembly of the various types and sizes of valves and valve boxes installed. Payment shall also include; excavation, selected embedment material, anti-corrosion embedment when specified, hauling, and disposition of excavated surplus material, backfill, concrete collar at the valve box where subjected to vehicular traffic, ductile iron riser pipe, cast iron boot, packing, tar paper, concrete grout where required, concrete reaction blocking, protective coating material for bolts, nuts, and ferrous surfaces, and polyethylene sleeve where required. For butterfly valves only, in addition to the above, such payment shall also include mechanical and transition couplings, coated and wrapped steel pipe and nipples required to complete the connection.

833

METER AND METER BOX INSTALLATION

1. DESCRIPTION

This item shall consist of meter and meter box installation and adjustment installed in accordance with these specifications and as directed by the Engineer.

2. MATERIALS

The materials for meter and meter box installation and adjustment shall conform to the specifications contained within the latest revision of SAWS Material Specification "Meter Boxes", Item No. 10-30. All meter boxes shall have the UC logo and 2” hole knock out for radio read transmitter as shown in the UC details.

3. CONSTRUCTION

3.1. Physical movement of existing meters and meter boxes to new locations may be required where service lines are transferred to new mains in conjunction with main replacement work. Unless specified otherwise, the Contractor shall move existing meters and meter boxes and reconnect and adjust customer's yard piping as part of transferring service lines. A dielectric coupling PVC schedule 80 shall be installed within the meter box between the meter and the customer's yard piping.

Round and oval meter boxes with round covers shall be salvaged and returned to the Owner by the Contractor. The Contractor shall also replace the salvaged meter boxes with the new, appropriately styled oval plastic meter box with oval cover, or rectangular meter box. Unless otherwise specified, the old service line shall be abandoned after the existing meter has been reset in the existing or new meter box.

Meter and meter box configuration, shall have the meter set horizontal, approximately 6 inches below the top of meter box, so that the meter is above the bottom of the meter box and in line with the meter box lid opening. The top of the meter box shall be flush with the existing ground surface. All excess soil above the meter coupling, meter flange and meter nuts inside the meter box shall be removed so that the meter register is clearly visible. The Contractor shall exercise special precautions during excavation at the existing meter location in order to minimize the disturbance of the customer's yard piping. However, if the existing meter elevation is low, the Contractor shall raise the existing meter to conform to the correct configuration indicated herein. Adjustment of meter to proper grade is incidental to the construction and will not be paid for separately.

Where required, pressure reducing valves shall be installed by the customer in accordance with the latest International Plumbing Code and shall be placed beyond the outlet side of the meter, but not within the Owner's meter box. The pressure reducing valve shall be the property of the water user who will be responsible for its

installation, maintenance, and replacement as required. The required PRV range is 15 to 150 psi.

3.2. The meter box adjustment shall not exceed 10 linear feet from the existing box.

4. MEASUREMENT

Relocation of meters and boxes will be measured by the unit of the various types and sizes of meters and boxes relocated.

5. PAYMENT

Payment for "Existing Meter and Existing Meter Box Relocation (3/4 inch through 2 inch meter)" will be made at the unit price bid for each existing meter and existing meter box relocated. Such payment shall also include; excavation, hauling and disposition of surplus materials, sand backfill, removal and replacement of yard piping with copper tubing of the various types and sizes and in the quantities necessary to complete the connection and adjustment between the relocated existing meter and existing meter box, and the existing yard piping.

Payment for "Existing Meter and New Meter Box Relocation (3/4 inch through 2 inch meter)" will be made at the unit price bid for each existing meter relocated to a new meter box. Such payment shall also include excavation, hauling and disposition of surplus materials, sand backfill, removal and replacement of whatever type surface structure encountered, salvaging the existing meter box, reconnection and adjustment of yard piping with copper tubing of the various types and sizes and in the quantities necessary to complete the connection between the relocated existing meter and new meter box, and the existing yard piping.

Payment for number one meter box installation in sidewalks and driveways shall be paid in the amount of difference between the standard meter box and the number one box.

834

FIRE HYDRANTS

1. DESCRIPTION

This item shall consist of fire hydrant installations using joint restraints in accordance with these specifications and as directed by the Engineer with the construction plans.

2. MATERIALS

Fire hydrants shall be most current East Jordan Iron Works, No. 5CD250, or American Darling, No. B-84-B. Fire hydrants shall open left and be installed in accordance with City of Universal City standard specifications and details.

The materials for fire hydrant installations shall conform to the specifications contained within the latest revision of SAWS Material Specification Item No. 95-10 “Specifications for Pipe Joint Restraint Systems,” Item No. 113-02, “Ductile Iron Restrained Joint Fittings for Use on Ductile Iron and Polyvinyl Chloride Pipe,” and Item No. 21-30, “ Dry-Barrel Fire Hydrants.”

3. CONSTRUCTION

3.1. General. Hydrants shall be connected to mains as shown on plans or as directed by the Engineer. They shall be installed in accordance with Standard Drawings. Hydrants shall also be installed in a location where there is accessibility and in a safe location where there is a minimum possibility of damage from vehicles or injury to pedestrians. In situations where hydrants are placed directly behind curbs, hydrant barrels shall be set so that no portion of the hydrant will be less than 12 inches, nor more than 7 feet from the front of the curb. Where hydrants are set in the lawn spaces between the curb and the sidewalk or between the sidewalk and the property line, no portion of the hydrant or nozzle cap shall be within 6 inches of the sidewalk.

Setting final grade of fire hydrants to match proposed or existing field conditions is the responsibility of the Contractor.

Hydrants shall be set in accordance with the Standard Drawings and shall be set plumb and shall have their nozzles parallel with or at right angles to the curb with the pumper nozzle facing the curb. Drainage and concrete pads shall be provided at the base of hydrants as specified. No fire hydrant drainage system or pit shall be connected to a storm or sanitary sewer.

3.2. Restrained Joints. Restrained mechanical joints that require field welding or groove cuts into the pipe barrel for restraint will not be accepted. Restrained joints shall be furnished for pipe at all changes in direction as indicated on the plans, details, or as directed by the Engineer. Restrained mechanical joints shall be locked mechanical joints. All joints shall conform to the San Antonio Water System Material Specification

"Pipe Joint Restraint Systems", Item No. 95-10. The restraint system shall be capable of a test pressure twice the maximum sustained working pressure of 350 psi for ductile iron pipe and pvc.

3.3. **Replacing and Relocating Existing Fire Hydrants.** When existing fire hydrants are to be replaced or relocated, the work shall be accomplished by either of the following:

3.3.1. Cutting or installing a tee of the size and type as indicated on the plans or as directed by the Engineer.

3.3.2. Using a tapping sleeve and valve of the size and type as indicated on the plans to install a new fire hydrant to an existing or new water main. Size on size taps will not be permitted.

3.3.3. Relocating the existing fire hydrant by closing the existing fire hydrant branch valve, removing the existing fire hydrant, extending the fire hydrant branch and installing the existing fire hydrant as specified herein.

The Contractor shall salvage the existing fire hydrants and other materials as designated in the field by the Construction Inspector and shall deliver this material to the City of Universal City. Fire hydrant branches shall be abandoned by cutting and capping the fire hydrant cast-iron tee at the service main and the surface restored to its original or better condition.

After a fire hydrant has been set, hydrants shall be painted with a suitable primer and finished with oil-based red paint from the top of the hydrant to a point 18-20 inches below the center line of the pumper nozzle and applied to all exposed metal surfaces above the hydrant base flange. The payment for fire hydrant painting shall be included in the unit cost for installing the fire hydrant.

3.4. **Installation on Water Mains.** Ductile Iron (DI) pipe, cast-iron and ductile iron fittings, and valves used in the placement of fire hydrants and connections to the main will be considered part of the fire hydrant installation and not a part of the main construction. No separate payment will be made for this pipe. Hydrants shall be connected to the mains as shown on plans or as directed by the Engineer. Hydrants shall also be installed in a location where there is accessibility and in a safe location where there is a minimum possibility of damage from vehicles or injury to pedestrians.

4. MEASUREMENT

Standard Fire Hydrants with 6 inch Valve and Box will be measured by the unit of each fire hydrant, valve, and box installed. Relocate Fire Hydrants will be measured by the unit of each fire hydrant relocated. Standard Fire Hydrants with Tapping Sleeve, 6 inch valve, and box will be measured by the unit of each fire hydrant, including the various sizes of tapping sleeves, valves and boxes installed.

5. PAYMENT

Payment included in following bid pay items shall include; excavation, backfill, selected material, anti-corrosion embedment when specified, hauling and disposition of surplus excavated materials, backfill, branch line pipe, nipples, and fittings

exclusive of the tee from the main line pipe, polyethylene sleeve where required, asphalted material for ferrous surfaces, joint restraints, concrete pad, restoration of existing fire hydrant sites and removal and relocation of existing fire hydrant as specified.

5.1. PAY ITEM No. 834.1 – Fire Hydrant: Installation of a new fire hydrant as specified in the contract documents and as specified herein for a fire hydrant with 6 inch valve and box.

5.2. PAY ITEM No. 834.2 – Tapped Fire Hydrant: Payment for installation of a new fire hydrant by tapping an existing or new water main as specified in the contract documents and as specified herein for a fire hydrant with tapping sleeve, 6 inch valve and box.

5.3. PAY ITEM No. 834.1 – Relocate Fire Hydrant: Payment for relocate fire hydrant shall include relocating an existing fire hydrant to a new location as specified in the contract documents and as specified herein. Restoration of the existing fire hydrant site shall be inclusive to this line item.

841

HYDROSTATIC TESTING OPERATIONS

1. DESCRIPTION

This item shall consist of hydrostatic testing operations, of water mains in accordance with these specifications.

2. MATERIALS

The materials for hydrostatic testing operations installation and adjustment shall conform to the appropriate specifications contained within the latest revision of SAWS Material Specifications.

3. CONSTRUCTION

3.1. Flushing. Immediately upon completion of pipe laying, the Contractor shall flush all mains laid. This flushing shall consist of completely filling sections of main between valves and then displacing such initial volumes of water by introducing clear water from existing facilities into and through the main to the point of discharge from the main being flushed. The flow-through shall continue until it is determined all dust, debris, or foreign matter that may have entered during pipe laying operations has been flushed out. The new line shall then be left under system pressure for testing.

To avoid damage to pavement and inconvenience to the public, fire hoses shall be used to direct flushing water from the main into suitable drainage channels or sewers.

3.2. Operation of Valves. No valve in the Owner's water distribution system shall be operated by the Contractor without prior permission of the Owner. The Contractor shall notify the Owner when a valve is to be operated and shall only operate the valve in the presence of the Owner's representative.

3.3. Hydrostatic Test. Except in the high pressure sections of the water distribution system where test pressures will exceed 150 psi, all new mains shall be hydrostatically field tested at a maximum test pressure of 150 psi before acceptance by the Engineer/Owner. Where designated as "High Pressure Area," all new mains shall be hydrostatically field tested at a maximum test pressure of 200 psi before acceptance by the Engineer/Owner. It is the intent of these Specifications that all joints be watertight and that all joints which are found to leak by observation during any test shall be made watertight by the Contractor. In case repairs are required, the hydrostatic field test shall be repeated until the pipe installation conforms to the specified requirements and is acceptable to the Engineer/Owner. The Contractor shall notify the Engineer/Owner prior to beginning the test and the City of Universal City Construction Inspector may be present during the pressure test.

3.4. **Test Procedures.** After the new main has been laid and backfilled as specified, but prior to chlorination and replacement of pavement, it shall be filled with water for a minimum of 24 hours and then subjected to a hydrostatic pressure test.

The specified test pressure shall be supplied by means of a pump connected to the main in a satisfactory manner. The pump, pipe connection, and all necessary apparatus including gauges and meters shall be furnished by the Contractor. Unless otherwise specified, the Owner will furnish water for filling lines and making tests through existing mains. Before applying the specified test pressure, all air shall be expelled from the main. To accomplish this, taps shall be made, if necessary, at the points of highest elevation and afterwards tightly plugged at no cost to the Owner. At intervals during the test, the entire route of the new main shall be inspected to locate any leaks or breaks. If any are found, they shall be stopped or repaired, and the test shall be repeated until satisfactory results are obtained. The hydrostatic test shall be made so that the maximum pressure at the lowest point does not exceed the specified test pressure.

The duration of each pressure test shall be a minimum of 4 hours for new mains in excess of 1000 linear feet and a minimum of 1 hour for new mains less than 1000 linear feet after the main has been brought up to test pressure. The test pressure shall be measured by means of a tested and properly calibrated pressure gauge acceptable to the Engineer/Owner. All pressure tests shall be continued until the Owner is satisfied that the new main meets the requirements of these Specifications.

Should any test of pipe in place disclose leakage greater than that listed in Table 841-1 or 841-2, "Hydrostatic Test Leakage Allowances," as applicable, the Contractor shall at his own expense locate and repair the defective joints until the leakage is within the specified allowance.

Leakage is defined as the quantity of water supplied into the newly laid main, or any valved section of it, necessary to maintain the specified leakage test pressure after the main has been filled with water and the air expelled.

Exhibit S-841 is a schematic showing the arrangement of the test apparatus as well as the detailed procedure for conducting the hydrostatic field test.

4. MEASUREMENT

Hydrostatic Pressure Test will be measured by the unit of each successful test conducted.

5. PAYMENT

Payment for "Hydrostatic Pressure Test" will be made at the unit price bid or each successful test. Such payment shall also include all pipe, valves, fittings, pumping equipment, pressure gauge, and other required apparatus incidental to the conduct of the test.

TABLE 841-1

HYDROSTATIC TEST LEAKAGE ALLOWANCES (MAXIMUM) @ 150 PSI

Nominal Pipe Diameter & Type	Allowable Leakage in Gallons Per Hour (GPH)*													
	100 L.F.	200 L.F.	300 L.F.	400 L.F.	500 L.F.	600 L.F.	700 L.F.	800 L.F.	900 L.F.	1000 L.F.	2000 L.F.	3000 L.F.	4000 L.F.	5000 L.F.
6" DI**	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88	0.99	1.10	2.20	3.30	4.40	5.50
8" DI**	0.15	0.29	0.44	0.59	0.71	0.88	1.03	1.18	1.32	1.47	2.94	4.41	5.88	7.35
12" DI**	0.22	0.44	0.66	.088	1.10	1.32	1.54	1.76	1.98	2.20	4.40	6.60	8.80	11.00
16" DI**	0.29	0.59	0.88	1.18	1.47	1.76	2.06	2.35	2.65	2.94	5.88	8.82	11.76	14.70
20" DI**	0.39	0.74	1.10	1.47	1.84	2.21	2.55	2.94	3.31	3.68	7.63	11.04	14.72	18.40
20" CSC	0.08	0.16	0.24	0.32	0.40	0.47	0.55	0.63	0.71	0.79	1.58	2.37	3.16	3.95
24" DI**	0.44	0.88	1.32	1.76	2.21	2.65	3.09	3.53	9.97	4.41	8.82	13.23	17.64	22.05
24" CSC	0.1	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.95	1.90	2.85	3.80	4.75
30" DI**	0.55	1.1	1.66	2.21	2.76	3.31	3.86	4.42	4.97	5.52	11.04	16.56	22.08	27.60
30" CSC	0.12	0.24	0.35	0.47	0.59	0.71	0.83	0.94	1.06	1.18	2.36	3.54	4.72	5.90
36" DI**	0.66	1.32	1.99	2.65	3.31	3.97	4.63	5.3	5.96	6.62	13.24	19.86	26.48	33.10
36" CSC	0.14		0.28	0.57	0.71	0.85	0..99	1.14	1.28	1.42	2.84	4.26	5.68	7.10
42" DI**	0.77	1.54	2.32	3.09	3.86	4.63	5.4	6.18	6.95	7.72	15.44	22.16	30.88	38.60
42" CSC	0.17	0.33	0.5	0.66	0.83	1	1.16	1.33	1.49	1.66	3.32	4.98	6.64	8.30
48" DI**	0.88	1.77	2.65	3.53	4.42	5.3	6.18	7.06	7.95	8.83	17.66	26.16	35.32	44.15
48" CSC	0.19	0.38	0.57	0.76	0.95	1.13	1.32	1.51	1.7	1.89	3.78	4.98	6.64	8.30
54" CSC	0.21	0.42	0.63	0.84	1.05	1.26	1.47	1.68	1.89					
60" CSC	0.24	0.48	0.72	0.96	1.2	1.44	1.68	1.92	2.16					

* PVC pipe shall be tested to DI pressures. GPH for CSC Pipe are manufacturer's maximum.

** DI pipe includes mechanical and push-on joints.

TABLE 841-2										
HYDROSTATIC TEST LEAKAGE ALLOWANCES (MAXIMUM) @ 200 PSI										
Nominal Pipe Diameter & Type	**Allowable Leakage in Gallons Per Hour (GPH)***									
	100 L.F.	**200 L.F.**	**300 L.F.**	**400 L.F.**	**500 L.F.**	**600 L.F.**	**700 L.F.**	**800 L.F.**	**900 L.F.**	**1000 L.F.**
6" DI**	0.13	0.25	0.38	0.51	0.64	0.6	0.89	1.02	1.14	1.27
8" DI**	0.17	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.7
12" DI**	0.26	0.51	0.77	1.02	1.28	1.53	1.79	2.04	2.3	2.55
16" DI**	0.34	0.68	1.02	1.36	1.7	2.04	2.38	2.72	3.06	3.4
20" DI**	0.43	0.85	1.28	1.7	2.13	2.55	2.98	3.4	3.83	4.25
20" CSC	0.08	0.16	0.24	0.32	0.4	0.47	0.55	0.63	0.71	0.79
24" DI**	0.51	1.02	1.53	2.04	2.55	3.06	3.57	4.08	3.59	5.1
24" CSC	0.1	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.95
30" DI**	0.64	1.27	1.91	2.55	3.19	3.82	4.46	5.1	5.73	6.37
30" CSC	0.12	0.24	0.35	0.47	0.59	0.71	0.83	0.94	1.06	1.18
36" DI**	0.76	1.53	2.29	3.06	3.82	4.58	5.35	6.11	6.88	7.64
36" CSC	0.14	0.28	0.43	0.57	0.71	0.85	0.99	1.14	1.28	1.42
42" DI**	0.89	1.78	2.68	3.57	4.46	5.35	6.24	7.14	8.03	8.92
42" CSC	0.17	0.33	0.5	0.66	0.83	1	1.16	1.33	1.49	1.66
48" DI**	1.02	2.04	3.06	4.08	5.1	6.11	7.13	8.15	9.17	10.19
48" CSC	0.19	0.38	0.7	0.76	0.95	1.13	1.32	1.51	1.7	1.89
54" CSC	0.21	0.42	0.63	0.84	1.05	1.26	1.47	1.68	1.89	2.1
60" CSC	0.23	0.46	0.69	0.92	1.15	1.38	1.61	1.84	2.07	2.3

*PVC pipe shall be tested to DI pressures. GPH for CSC pipe are manufacturer's maximum.

**DI pipe includes mechanical and push-on joints.

848

SANITARY SEWERS

1. DESCRIPTION

This item shall govern the furnishing, installation and jointing of sanitary sewer pipe of the size and type specified by the project's plans and specifications.

All plans, materials and specifications shall be in accordance with the Texas Administrative Code (TAC) rules to include: 30 TAC § 213, and Design Criteria for Sewerage Systems 30 TAC § 217, or any revisions thereto as applicable.

2. MATERIALS

Materials for sanitary sewer pipe and fittings shall be flexible. All pipe not listed shall be subject to approval by The City of Universal City.

2.1. **Rigid Pipe.** Ductile iron and concrete steel cylinder pipe shall for the purpose of this specification be known as rigid pipe.

2.2. **Flexible Pipe.** Pipe consisting of materials other than those listed above.

2.2.1. Any flexible conduit having a deflection of the inside diameter greater than 5% after installation will not be accepted.

Unless directed otherwise by the engineer, a “Go, No-Go” Deflection Testing Mandrel built in accordance with the detail drawing, as shown in DET-849-01, and 30 TAC § 217, shall be furnished at the Contractor’s expense and shall be used in testing pipe deflection for acceptance. Refer to Item No. 849, “Air and Deflection Testing (Sanitary Sewer),” for more information about mandrel deflection testing.

2.2.2. **Working room.** The working room for flexible pipe shall be a minimum of 6 inches.

2.2.3. **Pipe Stiffness.** All mains are to be SDR 26 PVC (ASTM D-3034) with a minimum stiffness of 115 PSI.

2.2.4. At waterline crossings and where water and sewer mains are parallel and separation distance cannot be achieved as per 30 TAC § 217.13, use pressure rated pipe SDR 26 PVC (ASTM D-2241) with a minimum pressure rating of 150 PSI. Rating, size, and pressure class shall be as shown on the plans. Pipe shall have an integral bell and gasket seal with the locked-in type gasket reinforced with a steel band or other rigid material conforming to ASTM F-477. The joint shall comply with the requirements of ASTM D-3139.

Pressure pipe/Force mains are required to 3/4" sewer gravel material used as bedding per Item 804.4.2.1.3. Pipes also shall be hydrostatically tested at minimum of 100 psi after their construction to ensure proper construction.

2.2.5. All sanitary sewer piping shall pass the low pressure test, as described in 30 TAC § 217.57.

2.3. **Concrete Pipe.** Concrete pipe shall not be used.

2.4. **Asbestos-Cement (AC) Pipe.** AC pipe shall not be used. Refer to SAWS Item No. 3000, "Handling Asbestos Cement Pipe."

2.5. **Fiberglass Reinforced Sewer Pipe, Non-Pressure Type.** Fiberglass reinforced sewer pipe, non-pressure type, shall be a factory-formed conduit of polyester resin, continuous roving glass fibers and silica sand built up in laminates and shall conform to the requirements of ASTM D-3262 including the appendix and subsequent specifications, and in accordance with to SAWS material specifications. Depths shall comply with requirement of ASTM D3681.

2.5.1. **Coupling Joints.** Joints for pipe and fittings shall be confined compression rubber gasket bell and spigot type joints conforming to the material and performance requirements of ASTM D-4161. Depths shall comply with requirement of ASTM D3681.

2.5.2. **Fittings.** Flanges, elbows, reducers, tees, wyes, laterals, and other fittings shall be capable of withstanding all operating conditions when installed. They may be contact molded or manufactured from mitered sections of pipe joined by glass-fiber reinforced overlays. For pipes 15" or larger in diameter, lateral openings 6 inch or greater in size shall be made using PVC sewer saddles conforming to ASTM D-2661 or insert a Tee connections conforming to ASTM D-3034 or approved equal. Minimum pipe stiffness shall not be less than 115 psi for direct bury applications.

2.6. **PSM Polyvinylchloride (PVC) Sewer Pipe.** Pipe shall be made from class 12454-B materials as prescribed in ASTM-D 1784. For pipes 4" to 15" in diameter, PSM pipe, fittings and joints shall conform to ASTM D-3034 and D-3212, with the exception that solvent cement joints shall not be used. All pipes that are 18" to 27" in diameter shall meet the requirements of ASTM F-679.

2.7. **Pressure Pipe/Force Mains.** Pipe shall be made from Class 1254-A or 1254-B, as defined in ASTM D-1784. All pipe, fittings, and joints shall meet or exceed the requirements of ASTM Designation 2241, with the exception that solvent cement joints shall not be used. The pressure rating, size, and pressure class shall be as shown on the plans. Pipe shall have an integral bell and gasket seal with the locked-in type gasket reinforced with a steel band or other rigid material conforming to ASTM F-477. The joint shall comply with the requirements of ASTM D-3139.

Pressure pipe/Force mains are required to have modified grade 5 material used as bedding. Pipes also shall be hydrostatically tested at minimum of 100 psi after their construction to ensure proper construction.

2.8. Mechanical or compression joints, concrete jointing collars, or non-reinforced rubber

adaptors shall be used only as approved by the Owner.

2.9. **Ductile Iron Pipe and Fittings.** Ductile iron pipe and fittings shall not be used.

2.10. **Concrete Steel Cylinder Pipe.** Concrete Steel Cylinder Pipe shall not be used.

2.11. All sanitary sewer pipe and fittings produced within the jurisdiction of UC shall be tested by a UC-approved laboratory method at the source of supply. All shipments of pipe not tested shall be accompanied by a certificate of compliance to these specifications prepared by an independent laboratory and signed by a Texas registered professional engineer.

3. CONSTRUCTION

All sanitary sewer mains shall be constructed in accordance with the specifications herein outlined and in conformity with the required lines, grades, and details shown on the plans and as directed by the Engineer. Successful passage of the air test, as described under TCEQ Criteria, shall be required for the acceptance of the mains.

3.1. **Water Main Crossings.** Where gravity or force main sewers are constructed in the vicinity of water mains, the requirements of the 30 TAC § 217.5 shall be met.

3.2. For excavation, trenching and backfill requirements see Item No. 804.

3.3. **Pipe Installation.** The Owner will inspect all pipe before it is placed in the trench and will reject any sections found to be damaged or defective to a degree that would affect the friction of the pipe. Rejected pipe shall be immediately removed from the site of the work. The Contractor shall be required to commence construction and laying of pipe at the downstream end of the sanitary sewer outfall line and proceed non-stop in a forward upstream direction. No pipe shall be laid within 10 feet of any point where excavation is in progress. Pipe laying shall proceed upgrade with the tongue or spigot pointing in the direction of flow. Pipe shall be lowered into the trench without disturbing the prepared foundation or the trench sides. The drilling of lifting holes in the field will not be permitted. Pipe shall be installed by means of a concentric pressure being applied to the pipe with a mechanical pipe puller. Pulling or pushing a joint of pipe in place by using a crane, bulldozer, or backhoe will not be permitted. Pipe shall be pulled home in a straight line with all parts of the pipe on line and grade at all times. No side movement or up and down movement of the pipe will be permitted during or after the pulling operation.

Should coupled joints of pipe be out of line or off grade, they shall be removed one joint at a time and brought to the proper line and grade. The lifting or moving of several joints of coupled pipe at one time to close a partially open joint or to fine grade under laid joints of pipe will not be permitted.

Also, Contractor shall insure that all existing or proposed manholes or structures shall remain visible and accessible at all times. No manhole or structure covers shall be covered by pavement, equipment, or other obstructions other than a removable, temporary lid provided for safety. Inspector shall cause all work to be suspended until this requirement is met without any valid claims of costs or schedule delays.

3.4. **Pipe Separation.** Sewer pipe separation distances shall be maintained in accordance with TCEQ rules 30 § 217.53.

3.4.1. A sewer collection system that parallels a public water supply pipe must have a vertical separation of at least two feet between outside diameters of the pipes.

3.4.2. A sewer collection system that parallels a public water supply pipe must have a horizontal separation of at least four feet between outside diameters of the pipes.

3.4.3. A sewer collection system that crosses a public water supply pipe must have a minimum separation distance of six inches between outside diameters of the pipes. All sewer collection piping must be below a public water supply pipe.

3.4.4. A sewer collection system that crosses over a public water supply pipe shall be encased in a joint of at least 150 psi pressure class pipe.

- Pipe shall be centered on the crossing;
- Pipe shall be sealed at both ends with cement grout or manufactured seal;
- Pipe shall be at least 18 feet long;
- Pipe casing shall be at least two nominal sizes larger pipe than the wastewater collection pipe. Steel or PVC pipe may be used for casing of at least 150 psi pressure class.
- Pipe shall be supported by spacers between the collection system pipe and the encasing pipe at a maximum of five-foot intervals.

3.5. **Laser Beams.** The use of laser beams for vertical control shall be required provided the Contractor makes available to the Inspector, when requested, a level and rod of sufficient sensitivity to accurately determine differences in elevation between points 300 feet apart with one instrument set-up. Contractor shall provide, as requested, a written summary to the Inspector of all elevations at all installed, repaired, or replaced sewer mains, manholes or structures.

No pipe shall be installed in tunnels except as provided on the plans, or with the permission of the Engineer. If the Contractor finds it necessary to install pipe in tunnels not provided on the plans, he shall submit to the Engineer, prior to commencement of work, a detailed outline of procedures, methods, and use of materials depending on existing soil conditions.

No horizontal or vertical curves shall be permitted in conformance with appropriate regulatory agency requirements.

Before leaving the work unattended, the upper ends of all pipelines shall be securely closed with a tight fitting plug or closure. The interior of laid pipe shall be kept free from dirt, silt, gravel, or foreign material at all times. All pipes in place must be approved before backfilling.

When replacing an existing system in place, Contractor shall maintain screens to prevent the entrance of construction debris into the sewer system.

4. MEASUREMENT

All sewer pipes will be measured from center of manhole to center of manhole or end of main. Measurement will be continuous through any fittings in the main, even though the fittings are pay items of the contract.

5. PAYMENT

5.1. Sewer pipe will be paid for at the contract bid price per linear foot complete in place for the types, size and depth constructed. Said price shall be full compensation for furnishing all materials, including pipe, trenching, pumping, concrete, plugs, laying and jointing, backfilling, select bedding and initial backfill material, tamping, water, labor, tools, equipment, and other incidentals necessary to complete the work.

5.2. When the minimum separation distances for any water and sewer piping facilities cannot be maintained per 30 TAC § 217.53, Contractor shall install SDR-26 PVC pipe pressure rated 150 psi. Payment for this higher pressure rated pipe shall be made the contract bid price per linear foot complete in place for the type and size constructed.

5.3. Sewer pipe fittings, as part of the main line such as wyes and tees, are inclusive in the cost of Item No.854, “Sanitary Sewer Laterals.”

5.4. Pay cuts will be measured from the top of ground prior to the Contractor's operation and along the centerline of the pipe to the invert of the pipe.

849

AIR & DEFLECTION TESTING (SANITARY SEWER)

1. DESCRIPTION

This item shall consist of air and deflection test in accordance with this specifications.

2. MATERIALS

The materials for air and deflection test shall conform to the appropriate specifications contained within the latest revision of SAWS Material Specifications.

3. TESTING OF INSTALLED PIPE:

An infiltration, ex-filtration or low-pressure air test shall be specified. Copies of all test results shall be made available to the Inspector upon request. Tests shall conform to the following requirements:

3.1. **Low Pressure Air Test.** The procedure for the low pressure air test shall conform to the procedures described in ASTM C-828, ASTM C-924, ASTM F-1417 or other appropriate procedures, except for testing times. The test times shall be as outlined in this section. For sections of pipe less than 36-inch average inside diameter, the following procedure shall apply unless the pipe is to be joint tested. The pipe shall be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure is stabilized, the minimum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be computed from the following equation:

$$T = \frac{0.085 \times D \times K}{Q}$$

T = Time for pressure to drop 1.0 pound per square inch gauge in seconds

K = 0.000419xDxL, but not less than 1.0

D = Average inside pipe diameter in inches

L = Length of line of same pipe size being tested, in feet

Q = Rate of loss, 0.0015 cubic feet per minute per square foot internal surface shall be used since a K value of less than 1.0 shall not be used.

There are minimum testing times for each pipe diameter as follows:

Pipe Diameter	Minimum Time	Length for Minimum Time	Time for Longer Length
Inches	Seconds/Ft	Feet	Seconds/Ft
6	340	398	0.855
8	454	298	1.520
10	567	239	2.374
12	680	199	3.419
15	850	159	5.342
18	1,020	133	7.693
21	1,190	114	10.471
24	1,360	100	13.676
27	1,530	88	17.309
30	1,700	80	21.369
33	1,870	72	25.856

* Note: Test time starts after the required 60 seconds of stabilization time.

The test may be stopped if no pressure loss has occurred during the first 25% of the calculated testing time. If any pressure loss or leakage has occurred during the first 25% of the testing period, then the test shall continue for the entire test duration as outlined above or until failure. Lines with a 27 inch average inside diameter and larger may be air tested at each joint. Pipe greater than 36“diameter must be tested for leakage at each joint. If the joint test is used, a visual inspection of the joint shall be performed immediately after testing. The pipe is to be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure has stabilized, the minimum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be 10 seconds.

Mains that are greater than 33 inch diameter must be tested for leakage at each joint, or as approved.

3.2. **Infiltration/Exfiltration Test.** The total exfiltration, as determined by a hydrostatic head test, must not exceed 50 gallons per inch of diameter per mile of main per 24 hours, at a minimum test head of 2 feet above the crown of the main at an upstream manhole. The Contractor shall use an infiltration test in lieu of an exfiltration test when mains are installed below the ground water level. In such cases, the total exfiltration, as determined by a hydrostatic test, must not exceed 50 gallons per inch diameter per mile of main per 24 hours at a minimum test head of 2 feet above the crown of the main at an upstream manhole, or at least 2 feet above the existing ground water level, whichever is greater. For construction work occurring within the 25-year floodplain, the infiltration or exfiltration must not exceed 10 gallons per inch diameter per mile of main per 24 hours at the same minimum test head as stated in the previous sentence. If the quantity of infiltration or exfiltration exceeds the

maximum quantity specified, the Contractor shall propose to the Engineer, and receive approval therefrom, all necessary remedial action, solely at the Contractor's own cost, in order to reduce the infiltration or exfiltration to an amount within the limits specified herein.

3.3. **Deflection Testing.** Deflection test shall be performed on all flexible pipes.

For pipelines with inside diameters less than 27", a rigid mandrel shall be used to measure deflection.

For pipelines with an inside diameter 27" and greater, a method approved by the Engineer or Inspector shall be used to test for vertical deflections.

The deflection test must be accurate to within +/- 0.2% deflection. The test shall be conducted after the final backfill has been in place at least 30 days. No pipe shall exceed a deflection of five percent. If a pipe should fail to pass the deflection test, the problem shall be corrected and a second test shall be conducted after the final backfill has been in place an additional 30 days. The tests shall be performed without mechanical pulling devices. The design engineer should recognize that this is a maximum deflection criterion for all pipes and a deflection test less than 5 % may be more appropriate for specific types and sizes of pipe. Upon completion of construction, the design engineer or other Texas Registered Professional Engineer appointed by the owner shall certify, to the Construction Manager, that the entire installation has passed the deflection test. This certification may be made in conjunction with the notice of completion required in 317.1(e) (1) of this title (relating to General Provisions). This certification shall be provided for the Commission to consider the requirements of the approval to have been met.

3.3.1. **Mandrel Sizing.** The rigid mandrel shall have an outside diameter (O.D.) not less than 95% of the inside diameter (I.D.) of the pipe. The inside diameter of the pipe, for the purpose of determining the outside diameter of the mandrel, shall be the average outside diameter minus two minimum wall thickness for O.D. controlled pipe and the average inside diameter for I.D. controlled pipe. The barrel section of the mandrel shall have a length of at least 75% of the inside diameter of the pipe. All dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.

3.3.2. **Mandrel Design.** The rigid mandrel shall be constructed of a metal or a rigid plastic material that can withstand 200 psi without being deformed. The mandrel shall have a minimum of nine "runners" or "legs," maintain an odd number of "runners" or "legs" if more than nine are used. A proving ring shall be provided and used for each size mandrel in use. See UC detail DET-849-01, "Mandrel Testing."

3.3.3. **Method Options.** Adjustable or flexible mandrels are prohibited. A television inspection is not a substitute for the deflection test. A deflect-o-meter may be approved for use on a case by case basis. Mandrels with removable legs or runners may be accepted on a case by case basis.

4. MEASUREMENT

Air/Infiltration/Exfiltration and Deflection Testing will not be measured for payment.

5. PAYMENT

No direct payment shall be made for Air and Deflection Testing, and all costs in connection therewith shall be included in the applicable contract price for the item to which the work pertains.

852

SANITARY SEWER MANHOLES

1. DESCRIPTION

This item shall govern the construction of standard sanitary sewer manholes complete in place and the materials therein, including manhole rings and covers. All material and construction work shall be in accordance with current Texas Commission on Environmental Quality (TCEQ) rules to include: Design Criteria for Sewage Systems 30 TAC § 217. All constructed manholes shall be watertight and coated with a City of Universal City approved sewer structural coating. Every manhole cover shall be watertight. Sewer manhole wing and cover castings shall meet the current requirements of AASHTO Designation M306.

Unless otherwise shown on the plans and details or approved by the Engineer, standard sanitary sewer manholes shall be constructed on influent or effluent pipes less than 24" in diameter with precast reinforced concrete manhole sections or be monolithically poured concrete manholes.

A standard sanitary sewer manhole shall be a single maintenance entrance cylindrical structure having a uniform internal diameter of 4, 5 or 6 feet structure to the bottom of the diameter adjustment section or cone. The base of the structure shall include the load bearing portion beneath and exterior of the structure, invert channels and the fill or bench portions adjacent to the lower sewer pipes within the structure. The maximum vertical height of the diameter adjustment section or cone shall be 36 inches.

Adjustment or throat rings may be used for elevation adjustment of the manhole ring and cover. Manhole ring concrete encasement as shown on the plan details shall be provided to attach the ring and cover to the diameter adjustment section or cone. Manholes which differ from the above description shall be governed by "Sanitary Sewer Structures", Item No. 850 from SAWS specifications.

An external drop manhole may be utilized if and where sewer lines enter a manhole higher than 24 inches above the manhole invert and approved by City of Universal City. A drop manhole pipe shall be provided for a sewer entering a manhole more than 30 inches above invert.

2. MATERIALS

2.1. Precast Reinforced Concrete Manhole Sections. Precast reinforced concrete manhole sections shall conform to the requirements of ASTM Designation C-478.

2.2. Monolithically Poured Concrete Manholes. A minimum of two and a maximum of four throat rings shall be used at each adjusted manhole for adjustability. Note: All new manholes installed shall not exceed four throat rings. All concrete for cast in

place manholes shall be Class “C” 3,600 psi minimum and conform to the provisions of "Concrete (Natural Aggregates)”, Item No. 300, of the City of Universal City governing specifications. All reinforcing steel shall conform to the provisions of "Reinforcing Steel", Item No. 301, of the City of Universal City Specifications.

2.3. **Mortar.** Mortar shall be composed of 1 part Portland Cement, 2 parts sand and sufficient water to produce a workable mixture. When used to plaster manholes, it may be composed of 1 part cement to 3 parts sand. Lime up to 10% may be used.

2.4. **Manhole Rings and Covers.** Universal City logo manhole rings and covers shall be cast or ductile iron and manufactured to the dimensions shown on the plans with a 30 inch minimum opening. Covers shall contain no holes or openings. Lifting bars with slots cast into the covers shall be provided for lifting purposes. Heavy duty, H-20 loading, ring and cover required in traffic areas. The nominal cover diameter shall be 32 inches, with a 30 inch clear opening, as required by TCEQ. Rings shall have a minimum of 4 - 1 inch holes/slots for anchoring purposes. Rings shall a minimum of 4 1/2 inches in height, or as otherwise accepted by the Engineer. Slots for embedment/ lightening are not allowed in ring flanges.

Watertight manhole rings and covers shall be cast iron and shall contain no holes or openings except as required for bolts. Lifting with slots adequate for pick insertion and cast into the covers shall be provided for lifting purposes. Covers shall seat on a minimum 5/16 inch diameter rubber ring conforming to the material requirements of ASTM Designation C- 443. The rubber gasket shall rest in a groove cast in the ring. A minimum of 4, 5/8 inch diameter, stainless steel, hex head bolts shall be provided for each cover. The 4 bolt holes in the covers shall be evenly spaced and provided with a minimum 1-1/2 inch diameter counter sink for the bolt heads. On the fastened and bolted position, the bolt heads shall not extend beyond the surface or the cover. Gaskets of a size and material as approved by the Engineer shall be provided for the bolts to insure air and water tightness. Alignment marks shall be provided on watertight rings and covers for proper bolt alignment.

The finished frames and covers shall have the bearing surfaces machined ground and sets of rings and covers shall be marked in such a way that they can be matched for assembly in the field. All covers shall have the words "Sanitary Sewer" and the Universal City logo cast thereon. Ring and cover shall have the approved foundry’s name, part number, country of origin preceded by “MADE IN” (example: MADE IN USA) in compliance with the country of origin law of 1984, and production date (example: mm/dd/yy) for tracking purposes. Each casting must be marked with DI and ASTM A536 or A536 80-55-06 to verify the materials used. Castings without proper markings shall be rejected.

2.5. **Throat Rings.** Adjustment throat rings shall be made of either HDPE or reinforced concrete rings having a maximum thickness of 2 inches. The internal diameter shall not be less than 30 inches, and the width shall be a minimum of 5 inches. Concrete shall conform to the provisions of "Concrete (Natural Aggregate)", Item No. 300, of the City Universal City Specifications. If concrete throat rings are to be installed they must be used in conjunction with a UV stabilized polyethylene liner and I/I barrier. I/I barrier must meet the following ASTM standards: ASTM D-790/1505 Density of Polyethylene Materials, ASTM D1238 Melt Flow index, ASTM 638 Tensile Strength @ Yield (50mm/mm), ASTM 790 Flexural Modulus, ASTM 648 Heat Deflection

temperature @ IGEPAL, ASTM 1693 EsCR, 100% IGEPAL/10% IGEPAL. A minimum of two and a maximum of four throat rings may be used at each manhole installed.

2.6. **Coating.** All new manholes shall be watertight and the interior walls coated with a City of Universal City approved sewer structural coating. Prior to coating, all manholes shall be vacuum tested, and approved.

For new, existing, and rehabilitated manholes, apply a combination of both products with the cementitious coating first, followed by the epoxy coating. Other approved materials are as follows.

2.6.1. **Cementitious coating.** With required one inch thick application.

- Permaform CR-5000
- Strong – Seal MS-2C
- Standard Cement Material Inc. Reliner
- Quadex Aluminaliner
- ConShield Biotech Armor

2.6.2. **Epoxy Coating.** With specified thickness application.

- Raven 405 Series High Build Epoxy Liner: Required thickness 125 mils, light blue finish
- Carboline “Plasite 4500” System: Required thickness 125 mils, light blue finish

2.7. **Sealing Manhole Sections.** All manhole joint section risers, cone sections, and grade ring shall be wrapped with Infi-Shield seals manufactured by Sealing Systems. Rubber material must meet ASTM C923/C877 and mastic material must meet ASTM C990.

2.7.1. **Gator Wrap.** For manhole joint section risers and cone sections, Gator Wrap seal shall be EPDM rubber coated with butyl adhesive that is non-hardening to total a minimum thickness of 60 mils, each layer having a minimum thickness of 30 mils. Gator wrap shall be 12” wide minimum as shown on the UC sewer manhole details.

2.7.2. **Uni-Band.** For grade rings, Uni-Band seal shall be EPDM rubber with a minimum thickness of 65 mils. For Uni-Band use non-hardening butyl mastic rubber sealant with minimum 2” wide and 1/8” thickness dimensions. Aerosol primer shall be used to enhance the bond strength of the seal to the structure.

3. CONSTRUCTION

Manholes shall be constructed of materials and workmanship as prescribed by these specifications, at such places shown on the plans or designated by the Engineer, and in conformity with the typical details and sketches shown. Venting, when required, and manhole spacing shall be in accordance with 30 TAC § 217.

3.1. Footings or bases of manholes shall be a minimum of 6 inches in depth below the bottom of the pipe.

3.2. All invert channels shall be constructed and shaped accurately so as to be smooth, uniform and cause minimum resistance to flow. The bench shall be finished smooth with a slope of 1/2 inch per foot from the manhole walls to the edges of the invert. The top half of all sewer pipes within the invert channel or bench zone shall be removed flush to the inside manhole walls.

3.3. Joints on sewer pipes shall not be cast or constructed within the wall sections of manholes.

3.4. Concrete cradles shall not be required for new pre-cast manholes. Concrete cradles shall be provided for all influent and effluent pipes on new monolithic manhole and sewer pipe systems. Concrete cradles shall extend beyond the outside walls of the manhole a minimum of 36 inches. On new monolithic sewer manhole and pipe systems and new pipe systems connecting to existing manholes, pipes entering a manhole above the lowest sewer shall project 2 inches from the inside wall. Such pipes shall be installed with a joint a minimum of 6 inches and a maximum of 18 inches from the outside manhole wall. A concrete cradle shall be provided for the pipe extending from the manhole wall a minimum distance of 36 inches.

3.5. Voids between exterior pipe walls and manhole walls at all pipe connections in manholes shall be filled with a non-shrink grout, concrete or mortar, as approved by the Engineer or as shown on the plan details and inspected prior to backfilling.

3.6. Prior to backfilling, compacting, or concrete encasing, all manhole joint section risers, cone sections, and grade ring shall be wrapped with Gator Wrap and Uni-Band accordingly. Install as shown on the manhole details and in accordance with the manufacturer's recommendation.

3.7. The Contractor shall be required to backfill all new manholes with an approved flowable backfill in accordance with the requirements of the right-of-way owner having jurisdiction up to 1 foot above the cone section.

3.8. Where connections to existing manholes are required, the adjacent pipe bedding shall be prepared to proper grade, the existing manhole neatly machine cut and the new pipe inserted so that the end is projecting 2 inches from the inside wall. The invert shall then be reshaped to properly channel new flows. Debris of any kind shall be kept out of new or existing manholes or mains. The use of a proper boot shall be used between the machined cut hole and pipe.

3.9. **Monolithically Poured Concrete Manholes.** The wall thickness of the manhole shall not be less than 6 inches. The structure shall be poured in a manner to produce dense, compacted walls free of honeycomb surfaces throughout the pour. The base shall be poured monolithically with the walls to the manhole.

3.9.1. **Membrane Curing Compound.** All membrane curing compound shall conform to the provisions of "Concrete Structures", Item No. 302, of the City of Universal City Specifications.

3.9.2. **Base Diameter.** The minimum base diameter shall be 8 inches greater than the outside diameter of the manhole.

3.9.3. **Finish.** Finish shall conform to all applicable provisions of "Concrete Structures", Item No. 302.

3.9.4. **Cold Joints.** A cold joint will be allowed should the manhole invert depth exceed 12 feet. One joint will be allowed per each 12 feet of depth and that joint shall be approved by the Engineer.

3.9.5. **Construction Methods.** Construction methods shall conform to all applicable provisions of "Concrete Structures", Item No. 302.

3.9.6. **Backfill.** No backfill shall be placed around the manhole until at least 24 hours after the pour has been completed. Flowable fill may be used from the base of the manhole to 1 foot below the cone section or otherwise as authorized by City of Universal City. Backfill for the cone section of the manhole shall conform to the provisions of "Secondary Backfill", Item No. 804.4.2.3.

3.10. A Throat rings shall be mortared between all bearing surfaces sufficient to provide a minimum, in place, mortar thickness of 1/4 inch. No more than 4 throat rings may be used on any manhole or no more than 21 inches from the top of the cone to the top of the ring and cover.

3.11. **Manhole Ring Encasement.** All manhole rings shall be encased with reinforced concrete as shown on the plan details or as approved by the Engineer.

3.11.1. Concrete used for manhole ring encasements shall conform to the provisions of "Concrete (Natural Aggregate)", Item No. 300. Manhole ring encasement shall extend 6 inches below measured from the top of the bottom concrete ring or the top of the cone, if no rings are used, and have a minimum width when measured at the manhole ring of 1 foot. The surface of the encasement shall be up to finish grade flush with the top of the manhole ring and cover.

3.11.2. Where manholes are constructed in existing streets and where directed by the Engineer or shown on the plans, the exterior exposed surfaces of the ring, mortar, throat rings and manhole surface shall be sealed with Infi-Shield Uni-Band.

4. TESTING

4.1. **Leakage Testing.** All manholes must pass a leakage test. The Contractor shall test each manhole, after assembly and backfilling, for leakage, separate and independent of all other sanitary sewer piping, by means of a vacuum test or other methods as approved.

4.1.1. **Vacuum Testing.**

4.1.1.1. **General.** Manholes shall be tested after installation and prior to backfilling with all connections (existing and/or proposed) in place. Lift holes shall be plugged with an approved non-shrink grout prior to testing. Drop-connections and gas sealing connections shall be installed prior to testing.

4.1.1.2. **Test Procedure.** The lines entering the manhole shall be temporarily plugged with the plugs braced to prevent them from being drawn into the manhole. The plugs shall

be installed in the lines beyond drop connections, gas sealing connections, etc. The test head shall be inflated in accordance with the manufacturer's recommendations. A vacuum of 10 inches of mercury shall be drawn, and the vacuum pump will be turned off. With the valve closed, the level vacuum shall be read after the required test time. If the drop in the level is less than 1 inch of mercury (final vacuum greater than 9 inches of mercury), the manhole will have passed the vacuum test. The required test time is determined from Table 852-1.

4.1.1.3. **Acceptance.** Manholes will be accepted with relation to vacuum test requirements if they meet the criteria above. Any manhole which fails the initial test must be repaired with a non-shrink grout or other suitable material based on the material of which the manhole is constructed. Manholes shall be repaired on the exterior surface only prior to backfilling. The manhole shall be retested as described above until a successful test is made. After a successful test, the temporary plugs will be removed.

4.1.1.4. **Repairs to existing manholes.** Any existing manhole which fails to pass the vacuum test shall be closely examined by the Owner and the Contractor to determine if the manhole can be repaired. Thereafter, the Contractor shall either repair or remove and replace the manhole as directed. The manhole shall then be retested. The Owner may elect to simply remove and replace the existing manhole with a new manhole.

4.1.1.5. **Measurement and Payment.** Vacuum testing of new manholes will not be a pay item. The cost of this work will be included in the bid price for the new manhole. Each vacuum test of an existing manhole shall be a separate pay item. Repairs to existing manholes shall be a separate pay item when authorized.

4.2. **Holiday Testing.** Inspect each sanitary sewer manhole using high-voltage holiday detection equipment. All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper, or other hand tooling method. After abrading and cleaning, additional protective coating material shall be applied to the repair area. All touch-up repair procedures shall follow the protective coating manufacturer’s recommendations.

If a sanitary sewer manhole fails to pass one of the above tests, it shall be repaired in accordance with the manufacturer’s recommendations and re-tested. It shall not be accepted until it passes all tests. All repairs and re-testing shall be at no additional cost to UC.

5. MEASUREMENT

5.1. Watertight ring cover standard sanitary sewer manholes zero feet to 6 feet deep and designated on the plans will be measured as the total number of such manholes constructed, including those exceeding 6 feet in depth from the lowest invert elevation to the top of the ring.

5.2. Manholes deeper than 6 feet shall be measured by the number of vertical feet in excess of 6 feet.

6. PAYMENT

6.1. Request for watertight ring and cover with UC logo and standard manholes shall be paid at the contract unit price bid for each such manhole, which price shall be full compensation for all precast sections or throat rings, UV stabilized polyethylene liner, I/I barrier, cones, bases, watertight rings and covers, manhole ring encasement, concrete, flowable fill, mortar, drop pipes and fittings, labor, tools, equipment, testing, tees, wyes, and incidentals necessary to complete the work. No separate payment for coating.

6.2. Extra depth manholes shall be paid for at the contract unit price bid per vertical foot as measured above.

6.3. Concrete cradles for pipes shall be measured and paid for at the contract unit price bid as provided for in "Concrete Encasement, Cradles, Saddles and Collars", Item No. 858.

6.4. Gravel subgrade filler for manholes shall not be measured separately for payment.

TABLE 852-1
MINIMUM TIME REQUIRED FOR A VACUUM DROP
OF 1" Hg
(10" Hg - 9" Hg) (Min:Sec)

Height of M.H. (Depth in Ft.)	48" M.H.	60” M.H.	72" M.H.
0 - 20'	:40	:50	1:00
22'	:44	:55	1:06
24'	:48	1:00	1:22
26'	:52	1:05	1:18
28'	:56	1:10	1:24
30'	1:00	1:15	1:30
Additional 2' Depths-Add T for	:04	:05	:06

854

SANITARY SEWER LATERALS

1. DESCRIPTION

This item shall consist of sanitary sewer laterals installed in accordance with these specifications and as directed by the Engineer. This item shall also consist of installation of two way sewer cleanout at the property line.

2. MATERIALS

The materials for sanitary sewer laterals shall conform to the specification contained in "Sanitary Sewers", Item No. 848.

3. CONSTRUCTION

3.1. Sanitary sewer laterals fittings and appurtenances shall conform to the material specifications and shall be installed by the Contractor as specified herein, or as directed by the Construction Inspector or the Engineer and in accordance with the Standard Drawings.

3.2. **Designation of Lateral.** A sewer pipe located between the sanitary sewer main and the customer's premise, is designated as a "sanitary sewer lateral."

3.3. **Lateral Installation.** All lateral installations shall be performed in accordance with "Sanitary Sewers", Item No. 848, and "Excavation, Trenching and Backfill", Item No. 804, and as described herein. For sanitary sewer mains that are 12" in diameter or smaller, all laterals shall be connected using the appropriate size tee/wye placed in line with the main line. For mains larger than 12", insert a tee conforming to ASTM 3034 or approved equal may be used.

Connection to the Customer's end of the lateral shall be performed using a stainless steel band coupling or approved equal. All stainless steel band couplings shall be concrete encased to prevent movement or breakage of the steel bands. All Cleanouts at job sites shall have installed an approved heavy duty sanitary sewer cap.

Cutting, excavation, and backfill shall be as specified herein and in accordance with applicable sections of "Excavation, Trenching, Backfill", Item No. 804.

4. MEASUREMENT

Sanitary sewer laterals shall be measured by the linear feet installed at the various diameter sizes. The dimension shall be taken from the centerline of the main to the connection at or within the customer's property line or premise. Measurement will be continuous through any fittings in the main.

5. PAYMENT

Sanitary sewer laterals shall be paid for at the contract bid price per linear foot complete in place for the type, and size constructed. Price shall be full compensation for furnishing all materials, including pipe, pipe fittings (to include wyes, tees, bends), pumping, bedding, trenching or boring, trench protection, backfilling, tamping, cutting pavement and surface structures of whatever type encountered and replacement with whatever type specified and other incidentals required to complete the work.

When the minimum separation distances for any water and sewer piping facilities cannot be maintained per 30 TAC § 217.53, Contractor shall install SDR-26 PVC pipe pressure rated 150 psi. Payment for this higher pressure rated pipe shall be made at the contract bid price per linear foot complete in place for the type and size constructed.

Payment for the installation of the two-way clean out shall be paid per each under the applicable line item. Only one-way cleanouts are required on the termination point of a dead end.

856

JACKING, BORING OR TUNNELING PIPES

1. DESCRIPTION

This item shall govern the furnishing and installation of pipe by the methods of jacking, boring, or tunneling as shown on the plans and in conformity with this specification.

2. MATERIALS

2.1. **Carrier Pipe.** Carrier Pipe shall be of the types and sizes shown on the plans and shall conform to the requirements of these specifications. If PVC pipe is to be utilized as carrier pipe, installation shall conform to Item No. 818 and/or Item No. 819, of the Construction Standard Specifications and shall be fully restrained in casing. For sanitary sewers, materials shall conform to Items No. 848.2, or as specified on the plans by Engineer, and in accordance with the Standard Drawings.

2.2. **Casing Pipe.** Casing, if required, shall be (1.) RCP, (2.) Steel, or (3.) Liner Plate.

2.3. **Grout.** Grout for annular spaces shall be sand cement slurry containing a minimum of 7 sacks of Portland Cement per cubic yard of slurry. All slurry shall be plant batched and transit mixed.

3. CONSTRUCTION

3.1. **Jacking.** Suitable pits or trenches shall be excavated for the purpose of jacking operations for placing end joints of the pipe. When trenches are cut in the side of embankment, such work shall be securely sheeted and braced. Jacking operations shall in no way interfere with the operation of railroads, streets, highways or other facilities and shall not weaken or damage such facilities. Barricades and lights shall be furnished as directed by the Engineer to safeguard traffic and pedestrians.

The pipe to be jacked shall be set on guides to support the section of pipe being jacked and to direct it in the proper line and grade. Embankment material shall be excavated just ahead of the pipe and material removed through the pipe, and the pipe forced through the opening thus provided.

The excavation for the underside of the pipe, for at least 1/3 of the circumference of the pipe, shall conform to the contour and grade of the pipe. A clearance of not more than 2 inches may be provided for the upper half of the pipe.

The distance that the excavation shall extend beyond the end of the pipe shall depend on the character of the material, but it shall not exceed 2 feet in any case.

Generally, the pipe shall be jacked from downstream end. Permissible lateral or vertical variation in the final position of the pipe from line and grade will be as shown on the plans or as determined by the Engineer.

3.2. **Excavation.** Excavation for "Boring" pits and installation of shoring shall be as outlined under "Jacking." Boring operations may include a pilot hole which shall be bored the entire length of crossing and shall be used as a guide for the larger hole to be bored. Water or drilling fluid may be used to lubricate cuttings. Variation in line and grade shall apply as specified under "Jacking."

3.3. **Tunneling.** Tunneling may be used when the size of the proposed pipe or the use of a monolithic sewer would make the use of tunneling more satisfactory than "Jacking" or "Boring." The excavation for pits and the installation of shoring shall be as specified under "Jacking." The lining of the tunnel shall be of the material shown on the plans. Access holes for grouting annular space shall be spaced a maximum of 10 feet.

3.4. **Joints.** Joints for pipe for "Jacking," "Boring," or "Tunneling," shall be as specified in "Sanitary Sewers", Item No. 848, or as shown on the project plans or shop drawings as per pipe manufacturer's recommendation.

3.5. **Grouting of Bores or Tunnels.** Annular Space between casing pipe and limits of excavation (borehole) shall be pressure grouted, unless otherwise specified on the plans.

4. MEASUREMENT

Jacking, Boring or Tunneling shall be measured by the linear foot of bore or tunnel as measured from face to face of jacking pits. Carrier pipe used in bores and tunnels or jacked into place shall be measured by the linear foot of pipe installed from end to end of pipe to the limits shown on the plans.

Casings or liners, where required by the plans, of the size and material required shall be measured by the linear foot actually installed in accordance with the plans.

5. PAYMENT

The work performed and materials furnished as specified herein, measured as provided above, shall be paid for at the contract unit price bid per linear foot of jacking, boring or tunneling, which price shall be full compensation for furnishing all materials (except carrier pipe, casings or liners), labor, tools, equipment and incidentals necessary to complete the work, including excavation, grouting, backfilling, restoration to original ground conditions, and disposal of surplus materials.

Carrier pipe shall be paid for at the contract unit price bid for "Carrier Pipe for Jacking, Boring or Tunneling" per linear foot of pipe installed and measured as prescribed above. Casings or liners shall be paid for at the contract unit price bid for "Casing or Liner" per linear foot of casing or liner installed and measured as prescribed above.

858

CONCRETE ENCASEMENT, CRADLES, SADDLES, AND COLLARS

1. DESCRIPTION

This item shall govern placing concrete encasements, cradles, saddles, collars, when called for by the project plans or as directed by the Engineer.

2. MATERIALS

Concrete: All concrete shall conform to the provisions of "Concrete (Natural Aggregates)", Item No. 300, shall be of the class and stregth as noted on the plans.

3. CONSTRUCTION

3.1. Concrete Encasement. When concrete encasement is shown on the plans or when directed by the Engineer, the trench shall be excavated and fine graded to a depth conforming to details and sections shown on the plans, or Standard Drawings. The pipe shall be supported by precast concrete blocks of the same strength as the concrete for encasement and securely tied down to prevent floatation. Encasement shall then be placed to a depth and width conforming to details and sections shown on the plans.

3.2. Concrete Cradles. When concrete cradles are shown on the plans or when called for by the Engineer, the trench shall be prepared and the pipe supported in the same manner as described in Paragraph 858.3.1, of this specification and shall be constructed in accordance with details and sections shown on the plans. Straps/Tie Downs shall be of No. 4 rebar diameter minimum or better as determined by City of Universal City Inspector.

3.3. Concrete Saddles. When shown on the plans or when directed by the Engineer, pipe to receive concrete saddles shall be backfilled in accordance with "Excavation, Trenching and Backfill", Item No. 804, to the spring line and concrete placed for a depth and width conforming with details and sections shown on the plans.

3.4. Concrete Collars. When shown on the plans or when directed by the Engineer, concrete collars shall be constructed in accordance with details and sections shown on the plans.

4. MEASUREMENT

Concrete Encasement, Cradles, Saddles, and Collars will be measured by the cubic yard of accepted work, complete in place. Reinforcing, if required, shall not be measured for payment.

5. PAYMENT

Concrete Encasement, Cradles, Saddles and Collars will be paid for at the unit price bid per cubic yard, which price shall be full compensation for furnishing and placing all materials, manipulation, labor, tools, equipment and incidentals necessary to complete the work. Payment for concrete encasement shall consist of 6 inches of concrete around the pipe where required, minus manholes/structures/etc.

870

SANITARY SEWER LIFT STATION

1. DESCRIPTION

The City of Universal City has hereby adopted the San Antonio Water System (SAWS) Lift Station Design & Construction Guidelines for the purpose of establishing rules and regulations for the design, development, and construction of lift stations and force mains. The City of Universal City has modified, amended and deleted portions of the SAWS Lift Station Design & Construction Guidelines as found in the document herein.

The City of Universal City has hereby adopted the SAWS Lift Station Design and Construction Standard Drawings ("Standard Drawings") referenced in these guidelines in conjunction with the Lift Station Design & Construction Guidelines. These Standard Drawings are hereby adopted by the City of Universal City for the purpose of establishing rules and regulations for the design, development and construction of lift stations and force mains.

2. GENERAL REQUIREMENTS

2.1. A consultant or developer who proposes to construct a lift station and force main system shall prepare a present value analysis of the cost of constructing gravity mains compared to the cost of the lift station/force main system. This analysis shall show that the lift station installation cost plus 30 years of operational and maintenance expenses would be less than the cost of the gravity mains. Lift stations will only be considered a viable option if the cost analysis clearly shows that the gravity sewers are not economically feasible. Lift stations will not be allowed where an acceptable alternative gravity route exists.

2.2. Design the lift station to consider the potential for expansion to build-out densities. The design of the lift station shall incorporate a wet well sized for the ultimate capacity of the water shed. The lift station design shall consider both the total number of acres and number of Equivalent Dwelling Units (EDU) to be developed. The flow capacities are determined in accordance with applicable chapters and sections of Texas Commission on Environmental Quality (TCEQ) Chapter 217 "Design Criteria for Sewerage Systems" dated August 28th, 2008 or the latest edition thereof.

2.3. All sanitary sewer lift stations shall be submersible type, with no restrictions on maximum motor horsepower or wet well depth. Suction lift and self-priming pumps will not be permitted.

2.4. All lift stations shall be designed to meet the requirements of these Universal City Lift Station Design and Construction Guidelines, and also meet or exceed the requirements of TCEQ 217.60, TCEQ 213 Subparts A and B (for lift station over Edwards Aquifer Recharge, Transition or Contributing Zones), 2011 NFPA National Electrical Code (NEC), 2007 National Electrical Safety Code (NESC), Occupational

Safety and Health Administration (OSHA) 2007 or latest editions, and contemporary industry practices. A lift station application shall include final construction plans, a design engineering report and complete set of specifications prepared by or under the direct supervision of a Texas Licensed Professional Engineer. All design information shall be signed, sealed, and dated by a Texas Licensed Professional Engineer. The lift station site layout shall show the proposed grades. See the Standard Lift Station Drawings for location of required proposed grades.

2.5. Lift stations located over the Edwards Aquifer Recharge, Contributing and Transition Zone shall be designed and constructed to ensure that bypassing of any sewage does not occur (TCEQ Chapter 213, Subchapter A §213.5(c)3(C)). All lift stations shall be designed to meet the requirements of these Design Guidelines and meet or exceed TCEQ Chapter 217, Subsection C from §217.59 to §217.68.

2.6. The firm pumping capacity of all lift stations shall be such that the expected peak flow can be pumped to its desired destination. Firm pumping capacity is defined as lift station total pumping capacity with the largest pumping unit out of service, or with either one or two pumps out of service (see Table 870-2). The firm pumping capacity shall be greater than the expected Peak Wet Weather Flow.

2.7. Lift Station site layouts shall consider clearances for unimpeded maintenance operations. The area surrounding the lift station components including, but not limited to, the wet well, pump and motor slabs, valve slabs, generator, electric service rack and tower shall be large enough to permit heavy equipment and vehicles ample room to maneuver. The lift station site shall be designed to allow maintenance vehicles to have direct access to the wet well, electric controls, generator and tower.

2.8. Access Road Design in Residential or Commercial Developments: The lift station shall have a permanent access road located in a dedicated right-of-way or permanent easement. The permanent access road surface shall have a minimum width of 16 feet and the pavement shall meet AASHTO HS 20-44 standard. Crushed stone, flexible base or similar materials are not considered all weather materials and will not be accepted. The permanent access road surface shall be designed to be above the water level caused by a 25-year storm event. The design of the permanent access road shall include plan, section and profile sheets of the access road, and drain pipes and details. The design shall limit the slope to no more than eight percent and grade break to three percent and provide soil erosion protection to prevent collection of sedimentation along the access road. Inside the boundary of a proposed residential development, design of the permanent access road shall minimize turns and achieve the straightest possible alignment. If a straight access road is not provided, the City of Universal City will determine whether or not an adequate turnaround is required to allow a 55 foot 18 wheeler tanker truck to safely turn around depending on wet well size, influent flow and site location. The turnaround shall meet the same pavement standard for the access road. In a phased development, a temporary access road alignment shall be reviewed and approved by the City of Universal City prior to the initial phase of development. City of Universal City written approval is required prior to any modifications to the temporary access road. Lift Stations access within a proposed commercial development shall be closely coordinated with the City of Universal City early in the design. The City of Universal City preference is for an exclusive driveway and paved access road that will be for City of Universal City use only. This access road shall have a straight horizontal alignment, and shall be paved

and configured to preclude the public from blocking the City of Universal City's access to the station. It shall be a minimum of 16 feet wide without any interference with, but not limited to vehicles, landscape, curbs, posts, bollards, fences, parking stalls, striping, and above grade appurtenances, etc. If these design conditions cannot be satisfied, then the lift station may have to be designated as a private lift station, and maintenance of all sewer facilities within the commercial boundary shall be maintained by the property owner or a legally designated association.

2.9. Provide two eight foot gates for a 16 foot clearance to allow access by large maintenance equipment. Lift stations with relatively long driveways must include pole gates at the entrance of the driveway. Turnarounds may be required for stations constructed along heavily traveled streets. Allow sufficient space for large maintenance vehicles to have unhindered access to the wet well, generator, tower, by-pass and on-site manhole. Entries located parallel to the roadway should also be considered. Lift stations are not allowed within the street right-of-way.

2.10. The lift station, including all electrical and mechanical equipment, shall be protected from a 100-year flood event including wave action, and remain fully operational during such event. Provide a letter dated, signed and sealed by a Texas Professional Engineer certifying the site is protected from such an event. Attach floodplain evaluations if required by the City of Universal City.

2.11. Provide protection of the lift station, including mechanical and electrical equipment, from access by any unauthorized person. The lift station shall be enclosed within an intruder resistant fence consisting of a chain link fence eight feet minimum in height, with a one foot section above consisting of three strands of barbed wire "up-riggers." Privacy slats shall be added to chain link fence, with approval by the City of Universal City. Privacy fences shall complement the character of the lift station location and will be evaluated on a case-by-case basis.

2.12. Provide a reinforced concrete base slab, or other appropriate feature, sized adequately to counteract buoyancy, and provide supporting design calculations. The concrete slabs of top of wet well, electrical rack, tower foundation and generator (when required) shall be four inches to six inches higher than the adjacent pavement.

2.13. The lift station site shall be completely paved. The pavement section shall be concrete, and the design shall be prepared by a Texas Professional Engineer. The design and construction shall be in accordance with all applicable City of Universal City Specifications for Construction, and include additional reinforcement of the subgrade and base. The pavement design shall consider loading exerted by a 55 foot, 18 wheeler, and 80,000 pound tanker truck. The pavement shall be shaped to the lines, grades, and typical sections that are on the approved construction plans. If trees are to remain in the paved area, leave a circular pervious area with a minimum 12 inch clearance around tree, and make sure the trees will not impede maintenance vehicle access.

2.14. Design shall provide for 3 / 4 inch minimum freeze proof water service with hose bib vacuum breaker attached to the hose connection. It shall be located within 10 foot radius of wet well.

2.15. Design shall provide for a galvanized steel supported canopy over electrical service rack that will provide a minimum seven foot vertical clearance, and five feet front span and 3.5 feet back span horizontal from the face and rear of the panel rack respectively. Due to the variety of soil conditions in the region, Design engineer must perform soil, foundation and structural analysis to ensure the canopy structure will withstand winds of up to 90 MPH. The canopy detail shown in the standard drawings is provided for illustration purposes and reflects the foundation minimum dimensions.

2.16. Provide engineering calculations of potential for hydrogen sulfide generation in force main and wet well, and provide recommendations to prevent and/or control generation of odors. As a standard practice, wet well retention time, and force main flush time shall not exceed 180 minutes. If the development is phased, this analysis shall be made for both initial and final phases. It is recommended for Design Engineers to coordinate with the City of Universal City during the early stages of the lift station design, this way different alternatives can be evaluated. It is the City of Universal City's preference to keep all pumps the same size and not to depend on Variable Frequency Drives for initial conditions, but is some cases this may be the only solution. Parallel force mains of different size must be evaluated to satisfy conditions for initial and final development.

2.17. All exposed pipe, valves, and fittings outside the wet well shall receive after installation a 100 percent solids epoxy coating system with a top coat system of urethane, suitable for the environment. Prior to application, prepare surfaces in accordance with manufacturer's instructions. Any reference to cleaning in the manufacturer's instructions shall be understood to refer to the applicable SSPC specifications. Thickness, mixing and application shall be in accordance with manufacturer instructions. Apply finish coat in accordance with the color- coding set forth in Table 870-1, below. Approved manufacturers are Tnemec, Carboline, Sherwin-Williams, PPG, and M.A.B. Paints.

2.18. All pump discharge pipe and fittings within wet well, except SS 316 and PVC, shall receive after installation, a 100 percent solids coal tar epoxy coating system. Thickness, mixing and application shall be in accordance with Manufacturers instructions. Prior to application, prepare surfaces in accordance with manufacturer's instructions. Any reference to cleaning in the manufacturer's instructions shall be understood to refer to the applicable SSPC specifications. Approved manufacturers are Tnemec, Carboline, Sherwin-Williams, PPG, and M.A.B. Paints.

2.19. For appropriate landscaping of the lift station site (outside the fence), comply with the City of Universal City Standard Specifications for Construction.

2.20. Service pole shall be located within the lift station site at a location where electric overhead wires do not cross over the lift station site. Locate service pole as indicated in Standard Drawings preferably; alternate locations must be evaluated and approved by the City of Universal City. Service pole must be located 20 feet away from the SCADA tower structure.

2.21. Lift station site shall be located or designed in a manner that will be protected from storm runoff entering the lift station site, and that will allow storm water to drain away from lift station site.

2.22. Lift station shall be placed at a sufficient distance from developed areas and designed with adequate odor control measures to limit the detection of odors within the developed area to an acceptable level.

2.23. Engineer shall ensure the specifications require the Contractor to submit minimum three hard copies and one electronic copy (in pdf) of the Operation and Maintenance Manuals of all equipment to the City of Universal City Inspector. Operation and Maintenance Manuals shall detail the following, but not limited to, technical data, performance levels, specifications, parts description, installation, operation and maintenance of electrical, mechanical, and instrumentation components.

TABLE 870-1	
UC LIFT STATION COLOR CODES	
Types of Equipment	**Color**
Pump Suction Piping (If Required)	Gray – Pantone Number 431 U
Header And Force Main Piping	Gray – Pantone Number 431 U
Pump/Motors And Mounts (If Apply)	Gray – Pantone Number 431 U
Potable Water Line	Avalon Blue – Pantone Number 558 C
Compressed Air Line (Where Used)	Green – Pantone Number 349
Power Conduit	Orange – Pantone Number 166
Control/Instrumentation Conduit	Yellow – Pantone Number 109
Recycle Water Pipe	Purple – Pantone Number 521 C

3. WET WELL DESIGN

3.1. **Dimensions.** Minimum 72 inches in diameter; larger as necessary to accommodate submersible pumping equipment, piping, supports, emergency storage volume and to support pump cycle times as indicated in Table 870-3. Depth of wet wells shall consider, but not limited to all the following: emergency storage volume, adequate submergence of submersible pumps, and suction piping for self-priming or dry pit pumps (if approved). Fiberglass reinforced polyester (FRP) wet wells shall be installed for diameters up to 18 feet, unless prior arrangements have been made with and approved by the City of Universal City to install precast concrete wet wells, and dry vaults.

3.2. **Emergency Storage.** Size the wet well to provide sufficient volume within the wet well, excluding the capacity of sanitary collection system upstream from the lift station. Emergency storage capacity shall be supported by engineering calculations. Design wet well emergency storage for the following capacities, using Average Daily Flow:

3.2.1. For lift stations within Edwards Aquifer Recharge and Contributing Zones: 60- minutes of wet well storage plus a generator, or

3.2.2. For lift stations over the Edwards Aquifer Transition Zone: City of Universal City staff will evaluate the site location, water stream proximity, remoteness, and geographical features to determine if the lift station site shall be treated as if it were over the EARZ. A generator is required. (See Section 870.9 “Emergency Provisions”).

3.2.3. For lift stations outside the Edwards Aquifer Recharge, Contributing and Transition Zones: 60-minutes of wet well storage plus a generator, or 120 minutes of wet well storage with generator. A generator is required. (See Section 870.9 “Emergency Provisions”).

For calculation purposes, the wet well emergency storage level begins at the Lead Pump On level until wet well level is two feet below spill level elevation. Spill level elevation is determined by the manhole upstream of wet well with the lowest top elevation, or by the wet well top slab elevation, whichever is lower.

3.3. The lift station design shall minimize odor potential. Locate incoming wet well gravity pipe to reduce turbulence. Minimize detention times in wet well during all phases of development. If detention times are greater than 180 minutes, the City of Universal City may require odor control measures based on evaluation of, but not limited to phasing considering construction phasing, prevailing wind direction, and proximity to neighborhoods. If odor control measures are needed, it shall consist of a chemical drum scrubber with top mounted blower to absorb odorous compounds for oxidizing. The drum scrubber shall be designed to operate at 99.5 percent gas removal. The design specification shall be prepared by the drum scrubber and media supplier. Approved manufacturer is Purafil, or a City of Universal City-approved equal.

3.4. The wet well floor shall be sloped toward the pump intakes and have a smooth finish (see Standard Drawings) in order to become a self cleaning wet well. There shall be no wet well projections that will allow deposition of solids under normal operating conditions. Include anti-vortex baffling on all lift stations with greater than three MGD (2,083 gpm) Peak Wet Weather Flow.

3.5. When permitted by the City of Universal City, construction of concrete wells shall include a full monolithic structure or a precast wet well structure with monolithic base. Design engineer shall evaluate the thicknesses of wet well wall and slabs, but the following thicknesses shall be met as minimum: wet well wall thickness 10 inches, wet well base slab 12 inches and wet well top slab 10 inches.

3.6. Line interior of concrete wet wells with a 100 percent pure calcium aluminate premix lining system. Surface preparation, thickness, mixing and application shall be in accordance with the manufacturer's instructions. Wet well joints shall be sealed per the manufacturer's recommendations. Approved manufacturer is Sewpercoat, or City of Universal City-approved equal.

3.7. The bottom of the excavation for the wet well structure shall be a level subgrade approximately 18 inches of crushed stone below the bottom of the wet well structure and native soils shall be compacted with excavation equipment for the installation of six inches of flexible base to support the base of the structure. Compaction of native soil and flexible base shall achieve minimum 98 percent of the maximum dry density as determined by the TXDOT testing method Tex 113-E.

3.8. 3,000 psi reinforced concrete shall be installed around wet well exterior to an elevation of 1/3 the total depth of the wet well structure, as measured from the well bottom up. The remaining 2/3 shall be backfilled with flowable fill. Wet well manufacturer shall design the wet well thickness.

3.9. Use 16 mesh 316 Stainless Steel screens on passive ventilation, gooseneck type, to prevent the entry of birds or insects into wet well. Mechanical and electrical equipment in the wet well shall be NFPA Class 1, Division 1 construction type. Size the passive ventilation to vent at a rate equal to the maximum pumping rate of the station and not

exceed 600 fpm through the vent pipe. The minimum air vent size shall be four inches in diameter, and it shall be made of stainless steel 316. Vent outlets shall be at least one foot above the 100-year flood elevation. All screening shall be installed in a manner that will allow for future replacement.

3.10. When dry wells are approved, provide permanent mechanical ventilation and lighting, if required by the City of Universal City.

3.11. Connection between wet well and dry well ventilation systems is not allowed.

3.12. Provide multiple air inlets and outlets in dry wells over 15 feet deep. Do not use dampers on exhaust or fresh air ducts. Avoid screens that are finer than #10 sieve or other obstructions within air ducts to prevent clogging.

3.13. When dry wells are approved by the City of Universal City, provide manual lighting/ventilation switches to override automatic controls installed for any intermittently operated lighting/venting equipment. The location of these switches will be at the Dry Well entrance.

3.14. Incorporate hoisting equipment, or access for hoisting equipment, for removal of pumps, motors, valves, etc. into the design. The City of Universal City will determine if hoisting equipment shall be included in the design, depending on size of equipment. When required by the City of Universal City, hoisting equipment will include overhead crane.

3.15. All accessory hardware in wet well including but not limited to chains, cables, bolts, nuts, fasteners, brackets, anchor bolts, washers, cable holders and slide rails, shall be 316 stainless steel.

3.16. The distance between the bottom of the wet well and the bottom of the gravity invert pipe shall be between five and seven feet. If distances greater than seven feet are required the gravity invert pipe must tie to wet well via drop pipe per City of Universal City Standard Drawings.

3.17. Fiberglass reinforced polyester (FRP) wet wells shall be manufactured from commercial grade unsaturated polyester resin or vinyl ester resin, with fiberglass reinforcements. The wet well shall be manufactured in one-piece including body, bottom and top, and it shall be sit over a concrete slab design to counteract buoyancy forces. Design engineer shall design the top concrete slab. Approved manufacturers are L.F. Manufacturing, and Containment Solutions, or City of Universal City-approved equal.

3.17.1. The resins used shall be a commercial grade unsaturated polyester resin.

3.17.2. The reinforcing materials shall be commercial Grade "E" type glass in the form of mat, continuous roving, chopped roving, roving fabric or a combination of the above, having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.

3.17.3. If reinforcing materials are used on the surface exposed to the contained substance, it shall be a commercial grade chemical-resistant glass that will provide a suitable bond with the resin and leave a resin rich surface.

3.17.4. Fillers, when used, shall be inert to the environment and wet well construction. Additives, such as thixotropic agents, catalysts, promoters, etc., may be added as required by the specific manufacturing process to be used. The resulting reinforced plastic material shall meet the requirement of this specification.

3.17.5. The exterior surface shall be relatively smooth with no sharp projections. Handwork finish is acceptable if enough resin is present to eliminate exposed fiber. The exterior surface shall be free of blisters larger than 1/2 inch in diameter, delamination and exposed fiber.

3.17.6. The interior surface shall be resin rich with no exposed fibers. The surface shall be free of grazing, delamination, and blisters larger than 1/2 inch in diameter, and wrinkles of 1/8 inch or greater in depth. Surface pits shall be permitted up to six square feet if they are less than 3/4 inch in diameter and less than 1/16 inch deep.

3.17.7. The bottom to be fabricated using fiberglass material. Bottom to be attached to wet well pipe with fiberglass layup to comply with A.S.T.M.-D3299 specifications. Reinforcement, if needed, shall be fiberglass channel laminated to wet well bottom per A.S.T.M.-D3299.

3.17.8. The fiberglass wet well top shall be fabricated using fiberglass material. Top to be attached to wet well pipe with fiberglass layup to comply with A.S.T.M.-D3299 specifications. Reinforcement, if needed, shall be fiberglass channel laminated to wet well bottom per A.S.T.M.-D3299.

3.17.9. Influent pipe shall be Kor-N-Seal or Inserta-Tee (refer to Standard Drawings for details). Sleeve shall be either PVC or Fiberglass Pipe, and it shall be installed and tested by the manufacturer. Installation of stubouts to be fiberglass layup to comply with A.S.T.M.-D3299 specifications.

3.17.10. Require wet well be designed for the project service conditions (initial and ultimate build out), assuming fully saturated soil external loading and buoyant uplift, with related design calculations included in the engineering report.

3.17.11. The (FRP) wet well shall be installed in strict accordance with the wet well manufacturer's recommendations.

3.17.12. Each wet well shall be marked with the following information.

- Manufacturer's name or trademark
- Manufacturing special number
- Total Length and nominal diameter

3.18. Wet Well Testing. An Exfiltration test must be performed immediately after the wet well has been backfilled and compacted. Exfiltration shall not exceed 0.0142 gal/hr per foot diameter per foot depth. The test must be done by plugging the gravity invert and filling up the wet well with water to either one foot below the wet well top slab, or

up to the manhole lid with the lowest elevation below top slab. (This level must be clearly temporarily marked in the wet well internal wall). Once the wet well is filled, it must be left for stabilization for 48 hours minimum prior to beginning the Exfiltration test. After the stabilization period, the wet well must be refilled up to the mark to begin the test. The test shall be done for two hours minimum, and no water may be added to the wet well during the test period. The Exfiltration test must be determined by measuring the amount of water required to raise the wet well level back to the mark at the end of the test period. The maximum allowable water loss to pass the test is determined by the following equation:

$$\text{Water Loss (gallons)} = 0.0142tDh$$

Where:
t = test time period (2 hours)
D = wet well diameter (in feet)
h = water level depth within wet well (in feet)

If the Exfiltration test fails the Design Engineer must work with the Contractor to determine all the necessary corrective actions to reduce the exfiltration. Once the repairs are completed the test shall be repeated. The wet well will pass the test when the exfiltration is equal or less then the allowable water loss. The City of Universal City Inspector, Contractor and Design Engineer shall witness the complete exfiltration test. Design Engineer shall provide a certified letter showing the results of the exfiltration test to the City of Universal City Inspector. The certification letter shall include a description of all steps taken to complete the exfiltration test, including water loss, wet well level mark, and any corrective actions taken if a prior test failed.

4. PUMPING EQUIPMENT DESIGN

4.1. Provide the required number of pumps, and adequate controls to alternate all pumps (See Table 870-2 for minimum number of pumps required).

4.2. All pumps, regardless of station design, shall be electric, centrifugal non-clogging units capable of passing incompressible spheres as indicated in Table 870- 2 (Minimum Sphere Pass), and shall have no less than four inch diameter suction and discharge openings. Semi chopper, vortex or grinder pumps may be accepted on case-by-case basis. 2-Pole motors may be approved by the City of Universal City on case-by-case.

TABLE 870-2

MINIMUM NUMBER OF PUMPS REQUIRED

Peak Wet Weather Flow	Minimum Number of Pumps	Minimum Sphere Pass
500 gpm or less	● 2 Pumps: 1 Lead, 1 Standby †	3 inch
Between 501 and 1200 gpm	▲ 3 Pumps: 1 Lead, 1 Lag, 1 Standby †	3 inch
Between 1201 and 3000 gpm	▲ 4 Pumps: 1 Lead, 1 Lag, 2 Standby ‡	3 inch
Over 3001 gpm	■ 5 Pumps: 1 Lead, 2 Lag, 2 Standby ‡	4 inch

NOTES: All pumps including Standby must alternate constantly.
● Lead Pump will discharge more than the Peak Wet Weather Flow.
▲ Lead Pump with Lag Pump will discharge more than the Peak Wet Weather Flow.
■ Lead Pump with Lag Pumps will discharge more than the Peak Wet Weather Flow.

† One standby pump required only.
‡ Two standby pumps required due to magnitude of flow.

4.3. Specify pump motors suitable for continuous operation and inverter-duty type (suitable for soft starters and variable frequency drives) at full nameplate load while the motor is completely submerged, partially submerged, totally non-submerged for submersible pumps.

4.4. Pumps shall be capable of meeting all system hydraulic conditions without overloading the motors. In addition, a minimum of 5-hp motor is required, unless prior arrangements have been made and approved by the City of Universal City. Submit pump head capacity and system curves to the City of Universal City, along with the lift station plans. Base the curves on the total of static head, friction losses through force mains, headers and pump risers. Pump duty point for nominal design flow shall be within the 75 percent and 115 percent range of pump's flow at Best Efficiency Point (B.E.P). This condition shall be satisfied for at least one and two pumps in operation. Points outside this range will be evaluated by the City Engineer and may be approved based upon performance, average energy consumption per month (kW-hr/month), etc.

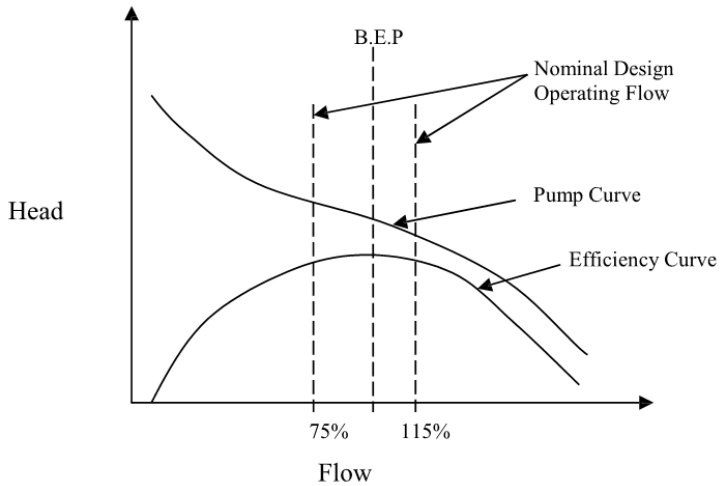

FIGURE 1: PUMP DUTY POINT BETWEEN 75% and 115% RANGE OF FLOW AT B.E.P.

4.5. Based on peak flow, pump cycle time shall not be less than those in Table 870-3.

TABLE 870-3		
MIMIMUM WET WELL LEVEL CYCLING		
Pump Horsepower	**Minimum Wet Well Cycling Using Peak Wet Weather Flow**	**Minimum Wet Well Cycling Using Average Daily Flow**
Less than 30	10 minutes: 3 Fill, 7 Empty	13 minutes: 10 Fill, 3 Empty
Between 30 and 75	17 minutes: 6 Fill, 11 Empty	22 minutes: 17 Fill, 5 Empty
Over 75	25 minutes: 8 Fill 17 Empty	32 minutes: 25 Fill, 7 Empty

NOTES:

- Wet well cycling is determined by the wet well internal volume established by the wet well internal diameter, and the distance between Lead Pump On and Pump Off levels.
- Fill time is the time that takes the wet well level to rise from Pump Off to Lead Pump On.
- Empty time is the time that takes a pump to drop the wet well level from Lead Pump On to Pump Off while wet well inflow is active. (Pump Run Time)

4.6. All lift stations shall operate automatically based on the water level in the wet well. Locate wet well level control device as indicated in Standard Drawings. Level control device and float switch shall be fully accessible without the need for personnel entering the wet well.

4.7. Submersible Pumping Stations.

4.7.1. The lift station shall consist of submersible centrifugal sewage pumps, stainless steel 316 guide rail system, wet well access, discharge seal and elbow, motor control center, starters, liquid level control system, SCADA monitoring system, and all hardware necessary to provide a complete working system. Every integral component of the guide system shall be stainless steel 316, which includes the following but not limited to: guide rails, brackets, fittings, bolts, nuts, fasteners, adapters, attachments, etc. Flanged discharges are not allowed.

4.7.2. Impellers shall consist of cast stainless steel or ductile iron. Mechanical Seals shall consist of Tungsten Carbide. Silicon Carbide seals will be evaluated and approved by the City of Universal City on case-by-case basis.

4.7.3. Motor insulation shall be Class H, be inverter duty type, and have a minimum service factor of 1.15.

4.7.4. Pump duty point shall be within the 75 percent to 115 percent range of pump's flow at Best Efficiency Point (BEP) for one and two pumps in operation as to achieve the maximum efficiency possible, and no substitutions will be accepted after the City of Universal City approval of the Lift Station construction plans and Engineering report. Designer shall consider different combinations of pumps, impellers and pipe sizes including discharge and force main piping in order to achieve the pump operating criteria and maximum efficiency. The engineering report shall include energy calculations to prove the proposed pump is the most efficient option. Exemptions may be considered on a case-by-case. Approved pump manufacturers are ITT Flygt, Hydromatic, and KSB.

4.7.5. Sealing of the pump unit to the discharge connection shall be a machined metal to metal water tight, hydraulically sealed contact.

4.7.6. The proposed elevation of all critical components shall be shown in the Drawings including, but not limited to pump intake line inverts, control and alarm levels, top of the wet well, top of the dry well, influent line invert(s).

4.7.7. Pumps shall be readily removable and replaceable without dewatering the wet well or disconnecting any piping in the wet well.

4.7.8. All electrical equipment/panels and controls shall be above ground.

4.7.9. All cables shall be continuous (no splices allowed), and intended for wastewater service applications.

5. FORCE MAIN

5.1. Install the Force Main at least four feet below finished ground surface, and higher than the gravity inlet line elevation.

5.2. Metallic detector Tape must be laid in the same trench as the force main. The detector tape must be located above and parallel to the force main. The detector tape must bear the label “PRESSURIZED WASTEWATER” continuously repeated in at least 1.5 inch letters.

5.3. Provide plan and profile of the force main in plans.

5.4. Install an isolation gate valve on all force mains, located immediately before they turn toward the underground.

5.5. Minimize the number of peaks and valleys along the Force Main profile to limit the accumulation of gases. All high points shall have two inch minimum air and vacuum release valves rated for raw sewage. Plans must include the air release valve installation detail. See Standard Drawings.

5.6. Force Mains shall transition into a gravity line within a manhole via drop manhole as to minimize turbulence. The crowns of the force main and outlet gravity line shall match where possible, with bench grouting installed to direct flow into the outlet with a minimal change in the gravity flow angle to minimize turbulence.

5.7. Minimum force main size will be four inches; however, size force mains so that flow velocity is between three and 3.5 feet per second (velocities slightly above three feet per second are recommended) with one pump in operation. Maximum flow velocities shall be 4.5 feet per second with two pumps in operation and six feet per second with three pumps in operation. For lift stations with more than two pumps, flow velocities may be as low as two feet per second with one pump in operation, but when three or more pumps operate a flow velocity equal to, or greater than five feet per second must be generated.

5.8. All pipe material shall consist of fusion-welded HDPE, and both engineering report and plans must indicate either Ductile Iron Pipe Size (DIPS) or Iron Pipe Size (IPS). Pipe

shall consist of HDPE solid wall referred as to Drisco 1000, Drisco 8600, Quali Pipe, Poly Pipe, and Plexco Pipe that is in compliance with ASTM F714. All pipe and fittings shall be high density polyethylene pipe and made of virgin material, and shall have a minimum working pressure rating of 150 psi. The pipe shall be manufactured from a High Density High Molecular weight polyethylene compound which conforms to ASTM D 1248 and meets the requirements for Type III, Class C, Grade P-34, Category 5, and has a PPI rating of PE 3048. Solid wall pipe shall be produced with a plain end construction for heat-joining (butt fusion) conforming to ASTM D 2657; no flanged or slip-on joints will be accepted. See City of Universal City Standard Specifications for Construction.

5.9. All lift stations located over Edwards Aquifer Recharge and Contributing Zones shall be designed with double barrel force mains to provide full redundancy. Lift Stations over the Edwards Aquifer Transition Zone, and Lift Stations outside Edwards Aquifer Recharge, Contributing and Transition Zones but with either Peak Wet Weather Flows of 1,200+ gpm or force main lengths of 5,000+feet will be evaluated by the City of Universal City to determine if double barrel force mains will be required. Double barrel force mains shall be connected (above ground) to the common header through a wye fitting, and an isolation gate valve shall be provided for each force main immediately after the wye. Double barrel force mains shall be designed to provide full redundancy.

5.10. Force mains pressure rating shall be at least 1.333 times greater than the pressure generated by instantaneous pump stoppage due to a power failure under maximum pumping conditions as determined by dynamic pressure analysis, but in no case shall be rated less than 150 psi. Design engineer must include an analysis showing the maximum surge pressure for such conditions in the engineering report, and provide a solution to prevent a force main break.

5.11. A force main average flush time analysis must be included in the engineering report. Average flush time shall not exceed 180 minutes. See Section 870.11.2.3.12 for example calculation.

5.12. Combination Air/Vacuum Release Valves must be installed in a dry vault with a minimum inner diameter of six feet and with a minimum 30 inch access opening. Location of force main and air release valve within dry vault must be in a manner that will provide safe working space and safe access. See Standard Drawings. Show in plans GPS coordinates of all air release valves installed along force mains.

5.13. Force mains must be tested by filling with water and pressurizing to 50 psi above force main nominal rated pressure. Force main must hold the test pressure for four hours.

5.14. A leak test must be also performed, and the leakage rate must not exceed 10 gallons per inch diameter per mile of pipe per day when the force main is pressure tested.

5.15. Per TCEQ Chapter 217 requirement, install isolation plug valves at least every 2,000 feet to facilitate initial testing and subsequent maintenance and repairs. Show GPS coordinates of each plug valve on the plans. Confirm such GPS coordinates in Record Drawings or As-built drawings.

6. ELECTRICAL EQUIPMENT

6.1. Electrical service shall be 277/480-volt, 3-phase, and 4-wire, unless otherwise approved by the City Engineer. Minimum service size shall be 200 amps. General lighting and power transformer shall be at least 10KVA, and shall be housed with load center in a separate stainless steel enclosure. Request for smaller electrical service shall be reviewed by the City Engineer and considered for approval on a case by case basis. All enclosures shall be white enameled stainless steel 304, rated NEMA 4X with lever type door closures. Pump control enclosure shall be double door type as to locate all 480V equipment on the right side and all 120V equipment on the left side. Single-phase systems are not allowed. Use the following color scheme:

480Y/277 Volts		120/240Volts 3P4W		24Vdc	
Phase A:	Purple	Phase A:	Black	Positive:	Blue
Phase B:	Brown	Phase B$_{(High)}$:	Red$_{(Orange)}$	Negative	White w/blue
Phase C:	Yellow	Phase C:	Blue		
Neutral:	White	Neutral:	White		
Ground:	Green	Ground:	Green		

6.2. Conductors for power shall be stranded copper, rated for 75 ºC, with insulation suitable for dry and wet locations. Sizing shall be done according to NEC requirements. Power conductors shall be continuous. Field splices are not allowed.

6.3. Wire size for controls shall be #14 AWG copper stranded rated for 90 ºC. Wire size for SCADA controls shall be #16 AWG copper stranded rated for 90 ºC.

6.4. Due to the potential presence of hydrogen sulfide and other corrosive gases, greases, oils, and other constituents frequently present in sewage, all mounting hardware shall be Type 304 Stainless Steel and install seal-offs in conduit leading into the pump control panel and junction boxes. All enclosures shall be Type 304 Stainless Steel, and disconnects shall be FRP-NEMA 4X. All enclosures and disconnects shall be lockable with a padlock.

6.5. Main electrical disconnect shall be housed in either a separate NEMA 4X, stainless steel enclosure and shall be equal to Square D, Class 3110, 600-volt class, heavy duty, service rated safety switch, NEMA 4X, with all copper current carrying parts, Model H36_DS. Provide with fusing class size based on the characteristics of the motor loads served and the available fault current. Main electrical disconnect shall be time delay fuse or time delay circuit breaker. Provide a surge arrestor in a separate NEMA 4X, SS304 enclosure mounted in the service pole mounting rack as indicated in the Standard Drawings. Approved Manufacturers: Square D, Siemens, General Electric, and Cutler-Hammer.

6.6. Electrical equipment shall comply with the latest version of the NFPA National Electrical Code (NEC) requirements for Class 1, Group C and D, Division 1 locations. Additionally, equipment located in wet wells shall be suitable for use under corrosive environments. Each flexible cable shall be provided with a watertight seal and separate strain relief. High water float switch shall be normally open and non-mercury type.

6.7. Free-standing electrical service and transfer switch shall be housed in heavy-duty electrical weatherproof, NEMA 4X, stainless steel 304 enclosures securely mounted onto the rack a minimum of 24 inches above the ground. Provide 120-volt, 20-amp duplex, GFI, receptacle in an “in-use” weatherproof box with clear cover. Light switches shall also be installed in a weatherproof box with an “in-use” clear weatherproof cover.

6.8. All electrical equipment shall be protected from the 100-year flood event and be protected from potential flooding from the wet well. If the electrical equipment is raised significantly to be above the 100-year flood event, then a platform shall be constructed with rails and adequate working clearance in front of the electrical equipment, with permanent ladder or steps for access. As a minimum, Motor Control Centers shall be mounted on a four inch tall concrete housekeeping pad. All electrical equipment and connections in wet wells and dry wells shall be rated for Class 1 Division 1 explosion proof.

6.9. Automatic transfer switches, motor controls, dry type transformers, load centers, and Micro-Comm SCADA monitoring system for generators, and wiring gutters, shall be mounted on a single rack under the Canopy as shown in the Standard Drawings. Mounting rack shall be constructed of type 304 stainless steel strut, 1-1/2 inch minimum, mounted on a minimum four inch diameter and ½ inch thick hot dip galvanized structural steel tube. See mounting rack layout and structural details on the Standard Drawings. Approved manufacturers: UNISTRUT, Kindorf, and B-Line. Touch up with cold galvanizing compound any scratches where coatings are applied. Close all exposed tube ends with proper size PVC plug caps. Do not use the electrical service pole for supports.

6.10. If a stand by generator is not required, provide quick connectors and a NEMA 4X manual transfer switch. Quick connectors shall be Crouse-Hinds, cam-lok, E1016 or 1017 Series (depending on total electric load), male type. Five connectors – three phases, ground and neutral, and shall be installed within an enclosure adjoining the manual transfer switch. The manual transfer switch shall be Square D, Class 3140, 600-volt class, double throw, non-fused safety switch, NEMA 4X, Model 8234_DS, or City of Universal City-approved equal. Size the transfer switch to handle the entire load of the lift station. Approved Manufacturers: Square D, Siemens, General Electric, and Cutler- Hammer.

6.11. The generator transfer switch shall be of the automatic type. Generally the generator shall be diesel fueled, but in Edwards Aquifer Recharge and Contributing Zones, if natural gas service is available, the generator shall be fueled by natural gas. Diesel fuel tanks shall be base tanks integrated into generator unit by OEM, shall include double wall containment, and shall be sized to run the generator for at least 10 hours continuously at 100 percent load. The concrete base to install the generator shall be provided with a spill containment structure to capture any spillage (see Standard Drawings for details). The generator shall have a four foot clearance all around, and it shall be provided with noise control package. Noise Control Package Specification for Generator shall be residential rated. Sound attenuation includes enclosure and exhaust muffler package. Sound attenuation system performance shall result in measured sound levels not to exceed 78 dB @ seven meters (23 feet), 60 Hz. Design Engineer shall perform a load analysis with the sequence of motor starting in order to know the motor starting loads and the motor running loads. Such electric load

calculations must be done in kVA units to account additional loads due to low power factor. The generator shall have a motor starting kVA capacity to limit the voltage dip to no more than 15 percent for any motor starting conditions. Such generator load analysis must be included in the engineering report. Approved manufacturer is Caterpillar.

6.11.1. Generator shall have a non-walk in weather protective enclosure.

- Sheet steel with side servicing panels, air intake louvers and rear control panel access door.
- Side servicing panels shall have two locking points; all panels and doors are key lockable.
- Pitched roof with silencing exhaust muffler mounted outside the enclosure.
- Completely install enclosure on generator mounting base.

6.12. Provide terminal blocks and panel wiring for future remote start and stop contacts.

6.13. If a dry well is used, consider it a confined space, and provide explosion proof dry well lighting adequate to illuminate the ladder and the floor of the dry well.

6.14. All underground electrical conduits shall be grey, rigid nonmetallic conduit (RNC). Field manufactured bends are not permitted. Only factory fabricated conduit bends are allowed. Buried conduit shall have a cover depth of 18 to 24 inches beneath the finished surface. Conduit shall comply with minimum NEC bend radius and not burned or kinked.

6.15. All exposed conduit shall be rigid aluminum. To avoid tripping hazards, conduits must be buried and/or embedded in concrete slabs.

6.16. Provide general illumination of one foot-candle (average) on the lift station equipment areas. Use metal halide fixtures for general illumination. Mount task lighting to the canopy as detailed in the Standard Drawings.

6.17. Provide ability to operate station with one pump removed for maintenance, by utilizing a Hand-Off-Auto switch and control logic that keeps alternating all the remaining pumps in service and no parallel switching in order to allow for proper lockout procedures. For self priming pumps, provide local non-fused disconnect with auxiliary contacts at motor per NEC.

6.18. Provide explosion proof local control in dry well, when one is used, to operate pumps for testing.

6.19. Install all conduit runs in initial construction sized to meet ultimate electrical and instrumentation needs.

6.20. The pump controller shall be provided with alternating lead-lag controls within a NEMA 4X enclosure. The pump control enclosure shall have two doors (480V equipment installed on the right side, 120V equipment installed on the left side), and shall also contain the motor disconnect circuit breakers, motor starters, level controller, and soft starters (when required).

6.21. Soft Starters must include by-pass mode capability, and will be required for either motor sizes of 50+ HP; force mains of 5,000+ feet long; flow velocities of 5+ feet per second (at firm pumping capacity); or static heads of 60+ feet. Soft starters must be rated for operation at 50 ºC. Soft starter shall be capable of allowing accelerating and decelerating ramps of 60 seconds without de-rating the soft starter capacity; however accelerating and decelerating ramps will be easily programmable to lower values. Approved soft starter is Benshaw, heavy duty rated (500 percent FLA for 30 seconds and 125 percent FLA continuous), open type, model RB2 with MX2 controls and integrated bypass contactor, or City of Universal City-approved equal. When soft starters are required, the pump control panel must be insulated and provided with a closed- loop climate controlled unit of 2,200 BTU @ 95ºF (minimum) operating at 120 V. Climate controlled unit approved manufacturer is McLean model T20-0216-G100, or City of Universal City-approved equal. See Standard Drawings for details. Contact the City of Universal City for possibility of using louvers, filters and miniature exhaust fans as a cooling alternative to A/C units. Adequate clearance must be provided to service/replace the A/C units.

6.22. Special considerations for submersible stations.

6.22.1. Design electrical supply, control and alarm circuits to allow for disconnection outside the wet well. Terminals and connectors shall be protected from corrosion by location outside the wet well in a NEMA 4X stainless steel enclosure.

6.22.2. Locate the motor control center outside the wet well, readily accessible and protected by conduit seals, to meet the requirements of the NFPA National Electrical Code to prevent the atmosphere of the wet well to enter the control center. The seal shall be so located that the motor may be electrically disconnected without disturbing the seal.

6.22.3. Pump motor cables shall meet the requirements of the National Electrical Code for flexible cords in wastewater pumping stations. Power cord terminal fittings shall be corrosion-resistant and constructed in a manner to prevent entry of moisture into the cable, and shall be provided with strain relief appurtenances.

6.23. Grounding system shall have a maximum ground resistance of five Ohms. Design Engineer will incorporate special soils such as graphite compounds to improve the ground resistance properties. Ground moisturizing ports shall consist of one inch PVC Schedule 80 pipe (when directly buried in soil) or one inch Schedule 40 galvanized pipe (when embedded in concrete), with perforated holes of 1/8 inch diameter, be buried and placed as close as possible to the grounding rods, as indicated in the Standard Drawings. The function of the moisturizing port is to inject water during dry weather to moisture the soil and maintain the quality of the ground resistance.

6.24. All electric conduits shall be sized in a manner that electric conductors shall not overfill the conduits. The conductor filling percentage for all conduits shall not exceed 40 percent. For motors with insulated jacketed power cables provided by pump manufacturer as an integral part of the pumping unit, the diameter of the electric conduit for such power cable shall have a diameter 1.58 times greater than the outer diameter of the power cable. When the calculated diameter for the conduit lies between two standard conduit sizes select the next larger size.

6.25. Laminated wiring schematics of Pump Control Panel and SCADA Panel shall be provided to the City of Universal City. Also each schematic shall be placed in each respective panel.

7. SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM (SCADA)

7.1. The work to be accomplished under this section shall consist of furnishing the equipment necessary for a complete automatic control and monitoring system to function as specified herein and as shown on the drawings. The system integrator shall furnish a completely integrated all solid-state radio telemetry base Supervisory Control and Data Acquisition (SCADA) system. It shall be the system integrator's responsibility to supply a system that is compatible with existing equipment, new equipment supplied by others as part of this contract, and equipment supplied in other contracts. The complete system shall be designed, fabricated, programmed, tested, started up, and warranted by a single supplier to insure a single source of responsibility.

7.2. This section covers a radio telemetry based SCADA and Instrumentation System to include:

- Sewage Lift Station Remote Unit(s). Programming changes as required to the existing Central Terminal Unit and Operator Display Console to support monitoring and control of the above Sewage Lift Station RTU.

7.3. General/Electrical Contractor Shall Supply:

- All equipment required in other sections of the project specifications.
- All labor for installation and start-up of the system.
- Free Standing Antenna tower with adequate tower foundation and height to support radio communications to the existing SCADA system.

7.4. System Integrator Shall Supply:

- Engineering submittal and shop drawings prior to installation.
- All the paper work and fees necessary to obtain a FCC radio license in the name of the Owner.
- All user licenses and fees for software supplied in this system with licenses in the name of the owner.
- Interface Modules and or software changes for communications to the existing SCADA system.
- Operation and maintenance manuals, as detailed in this section.
- All start-up labor and services, as required for equipment specified in this section.
- Operator training as detailed in this section.

7.5. Owner Shall Supply:

- Access and easements as needed for all sites.
- 120VAC power at all sites.
- Pressure sensing taps for all sensing points in the system.
- Meter pits for sensing tank levels or line pressures in the system.

7.6. The system described herein shall be the product of a manufacturer who can demonstrate at least ten (10) years of satisfactory experience in furnishing and installing comparable radio based telemetry/control systems for water and wastewater

installations. The manufacturer of this system shall maintain a 24-hour available inventory of all replaceable modules to assure the Owner of prompt maintenance service and a single source of responsibility. The manufacturer shall certify this to the Engineer in writing at the time of pre-qualification.

7.7. The approved systems integrator is:

Micro-Comm, Inc.

15895 S. Plfumm Rd

Olathe, KS 66066

Tel: 913-390-4500

Fax: 913-390-4550

Other integrators desiring to bid a project as "alternate" integrators must seek approval from the City of Universal City by providing a submittal (14) days prior to the bid date. Submissions that fail to include a complete submittal as detailed shall be deemed unresponsive. The Consulting Engineer and the Owner shall be the sole judge as to whether the alternate equipment is considered an approved equal. Approval of an alternate system by the Engineer will not relieve the alternate system of strict adherence to these specifications. The pre-bid submittal shall include the following:

7.7.1. An installation list with the names and phone numbers of both the Owner and Consulting Engineer for at least ten projects of similar size and complexity.

7.7.2. A "statement of compliance" detailing paragraph by paragraph the developer's compliance to these specifications.

7.7.3. Block diagrams for the various sites in the proposed system showing the selected pieces of hardware equipment to be used.

7.7.4. Sample electrical drawings for typical sites proposed in the project contract.

7.7.5. A product performance data sheet shall be included for each hardware component in the system (i.e. antennas, radios, coaxial cables & arrestors, programmable controllers, power supplies, time delays and relays, and the various sensors required) and each software component (programming & configuration software and operator display console software).

7.7.6. Radio path study for each radio path in the system. Developers shall satisfy themselves that the necessary radio frequency(s) can be obtained. The radio path study provided by each developer shall utilize either:

- Computer generated techniques utilizing a USGS three second terrain database to plot the path profiles for each radio path with elevation samples at not more than 200 foot increments.
- Actual field measurements to showing the necessary antenna heights, transmitter power, and antenna gains required to insure a 20db fade margin as detailed in this

design guide. A physical path analysis shall be made using temporary equipment installations and a radio communications analyzer to measure actual path margins. The developer shall include in his bid, all the calculations used to extrapolate the measured data. The developer is expected to obtain the necessary temporary FCC license for the study.

7.7.7. Communications diagram for the entire system showing normal CTU-RTU communications paths and Peer-to-Peer back-up communications paths.

7.8. **Approval Agencies.** The control system and its components shall comply will all applicable requirements of the following:

- Electrical Code Compliance (National & Local)
- UL 508A
- IEEE Compliance
- EIA Compliance
- FCC Compliance

7.9. Complete submittal shall be provided to the engineer for approval prior to equipment fabrication. The submittal data shall include the following:

7.9.1. Product Data - Provide product data sheets for each instrument and component supplied in the system. The data sheets shall show the component name as used on reference drawings, manufacturer's model number or other product designator, input and output characteristics, scale or ranges selected, electrical or mechanical requirements, and materials compatibility.

7.9.2. Shop Drawings - Provide drawings for each panel showing the wiring diagrams for control circuits and interconnections of all components. The drawings shall include wiring diagrams for all remote devices connected to the panel.

7.9.3. Panel Layout Drawings - A front panel and sub-panel layout shall be included as part of each control panel drawing. Components shall be clearly labeled on the drawing.

7.9.4. Installation Drawings - Typical installation drawings applicable to each site in the system shall be included.

7.9.5. Operator Interface Software - The submittal shall include a generic but detailed technical description of the Operator's Interface Software as proposed for this system including:

- Sample text screens and menus
- Sample graphics screens
- Sample report logs and printed graphs

7.10. **Maintenance Information**. Submit maintenance manuals and "as built" drawings on all items supplied with the system. The manuals and drawings are to be bound into one or more books as needed. In addition to "as built" engineering submittal data and drawings, the manual shall include trouble shooting guides and maintenance and calibration data for all adjustable items.

7.11. **Job Conditions.** All instruments and equipment shall be designed to operate under the environmental conditions where they are to perform their service. The equipment shall be designed to handle lightning and transient voltages as normal environmental hazards. The environmental conditions are as follows:

7.11.1. Outdoor - The equipment will be exposed to direct sunlight, dust, rain, snow, ambient temperatures from -20 to +120 degrees F, relative humidity of 10 to 100 percent, and other natural outdoor conditions. The installations shall be hardened to with stand normal vandalism.

7.11.2. Indoor - The equipment will be capable of operating in ambient temperatures of +32 to +130 degrees F and relative humidity of 20 to 100 percent.

7.12. **Delivery, Storage & Handling.** All items shall be stored in a dry sheltered place, not exposed to the outside elements, until ready for installation. All items shall be handled with appropriate care to avoid damage during transport and installation.

7.13. **Sequencing & Scheduling.** The Systems Integrator shall coordinate with other electrical and mechanical work including wires/cables, raceways, electrical boxes and fittings, controls supplied by others, and existing controls, to properly interface installation and commissioning of the control system.

7.13.1. Sequence installation and start-up work with other trades to minimize downtime and to minimize the possibility of damage and soiling during the remainder of the construction period.

7.14. The control system shall use "Programmable Logic Controllers" (PLCs) at all locations in the system as detailed later in this design guide. Each site in the system shall have a unique digital address. The Central Processing Units (CPUs) and Input/Output (I/O) cards used in each of the PLCs shall all be identical, fully interchangeable without reprogramming by the operator. The PLCs shall be "self-initializing" and "self- restoring" so that operator intervention is not required after power interruptions, transients from lightning storms, or component changes.

The system shall be composed of a Central Terminal Unit (CTU) that monitors and or controls the operation of multiple Remote Terminal Units (RTUs). The CTU shall be composed of a PLC (as described above) and one or more Operator Display Consoles (ODCs) with Human-Machine-Interface (HMI) software to display, alarm, record, all data received and for operator input for changes to the system.

The control system shall be capable of implementing multiple modes of communications in a single system to include: radio, leased phone-line, dial-up phone-line, high-speed data highway, fiber optic, and Ethernet communications as detailed in these design guide. The individual sites in the system shall simultaneously support both Master-Slave and Peer-to-Peer communications as needed implement the distributed control features listed in this design guide.

7.15. **Distributed Control Software Features.** The system shall be a "distributed control" type system that simultaneously provides for the features of both "supervisory control" (i.e. centralize control of RTUs from the CTU) and "distributed control" (i.e. RTU self-initiated control using local inputs and peer-to-peer communications with other RTUs)

in to a single unified control system. The control system shall simultaneously support both Master-Slave (i.e. CTU to RTU) and Peer-to-Peer (i.e. RTU to RTU) communications to provide completely automatic control with no single point of system wide failure in either the PLC system or the communications system. The systems integrator shall implement redundant communications paths between RTUs to maintain automatic control in the event of CTU or system wide communications failure. The control algorithms shall have the ability to integrate both hardware and software operator inputs (i.e. ODC setpoints and selector switch inputs) along with hardware inputs at the remote sites (i.e. remote Hand/Off/Auto selector switches, etc.) in to a unified cohesive automatic control system. As data is received, changed, or lost (i.e. a loss of signal from a RTU or CTU), the Central Unit control logic shall automatically adjust the controlling algorithm to the new situation. In general the RTUs shall receive and store control parameter commands as inputted by the operator from the CTU and the RTU. These inputs shall be displayed at both the CTU and RTU. Distributed control shall provide for fully automatic by the RTU based on the pre-programmed control algorithm, operator inputs received from the CTU, operator inputs received from the RTU front panel display, data received from other RTUs, and local inputs monitored at the RTU. For example, the RTU shall based on operator inputs automatically control the operation of pumps or valves based on level data received from other RTUs and local pressure, flow, and discrete inputs monitored at the RTU. Pump call/run/fail status shall be reported to the CTU for centralize display, alarming, and recording. The RTU distributed control algorithm shall handle the daily pump call/run/fail, automatic alternation, automatic transfer on fail, high discharge cut-off, low suction cut-off, low & high flow cut-off and basic tank fill or demand supply operations at the pump station for RTUs as detailed for each RTU. Supervisory control shall automatically or manually provide for the CTU to be able to override or modify the automatic operation of RTUs based on a pre-programmed control algorithm. For example, the CTU shall be able to automatically turn on or off pumps at RTUs or change RTU operational parameters as needed to satisfy "system" wide requirements such as peak load shedding for power or water distribution management during peak demand periods. The control system shall provide for multiple levels of control such that a single point of failure shall not render the control system in-operative:

7.15.1. In the event of an ODC failure, the PLC shall continue to poll all of the RTUs to collect data and provide supervisory control.

7.15.2. In the event of PLC failure at the CTU, the individual RTUs shall continue to provide fully automatic control using last stored operator inputs and peer-to-peer communications with other RTUs for control data as needed.

7.15.3. In the event of peer-to-peer communications failure between RTUs, the controlling RTUs (i.e. sites with pumps, valves, etc.) shall continue to provide automatic control based on locally sensed pressures and flows.

7.15.4. In the event of complete failure of local RTU at a booster station (or similar site), the failure shall cause a "system normal" lamp and relay to be de- energized to automatically re-engage any existing back-up control system (such as pressure switches, float switches, etc.) to maintain automatic control.

The system shall automatically revert to the next higher level of control as communications or equipment failures are repaired.

7.16. **Standard Control Software Features.** The supplied software shall not be a one-of-a-kind system, but rather a comprehensively designed software platform that provides a number of built in features that monitor local & remote inputs combined with standard software algorithms to provide an integrated system as follows:

7.16.1. Monitor local Hand/Off/Automatic (HOA) selector switch positions (i.e. on existing pump control panels) and integrate the switch position in to the control logic such that a HOA in HAND or OFF shall be considered by the control system as "un-available".

7.16.2. Provide for High Discharge Cut-off and Low Suction Cut-off control of pumps from locally entered setpoints at RTUs equipped with suction and discharge pressure transmitters and/or from existing pressure switches.

7.16.3. Provide automatic Pressure/Flow pump staging operation of pumps of different sizes (including variable speed pumps) from local discharge pressure and discharge flow inputs in a closed-loop system. The pumps shall be up-staged on decreasing discharge pressure and down-staged on decreasing flow rate. The control shall include PID (Proportional Integral Derivative) loop control of variable speed pumps mixed with constant speed pumps for the various stages required.

7.16.4. Provide "Compound Loop" PID control of final devices (i.e. chemical feeders) from multiple inputs (i.e. flow rate and a chemical process analyzer, such as chlorine residual).

7.17. **Radio Channel Data Operation.** The control system shall be specifically designed for radio channel data communications. The core of the system shall be over FCC licensed radio frequency spectrum intended for SCADA and remote control purposes. The systems integrator shall be responsible of obtaining the necessary FCC licenses for one or more frequencies as needed to establish both supervisory and distributed control.

All of the equipment required for operation of the system shall be directly owned by the Owner and included in the project contract. Systems using third party repeaters, trunking masters, or leased equipment will not be allowed. The Systems Integrator shall select radio equipment as detailed below to insure reliable operation and be able to implement all software features listed in this design guide whether currently required or described as a "shall be capable" feature.

The overall system design and operation shall provide a 20db pad over the minimum required for operation on all primary data paths (primary paths may include data relays) to insure a 98 percent reliability of communications. Remote site communications for distributed peer-to-peer communications shall provide 30db of pad to insure operation under all weather conditions and provide a 99.9 percent communications reliability. The 20db and 30db pad requirements and FCC rule compliance shall be demonstrated (at no additional cost) to the Engineer at his request. The testing shall be accomplished using an IFR AM/FM 1000S communications analyzer or equal equipment.

7.18. **Communications.** The CTU-RTU supervisory communications and RTU-RTU distributed control communications system shall operate in a half-duplex mode over a single "licensed" radio frequency using "point-to-point" communication techniques. The RTUs shall monitor for the channel to avoid data collisions with other RTUs during peer-to-peer communications. The system shall be capable of sharing the radio channel with other radio telemetry system.

To facilitate system layout and future expansion all RTUs shall under the direction of the CTU be able to implement store-and-forward communications to relay data and commands to and from other RTUs as required to establish the desired path. Should the assigned relay site for a distant remote be inoperative, the Central Unit shall automatically choose another remote site to access the distant remote. Any RTU shall be able to provide automatic antenna switching as part of their relaying operations.

All data transmitted shall be in digital word form using FSK (frequency shift keying) transmission. All transmissions shall include the address of the sender and the receiver, and be subject to check sum, parity, and framing error checks, to insure a minimum data reliability of one error in 1,000,000,000 bits. Any transmissions that fail the data checking will be retried until correct. No data correction methods will be allowed. A plug-in RS232C data port shall be provided at all locations in the system to allow the use of a standard data terminal to view data exchanges between the sites and to provide a means of extensive de-bugging.

The system shall provide a complete data update at least once every (2) minutes with some functions updating faster as required by local system conditions.

7.19. **Radio Channel Operation.** The system shall be capable of operation on the narrow band splinter frequencies of the Private Land Mobile Radio Services within the Federal Communications Commissions (FCC) rules and regulations regarding these telemetry channels. The manufacture shall guarantee operation under co-channel conditions with other radio systems without interference to this system. FSK tones, data baud rates, transmitter output power, transmitter deviation, antenna gain, and antenna height shall be chosen to comply with the FCC requirements Part 90 – Subpart 90.35 and 90.238 for the Industrial/Business frequency pools. The radio system shall specifically meet the operating requirement that the sum of the highest FSK frequency and the amount of deviation shall not exceed 1.7 kHz for 3F2 emission (or 2.8 kHz for
6F2 emission) as detailed by the FCC for the specific frequency assigned.

CTUs and RTUs shall be capable of automatically switching antennas and/or radios (including radios on different frequencies) during CTU-RTU, RTU-RTU, and store & forward communications. The antenna/radio switching at remote units shall automatically default back to RTU-CTU paths if communications are lost with the CTU.

7.20. **FCC Licensing.** The system manufacturer/supplier shall be responsible for collecting all information, generating all paper work, and paying all fees required obtaining a license on behalf of the Owner.

7.21. Industrial Programmable Logic Controllers (PLCs) shall be used at all locations. The PLCs shall have an operational range of 0-60degC and five to 95 percent relative humidity. The PLCs shall all be from the same family of controllers, scalable from very

small to very large applications, and programmed from identical programming software used for all processors. The PLCs shall be readily available on and directly purchasable online from the manufacturer's website. The PLCs shall be Allen-Bradley CompactLogix or Micro-Comm M1550 Series controllers.

The software at all locations shall be stored in a user removable non-volatile CompactFlash or similar type ROM memory that can be exchanged under power, used to upgrade sites in the field, and store historical data (local trends, accumulators, etc.) for retrieval locally or by the central unit. The memory modules shall store all site-specific logic and configurations including communication parameters, control algorithms, analog input/output scaling, PID control parameters. The module shall be programmed via the CPU and without the use of external adapters. The PLCs shall include "watch- dog" circuitry and be "self-initializing" without operator intervention. In the event that the program or configuration data is corrupted, the CPU shall reload the program and configuration data from the EEPROM memory module.

The PLCs shall be fully online programmable while the PLC continues to communicate with the rest of the system and performs its assigned control tasks. The PLCs shall support "fill-in-the-blank" type configuration for basic operation and to set-up common features such as COM port set-up, peer-to-peer data collections, local back-up control set points, input and output setup, output on/off time delay settings, front panel display setup, etc. The PLC shall also support a process script language or ladder logic type programming for site-specific customizations including special input and output manipulations, local sequential control, math functions, and PID control as follows:

- Relay (Bit) Type - Examine if ON, Examine if OFF
- Timer & Counter - Timer ON, Timer OFF, Timer DONE
- Compare Functions - Equal, Not Equal, Greater Than, Less Than, etc.
- Math Functions - Add, Subtract, Multiply, Divide, Square Root
- Scaling Functions - Scale & Scale with Parameters
- Logical Functions - AND, OR, & NOT
- Program Control - Jump & Skip Next functions
- PID - PID with compound loop input

The PLC programming software shall be written for the 32 bit interface of Windows XP. The supplier shall provide a licensed copy of the PLC configuration and programming software along with the necessary communications cables to the owner. Training on the use of the software shall be provided as part of the system training.

7.22. **Construction.** The PLC shall use modular construction. The base unit shall be composed of the power supply, CPU, communications modules, and basic inputs and outputs (I/O). The unit shall have expandable inputs and outputs using a "rack-less" DIN rail mount design and capable of supporting local I/O (via an integrated high-performance serial I/O bus) and remote I/O via an industrial serial bus. All terminations shall use removable, NEMA-style "finger-safe" terminal blocks so that individual modules may be removed without disturbing adjacent modules.

The PLC shall be capable of being powered from AC, DC, or solar sources. DC and solar powered PLCs shall have an integral battery charging circuit that protects the external battery from over and under voltage conditions and provides automatic charging of the battery after power failures. The back-up power supply shall be either

12VDC with 24VDC DC/DC converter or 24VDC with a 12VDC DC/DC converter to run the 12VDC radio and 24VDC to power external sensors from a single battery source. Series tapped 24VDC batteries for 12VDC will not be allowed. Back-up batteries shall be rechargeable sealed lead-acid type batteries as manufactured by PowerSonic or equal. The back-up battery shall provide for 24 hours of back-up operation at water tower remote units and three hours at all other sites.

The PLC shall have a minimum of two (2) communications ports. The first shall be used primarily for CTU-RTU and RTU-RTU communications. It shall support baud rates of 110-19,200 baud and have a plug-in standard 25pin or 9pin sub-D connector that provides a full RS232 interface and radio modem interface. The second communications port shall provide programming, operator front panel interface, multiple PLC interconnect and other local communications. It shall support baud rates of 110-19,200 baud and have a 9-pin sub-D interface. The communications ports shall include LED's to show the status of all control lines. The PLC shall also optionally support Ethernet communications as detailed in this design guide.

The PLC shall utilize a rack-less design and provide for sufficient installed and configured spare inputs and outputs (I/O) to meet the site requirements as detailed and provide for 25 percent spares of each type. The unit shall have a minimum of (4) discrete (relay) outputs, (8) discrete inputs (DI), (4) analog inputs (AI), and (2) analog outputs (AO). The analog inputs shall provide for sensor excitation with separate fuses for each input. The fuses may be the self-resetting type. All input and output connections to the PLC shall be via Nema "finger-safe" plug-in terminal blocks.

The PLC shall support both local and remote I/O. Input/Output cards shall be mounted on a DIN rail channel. The PLC inputs, outputs, and operator interface shall be as follows:

7.22.1. **Discrete Outputs.** The discrete outputs shall be isolated relay outputs rated at 5.0A continuous @ 240VAC. LEDs on the front of the PLC base unit or expansion module shall indicate the status of each output point. Interposing relays shall be provided if the voltage or current of the external load on a contact exceed the 5.0A 240VAC ratings. Each output shall be provided with operator settable software ON and OFF time delays.

7.22.2. **Discrete Inputs.** The discrete inputs shall be optically isolated and provide for 24VDC excitation to remote sensors and switches. Each input shall be separately fused or current limited such that accidental grounding shall not render the other inputs non-functional. LEDs on the front of the input module shall indicate the status of each input point.

7.22.3. **Analog Inputs.** The analog inputs shall provide filtered and scalable analog to digital conversion of input signals. The analog inputs shall be switch selectable from 0-5VDC to 0-20mADC and provide a minimum of 0.3 percent resolution and 0.5 percent accuracy over the temperature range of 0-70degrees C. The PLC shall provide separately fused 24VDC excitations to the remote sensors.

7.22.4. **Analog Outputs.** The analog outputs shall provide a 4-20mA isolated signal to other panels and devices as specified.

7.22.5. **Pulse Inputs.** The high-speed counter/pulse inputs shall provide for pulse rates up to 1KHz direct from flow meter transmitter heads without interposing equipment. The pulse input shall include fused 12VDC excitation to the meter transmitter.

7.22.6. **Power Supply.** Each PLC assembly shall include an integral power supply. Power supplies shall be designed for 12VDC or 24VDC input power and suitable for use in battery back-up operations. DC/DC converters shall be required to insure that both the 12VDC and 24VDC are regulated separately from the common source.

7.22.7. **Keypad & Display Unit.** The optional keypad & display unit shall have a 4x20 back-lighted LCD display to display the status of all local inputs and the tank level of the associated control water tower level. The 5x5 keypad shall provide for operator input of set points and timer settings. The operator interface shall be menu driven and provide for dedicated keys for cursor position and input functions. The operator interface shall provide for up to 50 screens of data display. The keypad & display unit shall be supplied and mounted on the front of the PLC enclosure if detailed in the specific PLC I/O requirement list. The keypad & display unit shall maintain the Nema 4 rating of the PLC enclosure.

Refer to "Detailed Equipment Description" at section 870.8 for specific front panel display requirements.

7.23. **Enclosures.** The remote unit enclosures for indoor mounting shall meet all the requirements for NEMA Type 12 enclosures. The enclosures body shall be made of a minimum 14 gauge steel with continuously welded seems and be furnished with external mounting feet. The enclosure door shall be made of minimum 16 gauge steel with a 14 gauge steel hinge. Enclosures larger than 16x14 shall have a rolled lip on three sides of the door for added strength. The door opening shall have a rolled edge on four sides to protect the door gasket. The door gasket shall be heavy neoprene and attached to the door with oil resistant adhesive. Sub-panels shall be 14- gauge steel for 16x14 enclosures and 12 gauge for larger enclosures. The enclosure finish shall be gray polyester powder coating inside and out over phosphatized surfaces. The subpanels shall be finished in white. Nema 12 enclosures shall be Hoffman "CH" or "CONCEPT" wall mount enclosures.

Remote site installations requiring equipment to be mounted outside shall have a double box enclosure with the remote unit enclosure mounted inside a lockable NEMA 3R enclosure. The double enclosure shall be required to control vandalism, provide complete weather protection, reduce the heating effects of the sun, and prolong the life of the equipment. The NEMA 3R enclosure shall be constructed of 14 gauge galvanized steel, with a drip shield top and seems free sides front and back, and a stainless steel hinge pin. The enclosure finish shall be gray polyester powder coating inside and out over phosphatized surfaces. The NEMA 3R enclosure shall be Hoffman Bulletin A-3.

The remote unit enclosures mounted in damp corrosive areas (such as concrete meter vaults) shall be NEMA Type 4X rated enclosures. The enclosures shall be made of molded fiberglass polyester and be furnished with external mounting feet. The door shall have a seamless foam-in-place gasket and corrosion-resistant hinge pin and bails. Sub-panels shall be 14-gauge steel for 16x14 enclosures and 12 gauge for larger enclosures. The enclosure finish shall be a light gray inside and out. The

subpanels shall be finished in white. Nema type 4X enclosures shall be Hoffman "Fiberglass Hinged Cover".

Refer to "Detailed Equipment Description" at section 870.8 for specific front panel display requirements.

7.24. **Local Control Functions.** In general the PLC shall be programmed to provide generic control functions as detailed earlier and to work in concert with the CTU. The integrator shall be responsible to meet with the owner and the engineer to develop the automatic control strategy required for the system.

Refer to "Detailed Equipment Description" at section 870.8 for specific front panel display requirements.

7.25. The radio transceivers shall be standard "un-modified" radios that can be tuned, aligned, and repaired at any two-way radio shop. Interface to external data modems shall be through the front panel microphone jack. The radios shall be synthesized and fully field programmable and include a built-in time-out timer to disable the transmitter after 0-60seconds. The units shall be tuned to FCC specifications for the specific frequency assigned. The radio equipment shall be FCC type approved and the system capable of operation on the 3KHz or 6KHz narrow band splinter frequencies (154 or 173MHz) in the Industrial/Business radio service.

7.26. **VHF Radio Transceiver (154Mhz or 173Mhz).** The system manufacturer shall supply a 5-watt VHF radio transceiver to insure a high level of quality and reliability. The radios shall be adjustable to 4-watts output power as may be required by the FCC for ERP (Effective Radiated Power) restrictions. All connections to the radio shall be plug-in. The VHF radio transceiver shall have the following specifications:

Transmitter:

RF output power	25 watts minimum (adjustable to 4)
Spurs & Harmonics	16 dBm (25uW) (or -50dBc)
Frequency stability	±0.00025% (-30 to +60 degrees C) Emission 6F2 (2.5kHz DEV max) or 3F2 (1.2kHz DEV max)
FM hum and noise	-40 dB
Receiver:	
Sensitivity	0.35uV @ 12 dB SINAD (.5uV @ 20db quieting)
Selectivity	-65 dB
Spurious image rejection	-50 dB
Inter-modulation	-65 dB
Frequency stability	±0.00025% (-30 to +60 degrees C) Receive
bandwidth	*6kHz (or 3kHz) as required to match the transmitter

* The receiver bandwidth shall be reduced to match the transmit bandwidth of the transmitter q and provide a minimum adjacent channel rejection of -50db.

The radio transceivers shall be a Motorola Radius CM200 or a Microwave Data Systems 1710.

7.27. **Antenna & Coaxial Cable.** The radio antennas at all locations shall be a five element Yagi, constructed with 3/8 inch diameter solid aluminum rod elements and 1-1/16 inch diameter aluminum pipe element support with a type N coaxial connector. The antenna shall have a minimum 8.0db forward gain with a 20.0db front-to-back ratio. The antenna shall be wind rated for a 100-MPH wind speed. The VHF antennas shall be MC-Yagi or Celwave PD688S. The UHF antennas shall be MC-Yagi or Celwave PD688S

Antennas shall be cabled to the transmitter enclosure connection by a RG/8U type low loss (less than 1.8db per 100ft @ 100MHz) coaxial cable with cellular polyethylene (foam) dielectric. The coaxial cable shall have a braided copper shield coverage of 97 percent and a long life weather resistant polyvinyl chloride jacket. The antenna coaxial cable connection shall be a constant impedance weatherproof Type N connector, taped with a weather resistant electrical tape to insure a lifetime watertight assembly. The coaxial cable shall be Belden 8214 or 9913 cable.

7.28. **Antenna Lightning Protection.** Coaxial connection to remote and central unit enclosures shall be by means of a coaxial type bulkhead lightning arrestor. The units shall be rated at 1-kilowatt with a minimum 500V and maximum 2000V-breakdown voltage. Coaxial lightning arrestors shall be a PD-593 or PolyPhaser IS-B50LN-C1.

7.29. **Antenna Mounting Systems.** Antennas shall be mounted at a height above ground that is consistent with FCC rules and regulations and provides adequate signal fade margin as described earlier. Antennas must be a minimum of 15 feet above ground and mounted as follows:

7.29.1. **Antenna Towers (greater than 20 feet).** A bracketed antenna tower shall be supplied where specifically noted on the plans or in the RTU & CTU site descriptions. The tower shall be assembled from 10 sections built on a 12-1/2 inches (or 18 inches for ROHN 45G) equilateral triangle design. Tower sections shall be constructed of 1-1/4 inch steel tubing with continuous solid steel rod "zigzag" cross bracing electrically welded to the tubing. The entire 10 foot sections shall be Hot-Dip Galvanized after fabrication for long life. The antenna towers shall be ROHN Model 25G (for unsupported heights of up to 33 feet) or ROHN Model 45G (for unsupported heights less than 45 feet).

7.30. All items in the control system (electronic cards, power supplies, radios, time delays, relays, etc.) shall be of plug- in construction, make use of a plug-in wiring harness, use plug-in terminal blocks, and be interchangeable without recalibration. To insure field repair-ability by non-technical personnel, equipment that must be un-wired for replacement will not be accepted.

The following instrumentation devices and techniques shall be used as specifically called for in the RTU and CTU input/output sections of this design guide.

7.31. **Power Supplies.** The DC power supplies shall provide ±0.1 percent line and load regulation with ±10 percent input variations. They shall have a temperature coefficient of ±0.02 percent per degree C. The input/output isolation shall be 100 Mohms DC (900Volts AC) with output transient response of 50 microseconds maximum. The power supplies shall be sized to operate the remote unit equipment with or without the back-up battery in place. Power Supplies shall be a Power One Series MAP130, Sola SLS, or approved equal.

7.32. **Battery Back-Up Operation.** The remote units indicated shall be supplied with battery back-up operation. The rechargeable batteries shall be the sealed solid gelled electrolyte types, designed for float or standby service. Unless noted otherwise in the RTU descriptions, batteries shall be sized to maintain 24 hour service at water tower remotes and eight hour service at pump stations and other remotes. The remote shall include a charging module to recharge the battery when power is resumed, maintain the charge between outages, and provide a low voltage cut-off to protect the battery from excessive discharge during prolonged outages. All discrete, analog, and pulse inputs (i.e. switch closures, pressure, level, flows, etc.) shall continue to function on battery backup. Batteries shall be Globe Gel/Cell or approved equal.

7.33. **Single Phase 120VAC Power Line Lightning Protection.** Every site in the system shall be equipped with AC line filtering and lightning protection. The equipment shall provide 2-stage lighting/transient protection including inductive and capacitive filtering and MOV over-voltage protection.

7.34. **Level & Pressure Transducers.** Level & pressure transducers shall be of the all solid- state two-wire transmitter type with a 4-20mA output from a 10.5-24VDC excitation. The units shall be powered from the RTU power supply. The transducers shall have a combined error (linearity and hysteresis) of ±0.25 percent full scale and be temperature compensated to ±2.5 percent per 100 degrees Fahrenheit. Zero and span adjustments shall be standardized so that transducers are interchangeable without recalibration. All exposed or wetted parts shall be series 316 stainless steel, PVC, or Buna-N. The units shall be capable of a three times full scale over pressure without damage or change of calibration.

The transducers shall be mounted at the sensing point and wired to the enclosure. The transducers shall have a 1/4 inch or 1/2 inch NPT process pressure connection. Transducers for above ground mounting shall have a 1/2 inch conduit connection for cable entry. Transducers at water towers (and other outside locations) shall be mounted below grade and below frost line to prevent freezing. Below grade mounted units shall have factory signal cabling and be suitable for a minimum of 100 foot submerged duty.

Level transducers for clear-wells and wet wells shall be suspended in the clear-well or wet well and supplied with sufficient factory installed cable to access a "clean/dry area" junction box. The suspension cable shall have a polyethylene jacket and internal venting to provide for atmospheric sensing of the non-process side of the diaphragm. The sensors shall have a multi-ported pressure-sensing end that protects the diaphragm while sensing the level of viscous liquids or slurries. The cable connection in wet-well applications shall have a non-fouling guard to prevent buildup of foreign materials.

Pressure/Level transducers shall be Micro-Comm L5N series, Consolidated A300 Model 221GEE, or Ametek Model 57S.

7.35. **High/Low Wet Well Floats.** The high/low wet well alarm floats shall be direct acting float switches. The floats shall have a polypropylene case containing a hermetically sealed mercury switch and be supplied with 40 feet of PVC type STO cable. The float switches shall be Anchor Scientific Roto-Float series, Cynergy4 FFseries, or approved equal.

7.36. **General.** The existing "Central Unit" is composed of two or more separate CPUs communicating over a high-speed serial data links. The first computer (called the Central Terminal Unit or CTU) is a PLC as specified earlier and provides all communications with remote units, local inputs and outputs, and local hardware display devices. The second computer (called the Operator Display Console or ODC) is responsible for the operator interface to the system and provides display, alarm, and logging of all data.

7.37. **Local Control Functions.** In general the CTU and ODC shall be programmed to provide generic control functions as detailed earlier. The integrator shall be responsible to meet with the owner and the engineer to develop the automatic control strategy required for the system. The existing CTU and ODC programming and software shall be upgraded as required to provide monitoring of the new lifts station site.

Refer to "Detailed Equipment Description" at section 870.8 for specific front panel display requirements.

7.38. **Equipment Examination.** The control system shall be completely tested prior to shipment. The entire control system shall be "Burned In" at the factory for a period of at least 20 days. The component equipment shall be computer tested and temperature cycled at zero degrees and at fifty degrees centigrade.

7.39. **System Start-Up.** The manufacturer shall supply "Factory" personnel for start-up service as needed to insure satisfactory operation. Subsequent trips to the job site to correct defects shall be made at no charge to the Owner during the warranty period.

7.40. **Warranty/Support Program**

The control system manufacturer shall supply a FIVE (5) year parts and labor warranty and comprehensive support program for all items and software supplied under this section (except as noted below). Power surges and lightning damage shall be included as part of the warranty.

The warranty shall begin from the time of "substantial completion" as issued by the engineer. The manufacturer shall provide a 24-hour response to calls from the Owner. The manufacturer, at his discretion, may dispatch replacement parts to the Owner by next-day delivery service for field replacement by the Owner. Any damage to the control system caused by the actions of the Owner in attempting these field replacements shall be the sole responsibility of the manufacturer. If, during the warranty period, satisfactory field repair cannot be attained by field replacement of

parts by the Owner, the manufacturer shall dispatch "factory" personnel to the job site to complete repairs at no cost to the Owner.

The support program shall begin from the time of "substantial completion" as issued by the engineer. The support program shall include free updating of all software as needed and providing free phone support from the integrator throughout the warranty period.

Instrumentation supplied, as part of the project contract shall be covered by a one (1) year warranty beginning with "substantial completion".

8. DETAILED EQUIPMENT DESCRIPTION

8.1. Lift Station Requirements.

8.1.1. Installation Requirements:

Sites: New Lift Station

Telemetry Control and Pump Command outputs (if required) to other panels shall be dry isolated contacts on relays. Local pressure inputs shall be by two-wire transducers as specified.

The Lift Station equipment shall be housed in a NEMA 4X Fiberglass enclosure as specified earlier. The lift station equipment shall include an internal power switch, power supply radio, PLC modules bulkhead coaxial cable lightning arrestor, front panel mounted 4x20 keypad/display unit and a power line lightning arrestor as specified earlier.

The antenna shall be mounted on a free standing antenna tower as determined by the systems integrator with 3/4 inch rigid conduit and a weather-head run to the RTU enclosure for a below ground well pumps as previously specified. The tower shall be located within the lift station site in a place where maintenance vehicles have straight access. The minimum separation between the tower and overhead electric lines shall be 40ft.

8.1.2. Front Panel Display Requirements:

1. Keypad & Display assembly to display all inputs and output status

8.1.3. Discrete Outputs:

1. Spare
2. Spare
3. Spare
4. Spare

8.1.4. Discrete Inputs:

1. Power Failure/Power Normal
2. Pump #1 RUNNING
3. Pump #2 RUNNING
4. Pump #1 Stator Leak (dry contact supplied by others)
5. Pump #2 Stator Leak (dry contact supplied by others)

6. Pump #1 Motor Overload trip (dry contact supplied by others)
7. Pump #2 Motor Overload trip (dry contact supplied by others)
8. Pump #1 High Motor Temperature (dry contact supplied by others)
9. Pump #2 High Motor Temperature (dry contact supplied by others)
10. Pump #1 In Auto (from pump control panel by others)
11. Pump #1 In Hand (from pump control panel by others)
12. Pump #2 In Auto (from pump control panel by others)
13. Pump #2 In Hand (from pump control panel by others)
14. High Wet Well (scripted from wet well level analog input or separate float switch)
15. Low Wet Well (scripted from wet well level analog input or separate float switch)
16. Transfer Switch Fail (dry contact by others)
17. Generator Running (dry contact by others)
18. Generator Fail/Overcrank (dry contact by others)
19.- #24. Spare Inputs

8.1.5. Analog Inputs:

1. Wet Well Level (New Transducer as specified earlier)
2. Force Main Pressure (4-20mA from Pump Control Panel Supplier)
3. Panel Internal Temperature (from internal PLC/RTU temperature sensor)
4. Spare

8.1.6. Analog Outputs:

1. Spare
2. Spare

9. EMERGENCY PROVISIONS

9.1. Lift Stations shall be designed to insure that no discharges of untreated wastewater will occur at the lift station or any point upstream of the collection system due to loss of power or mechanical failure within the operating time frames defined in this section. All lift stations shall be provided with service reliability based on the following paragraphs.

9.2. The wet well emergency storage capacity of lift stations over the Edwards Aquifer Recharge and Contributing Zones shall be provided with a wet well storage capacity equal to 60 minutes calculated with Average Daily Flow. In addition to the 60-minute wet well emergency storage capacity requirement, emergency power shall be provided by on-site stand-by generator and automatic transfer switch sized to operate 100 percent of lift station electric loads. See Section 870.6.10 and Standard Drawings for generator requirements. In addition force mains shall be double barrel, and the pumps shall be able to discharge at firm pumping capacity through a single force main.

9.3. The wet well emergency storage capacity of lift stations not over the Edwards Aquifer Recharge, Contributing and Transition Zones shall have the wet well and incoming gravity sewer lines designed to insure that no discharges of untreated wastewater will occur at the lift station or any point upstream of the collection system for a period of time equal to 120 minutes (calculated with Average Daily Flow) of wet well emergency storage (excluding the upstream collection system) for lift stations with on-site stand-by generators. If no records are available, the designer shall use 120 minutes of Average Daily Flow (ADF) to calculate required retention capacity. The City of

Universal City may allow a minimum of a 60-minute retention time if a stand-by generator is included in the design. Power outage records shall be on the utility company letterhead, bear the signature of a utility representative, identify the location of the lift station, list the total number of outages that have occurred in the past 24 months, and indicate the duration of each power outage. For calculation purposes, the start of the outage period or mechanical failure shall begin at the Lead Pump On level elevation. See Section 870.3.2 for clarification.

9.4. The use of a spill containment structure as a means of providing service reliability is prohibited. Spill containment structures may be used in addition to one of the service reliability options detailed in this section, provided a detailed management plan for cleaning and maintaining the spill containment structure is discussed in the final engineering design report. Additionally, any spill containment structures shall be fenced with an eight foot fence which has a minimum of three strands of barbed wire and which has a locked gate. Spill containment structures shall not be used to reduce other power reliability requirements in any way.

9.5. An audio-visual alarm system (red flashing light and horn) shall be provided for all lift stations. The audiovisual alarm shall be activated only by wet well high level alarm, by both level controller and high level float switch.

9.6. Emergency (quick-connection) pump by-pass system shall be provided at all lift stations.

Connection shall be sized according to station and header pipe size (four, six or eight inches), and shall consist of a gate valve and adapter flange with camlock “quick-disconnect” male fitting with dust cap. Provide a check valve to allow flow only in the Force Main discharge direction.

9.7. Lift stations equipped with soft starters must be provided with a full voltage by-pass starter to by-pass the soft starter units should they become damaged. The motor control panel must be provided with a selector switch that will allow operating the motors through soft starter or regular starter.

10. SAFETY REQUIREMENTS

10.1. **Overhead Wires.** Do not run overhead wires over lift station site. Overhead wires include, but are not limited to, primary and secondary electric lines, electric service drop, and cable and telephone lines. If a secondary overhead electric service drop is required to feed the lift station, the service pole must be located in a place where the service drop will be at least: 10 feet away from canopy, 20 feet away from wet well, header piping and generator, and 40 feet away from SCADA tower structure.

10.2. **Electric Conduits and Small Pipes.** Eliminate tripping hazards from electric conduits and small pipes across the surface of the lift station. They must be buried in the ground or embedded in concrete slabs.

10.3. **Arc Flash Analyses.** Include an Arc Flash Analysis in engineering report. Reduce arc flash Hazard/Risk Rating to Category 2 if they originally are Category 3 or 4 by making adjustments to circuits. Electric panels must include proper warning labels.

10.4. **Bollards.** Install bollards to protect equipment located at the end of driveways, or in tight locations. If lift stations are adjacent to streets of driveways, install bollards between the equipment and the street. Removable bollards in buried sleeves are acceptable.

10.5. **Handrails.** Install removable aluminum handrails around wet well openings and dry vault openings. Portable handrails must slide into sleeves embedded in the concrete slabs. Surface-mounted brackets are not acceptable. Design shall comply with OSHA Standards, 1910.23 or 1910.27 as applicable.

10.6. **Enclosed Dry Vaults (if approved).**

10.6.1. Install blowers and lights. Circulation of fresh air in vaults would have to be complete and deliver at least six air changes per hour.

10.6.2. Locate access covers and ladders so personnel entering the vault land on flat surface, rather than on top of pipes, valves or other equipment.

10.6.3. Provide at least a 28 inch clearance around pipes and mechanical structures and at least 36 inches for all electrical equipment and panels for employee access.

10.6.4. Ladders (if used) shall be of aluminum and shall comply with OSHA Standards, 1910.23 or 1910.27 as applicable.

10.7. Design shall include a freeze proof emergency eyewash and shower station located within 10 foot radius of wet well.

10.8. One or more lockable aluminum hatch covers with anti-slip top surface shall be installed in the wet well cover for access to the wet well, pumps, floats and level control devices. Minimum hatch dimensions shall be three feet by four feet, or as required; allowing plentiful clearance for removal of submersible pumps and access to wet well. Hatch safety grate shall be installed to provide fall protection and shall consist of aluminum material. Safety Grate shall be designed to have gaps of not more than five inches, and to be flush with the top of the wet well concrete slab. Black and yellow strips shall be painted around access hatch using Epoxy Enamel (Tnemec, or equal) coating system. Also a “Caution! Fall Hazard” sign shall be painted/stenciled on all four sides of the hatch. Coating requirements and thickness shall be in accordance with Manufacturer’s recommendations.

10.9. No fixed ladders are permitted in the wet well; however when used elsewhere, ladders shall be aluminum with non-skid rungs and must comply with all other of OSHA 1910.27, Fixed Ladders requirements.

11. SUBMITTAL REQUIREMENTS

11.1. An engineering design report that include construction feasibility and site analysis, a present value analysis with detailed capital and O&M cost estimate, flow development for initial and final phases of the development, wet well design, wet well detention time and force main flush time for both initial and final phases, system curves, pump curves and head calculations (Total Head including Static Head, Friction Losses, Minor Losses, NPSH, Total Suction Lift (when applicable)).

Calculations and system curves at both minimum (all pumps off) and maximum (last normal operating pump on) static heads, and friction losses based on material of pipe selected, for each pump and for the combination of pumps (modified pump curves). Buoyancy calculations for the wet well in order to design a concrete slab heavy enough to keep the wet well in place. Energy consumption calculations shall be presented comparing different pumps, impellers and pipe sizes in order to select the most efficient pump. Where a suction lift is required, the report shall include a calculation of the available net positive suction head (NPSH) and a comparison of that value to the required NPSH for the pump(s) selected, as well as calculations for the total suction lift. The overall layout of the development and the development master plan shall be submitted for City of Universal City review.

11.2. The engineering design report shall be presented in the following format, although the designer is not required to use the same formulas:

11.2.1. **Title Page.** Title page should include the project name, date, developer/owner's name and engineering firm preparing plans.

11.2.2. **Sewer System Information.**

11.2.2.1. Introduction
a) Type, Location and size of development
b) Number of and range in size of lots or buildings to be serviced

11.2.2.2. Existing Sewer System
a) Location and type of gravity system the force main will discharge into.
b) State whether the entire development will be serviced by the proposed phase or if several phases will be involved.
c) State the number of lots this phase will encompass initially and finally if future phases are to be constructed.

11.2.3. **Pump Station and Force Main Design Calculations.** (The following formulas are provided as guidelines. The design engineer can use other formulas, of preference, to achieve the same results.)

11.2.3.1. Site Characteristics, And Allowances, To Calculate Flows:
a) Residential EDUs @ 240 gals/day per EDU
b) Commercial SF @ 0.07 gals/day per SF
c) Multi-family Units @ 0.70 EDUs per Unit
d) Peaking Factor – 2.5 times the Average Daily Flow
e) Inflow and infiltration (I/I) Allowance of 300 GPD/acre

11.2.3.2. Average Dry Weather Flow (ADF): This is the flow developed without the maximum flow peaking factor. This flow is used to determine the average detention time in the wet well.
a) ADF (GPD) = Residential (single and multi-family) + Commercial GPDs
b) ADF (GPM) = ADF (GPD) / 1440 (Min/Day)

11.2.3.3. Peak Dry Weather Flow (PDWF): This flow is used to determine pipe size in the collection system.
a) Peaking Factor = 2.5 for Proposed Residential Development

b) PDWF (GPD) = PF * ADF
c) PDWF (GPM) = PF * ADF (GPM)

11.2.3.4. Peak Wet Weather Flow (PWF): This flow is used to determine the lift station design capacity. All lift stations shall be designed to handle the maximum wet weather flow for its service area.
a) Inflow and Infiltration (I/I): Total Development Acreage * 300 GPD/acre
b) PWF (GPD) = PDWF (GPD) + I/I (GPD)
c) PWF (GPM) = PWF (GPD) / 1440 (Min/Day)

11.2.3.5. Minimum Dry Weather Flow (MDWF): This is used to determine the maximum detention time in the wet well.

$$MDWF = (0.2* (0.0144 * ADF)^{0.198}) * ADF$$

11.2.3.6. Minimum Pump Requirements (Peak Wet Weather Flow, PWF):
a) For two-pump stations, size each pump to handle PWF.
b) Calculate Total Dynamic Head (TDH):
   1) Static Head (Hs)
      Eh = Maximum force main elevation
      El = Wet well low water elevation
      Hs = Eh – El
   2) Loss (Lf) due to friction in force main
      Length = Total equivalent length of force main and piping on station
      Lf = Length x Friction Factor
      (Use Hazen-Williams C of 100 and 140 for friction losses)
   3) TDH = Hs + Lf
c) Plot System Curve on Pump Curve and determine operating point to select proper pump sizes.

11.2.3.7. Net Positive Suction Head: For suction lift stations, compare the net positive suction head ($NPSH_R$) required by the pump with the net positive suction head available ($NPSH_A$) in the system, at the operating range. The NPSH available shall be greater than the NPSH required by at least three feet.

$$NPSH_A \text{ (suction lift)} = P_B + H_S - P_V - H_{fs}$$

Where:
P_B = barometric pressure in feet absolute, use 33.4 feet
H_S = minimum static suction head, in feet
P_V = vapor pressure of liquid in feet absolute, use 1.4 feet
H_{fs} = friction loss in suction, in feet (including entrance losses and minor losses)

a) Velocity Produced in Force Main with one pump in operation shall be between three and 3.5 feet per second. 4.8 feet per second or less with two pumps in operation. Six feet per second or less for three pumps in operation. May be as low as two fps with one pump in operation for lift stations with three or more pumps:

$$Vfm = 0.4087099 * (Q / d^2)$$

Where:
Q = Discharge flow for selected pump(s), in gpm
d = Force Main interior diameter, inches

11.2.3.8. Total Suction Lift:

a) A total suction lift calculation must be performed for self-priming pumps. The total suction lift is the addition of the static suction lift plus the friction losses along the suction pipe. The static suction lift is the distance between the wet well level elevation at All Pumps Off and the elevation of the impeller eye.

Total Suction Lift = Static Suction Lift + Friction Losses along Suction Pipe

Static Suction Lift = Impeller eye elevation – elevation of wet well level at All Pumps Off

11.2.3.9. Storage Requirements:

a) Required Wet Well Volume (volume between "lead pump on" and "all pumps off" elevation):

Vr (Gals) = Pump GPM * T (Minimum Cycle Time, Table 870-3, Section 870.4 of this document)

b) Required Volume of Storage (Vs)

• Not over the Edwards Aquifer recharge, transition and contributing Zone:
Vs (Gals) = ADF (GPD) * [(1hr. min/2 hr. max storage) / 24 hours per day]

Vs (CF) = Vs (Gals) / 7.481 CF per Gal
• Over the Edwards Aquifer recharge, transition and contributing Zone:
Vs (Gals) = ADF (GPD) * [(1hr.storage) / 24 hours per day]
Vs (CF) = Vs (Gals) / 7.481 CF per Gal

c) Dimensions of Storage Facility

1) Wet Well diameter, minimum 72 inch diameter
2) Wet Well Depth = $\frac{4\ x\ Vs\ (CF)}{\pi\ x\ D^2}$

Where:
VS = wet well storage volume in cubic feet
D = wet well inner diameter in feet

11.2.3.10. Buoyancy Checks: A buoyancy check shall be performed for the pump station wet well and the retention chamber.

11.2.3.11. Water Hammer Calculations: Calculate surge pressures and compare to the pressure rating of the force main pipe to determine the need for a surge relief valve.

$$a = \frac{4660}{2\sqrt{\frac{Ew\ x\ Di}{Ep\ x\ Tp}}}$$

Where:
a = pressure wave velocity factor
Ew = water bulk modulus (300,000 psi)
Di = force main pipe inner diameter (inches)
Ep = force main material modulus of elasticity (130,000 psi for HDPE)
Tp = force main pipe wall thickness (inches)

$$P = \frac{a\ x\ V}{2.31\ x\ g} + \text{operating pressure}$$

Where:
P = water hammer pressure (psi)
a = pressure wave velocity factor
V = flow velocity in force main at firm pumping capacity (ft/s)
g = acceleration of gravity (32.2 ft/sec²)
2.31 = conversion factor

11.2.3.12. Force Main Flush Time Calculations: Calculate force main average flush time.

Instructions:

a) Basic Information Required:
1) Wet Well Diameter (D)
2) Distance between All Pumps Off and Lead Pump On ($\Delta h_{On\text{-}Off}$)
3) Wet Well Inflow (Q_i)
4) Pumped Flow (Q_o)
5) Force Main Length (L)

b) Basic Calculations Required:
1) Wet Well Filling Time (WWFT) The wet well filling time is the time that takes to raise the wet well level from All Pumps Off to Lead Pump On.
2) Pump Running Time (PRT) The pump running time is the time that takes to drop the wet well level from Lead Pump On to All Pumps Off.
3) Pump Wet Well Detention Time (WWDT) The wet well detention time is the addition of the wet well filling time plus the pump running time.
4) Flushing Cycles (FC) The flushing cycles are the number of cycles required to flush the force main.
5) Flush Time (FT) The flush time is the time that takes to flush the force main completely.

c) Formulas:
1) Equation 1: Wet Well Filling Time (WWFT)

$$\text{WWFT} = \frac{7.481\pi D^2(\Delta h_{On-Off})}{4Q_i}$$

Where:
D is the Wet Well Diameter in feet
$\Delta h_{On\text{-}Off}$ is the distance in feet between Lead Pump On and All Pumps Off
Q_i is the wet well inflow in gal/min

WARNING!
Use Average Daily Flow to calculate Average Wet Well Filling Time.

2) Equation 2: Pump Running Time (PRT)

$$PRT = \frac{7.481\pi D^2(\Delta h_{On-Off})}{4(Q_o - Q_i)}$$

Where:
D is the Wet Well Diameter in feet
Δh_{On-Off} is the distance in feet between Lead Pump On and All Pumps Off
Q_i is the wet well inflow in gal/min
Q_o is the pumped flow in gal/min

WARNING!
Use Average Daily Flow to calculate Average Pump Running Time.

3) Equation 3: Wet Well Detention Time (WWDT)

$$WWDT = WWFT + PRT$$

Where:
WWFT is the wet well filling time in minutes
PRT is the pump running time in minutes

WARNING!
Use average wet well filling time and average pump running time to calculate average wet well detention time.

4) Equation 4: Flushing Cycles (FC)

$$FC = \frac{L}{60V(PRT)}$$

Where:
L is the force main total length in feet
V is the flow velocity within the force main in ft/s
PRT is pump running time in minutes

WARNING!
Use average pump running time to calculate average flushing cycles.

IMPORTANT!
Normally the flushing cycles are composed by whole and decimal numbers. It is required to separate the whole part from the decimal part in order to be used in the following equation.

5) Equation 5: Flushing Time (FT)

$$FT = (FC_W)(WWDT) + (FC_D)(PRT)$$

Where:
FC_W is the whole part of the flushing cycles

WWDT is the wet well filling time in minutes
FC_D is the decimal part of the flushing cycles
PRT is the pump running time

WARNING!
Use average flushing cycles, average wet well detention time and average pump running time to calculate average force main flushing time.

d) Example:

A lift station with a 12 foot diameter wet well has a 3000 foot force main. The average daily flow is 150 gal/min. The distance between Lead Pump On and All Pumps Off is two feet. The pumps discharge 600 gal/min, and the flow velocity within the force main is 3.25 ft/s. Calculate the average force main flush time.

Procedure

Step 1: Calculate average wet well filling time with equation 1 as follows:

$$\text{WWFT} = \frac{7.481\pi D^2(\Delta h_{On-Off})}{4Q_i} \Rightarrow \frac{7.481\pi(12)^2(2)}{4(150)}$$

The Average Wet Well Filling Time is 11.28 minutes.

Step 2: Calculate average pump running time with equation 2 as follows:

$$\text{PRT} = \frac{7.481\pi D^2(\Delta h_{On-Off})}{4(Q_o - Q_i)} \Rightarrow \frac{7.481\pi(12)^2(2)}{4(600-150)}$$

The Average Pump Running Time is 3.76 minutes.

Step 3: Calculate average wet well detention time with equation 3 as follows:

WWDT = WWFT + PRT ⇒ 11.28 + 3.76

The Wet Well Average Detention Time is 15.04 minutes.

Step 4: Calculate average flushing cycles with equation 4 as follows:

$$\text{FC} = \frac{L}{60V(PRT)} \Rightarrow \frac{3000}{60(3.25)(3.76)}$$

The Average Flushing Cycles are 4.09 cycles.

Step 5: Calculate average force main flush time with equation 5 as follows:
FT = (FCW)(WWDT) + (FCD)(PRT) ⇒ (4)(15.04) + (0.09)(3.76)

The Average Force Main Flush Time is 60.49 minutes.

Step 6: Summary Table. Make a table showing all the results of the calculations as follows:

Table 1: Average Flush Time Results

Wet Well Diameter	12.00	Average Wet Well Filling Time	11.28
Distance between Lead Pump On and All Pumps Off	2.00	Average Pump Running Time	3.76
Average Daily Flow	150.00	Average Wet Well Detention Time	15.04
Pumped Flow	600.00	Average Flushing Cycles	4.09
Force Main Length	3000.00	**Average Force Main Flush Time**	**60.49**
Flow Velocity Within Force Main	3.25		

11.2.4. **Cycle Times.** Calculate detention times (Td) for Average Daily Flow, Peak Wet Weather Flow, and Minimum Dry Weather Flow.

Td = Tf + Te

Where:
Tf = time to fill wet well in minutes = Vr / i
Te = time to empty wet well in minutes = Vr / (Q – i)
Vr = Required Wet Well Volume (see 870.11.2.3.9.a of this section)
i = Flow into the station for given condition
Q = Pump capacity in gpm

11.2.4.1. Average Detention Time (based on Average Dry Weather Daily Flow):
a) Tf = Vr /ADF (GPM)
b) Te = Vr/(Q-ADF)
c) Td (ADF) = Tf + Te

11.2.4.2. Maximum Detention Time (based on Minimum Dry Weather Flow):
a) Tf = Vr /MDWF (GPM)
b) Te = Vr / (Q – MDWF)
c) Td (MDWF) = Tf + Te

If detention times exceed 180 minutes, the City of Universal City may require the design and installation of a chemical drum scrubber with top mounted blower for odor control. See Section 870.3.3 for details.

11.2.4.3. Total Cycle Times:
Pump ON for Te
Pump OFF for (2) Tf + Te

The pump is on for one pumping cycle of Te and off for 2 storage cycles of Tf plus one pumping cycle of Te because pumps alternate.

11.2.5. **Listing Of Results From The Design Calculations To Be Presented In The Following Order:**

1) Number of Lots or Buildings
2) Acreage of lift station subcatchment
3) Average Daily Flow in GPM
4) Peak Dry Weather Flow in GPM

5) Peak Wet Weather Flow in GPM
6) The Volume of the Retention Chamber
7) Static Head
8) Total Dynamic Head
9) Net Positive Suction Head Available ($NPSH_A$) from system
10) Static and Total Suction Lift (for self-priming pumps only)
11) The Pump Selected including the following:
    a) Manufacturer
    b) Model
    c) Impeller Diameter
    d) Flow
    e) Head
    f) NPSHR
    g) Break Horse Power
    h) Efficiency
12) Pump Motor Data
    a) Rated Power
    b) Efficiency
    c) Power Factor
    d) NEMA Code Letter
    e) Voltage
13) Net Positive Suction Head Required (NPSHR) from pump
14) Total Detention Times for, Maximum Dry Weather Flow, and Average Dry Weather Flow
15) Total Cycle Times for, Maximum Dry Weather Flow, and Average Dry Weather Flow
    a) Number of Minutes ON (Pumping Time)
    b) Number of Minutes OFF (Fill Time)
16) Material, Class, Size, Inner Diameter, Rated Pressure and Length of Force Main
17) Flow Velocity in Force Main
18) Force Main Average Flush Time
19) Water Hammer Analysis
20) Wet well buoyancy calculations
21) Generator analysis (if a generator is included in the design)

11.2.6. Cost Effectiveness Analysis

Present value analysis comparing the cost of constructing gravity mains with the cost of the lift station and force main system, as described in Section 870.2.

12. LIFT STATION DESIGN AND CONSTRUCTION STANDARD DRAWINGS

Standard Drawings as referenced herein are located on the SAWS website.

This page is intentionally left blank

900 Items

This page is intentionally left blank

900

EXCAVATION, TRENCHING, AND BACKFILL FOR UTILITIES

1. DESCRIPTION

This section shall govern the excavation, trenching, and backfilling for gas, electric, communications, and other utilities unless otherwise noted on the plan details and the specifications. All references to "utility line" within this specification are henceforth referencing the utilities listed above. The work shall include all necessary drainage, dewatering, pumping, bailing, sheeting, shoring and incidental construction. All existing utilities shall be protected from damage during the excavation and backfilling of trenches and, if damaged, shall be replaced by the Contractor at his expense. Unless otherwise shown on the plans, proposal, or contract documents, all excavation shall be unclassified and shall include all materials encountered regardless of their nature or the manner in which they are removed, to include but not limited to rock, stone, sand, organic material, or whatever material is encountered. The Contractor shall at all times conform to the latest applicable provision of subpart "P" entitled "Excavation, Trenching, and Shoring of OSHA Safety and Health Regulations for Construction", or most applicable approved equal provision. An excavation plan submittal signed and sealed by a Texas licensed professional engineer shall be submitted, if applicable, one week prior to start of actual construction activities where the planned excavation is 20 feet or greater.

2. EXCAVATION

The Contractor shall perform all excavation of every description and of whatever substances, including rock, encountered to the lines and grades shown on the plans or determined by the Engineer. During excavation, material shall be stockpiled in orderly manner a sufficient distance from banks of the trench to avoid overloading and to prevent slides or cave-ins. All excavated materials not required or suitable for backfill shall be removed and properly disposed of by the Contractor or as directed by the Engineer. Grading shall be done as may be necessary to prevent surface water from flowing into trenches or other excavations, and any water accumulating therein shall be removed by pumping or by other approved methods.

Sheeting and shoring shall be installed in accordance with safety requirements for the protection of the work, adjoining property, and for the safety of the personnel. Unless otherwise indicated, excavation shall be by open cut, whether by hand, backhoe, ram-hoe, rock saw, or whatever method as necessary. Short sections of a trench may be tunneled, if in the opinion of the Engineer representing the Owner, the pipe or structure can be safely and properly installed or constructed, and backfill can be properly compacted in such tunnel sections.

2.1. Archaeological. "Unidentified Archaeological Sites": If the Contractor should encounter a section of an acequia (early Spanish irrigation ditch) or any other archaeological deposits during construction operations, the Contractor must stop

excavation immediately and contact the City of Universal City Inspector. The Contractor cannot begin excavation again without written permission from the City of Universal City. When utility work is part of a joint bid project with the City of Universal City, and more than three days are required for investigation (not including holidays and weekends) and also the Contractor cannot work on other areas, the Contractor will be permitted to negotiate for additional construction time. The Contractor shall submit a request in writing within ten days after date of the first notice. If the time required for investigation does not exceed three days for each event, contract duration will not be extended.

2.2. **Safety Devices.** The Contractor shall provide and maintain barricades, flags, torches, and other safety devices as required by local, state, and federal codes and ordinances and conduct work to create a minimum inconvenience to the public. Temporary suspension of work does not relieve responsibility for the above requirements.

2.3. **Safety and Health Regulations.** The Contractor shall at all times conform to all applicable regulations of Subpart "P" entitled "Excavation, Trenching, and Shoring of OSHA Safety and Health Regulations for Construction"; and all applicable state and local rules and regulations.

3. TRENCHING

3.1. Trench walls shall be vertical. The practice of undercutting at the bottom or flaring at the top will not be permitted except where it is justified for safety or at the Engineer's and/or Inspector's direction. In special cases, where trench flaring is required, the trench walls shall remain vertical to a depth of at least 6 inches above the top of the utility line.

The trench bottom shall be square or slightly curved to the shape of the trenching machine cutters. The trench shall be accurately graded along its entire length to provide uniform bearing and support for each section of utility line installed upon the bedding material. The utility line shall rest upon the new bedding material for its full length.

Where over-excavation occurs, the under-cut trench shall be restored to grade at no cost to the Owner by replacement with a material conforming to the requirements of the bedding material or a material approved by the Engineer.

3.1.1. **Minimum Width of Trench.** The minimum width of utility line trenches, measured at the outside diameter, shall be not less than 12 inches greater than the exterior diameter of the utility line, exclusive of bells or collars. The minimum base width of such trench shall be not less than 12 inches greater than the exterior diameter of the utility line, exclusive of special structures or connections. Such minimum width shall be exclusive of trench supports and not greater than the width at the top of the trench.

3.1.2. **Maximum Width of Trench.** The maximum allowable width of trench for utility line measured at the top of the utility line shall be the outside diameter of the utility line (exclusive of bells or collars) plus 24 inches. A trench wider than the outside diameter plus 24 inches may be used without special bedding if the Contractor, at his expense,

furnishes utility line of the required strength to carry additional trench load. Such modifications shall be submitted to the Owner and approved in writing. Whenever such maximum allowable width of trench is exceeded, except as provided for on the drawings, or in the specifications, or by the written approval of the Owner, the Contractor, at his expense, shall encase the utility line in concrete from trench wall to trench wall, or other utility line bedding material approved by the Owner. Any excavation wider than this maximum width or subsequent Surface or Paving work, will be done at the Contractor's expense.

The depth of cut as indicated on the cut sheet for pay purposes may be more or less than the actual excavated depth. The variation is based on the surface elevation prior to the Contractor's operation and the invert of the utility line.

3.2. When unsuitable bearing materials such as water, silt, muck, trash, debris or rock in ledge, boulder or coarse gravel (particle size larger than 1- 3/4 inch) is encountered at the bearing level, the Contractor shall over excavate and remove such materials to a depth no less than 6 inches below the bottom of the pipe and replace it with a material conforming to the requirements of Paragraph 900.4.2.1 or as approved by the Engineer and/or Inspector.

3.3. **Dewatering.** Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding project site and surrounding area.

3.3.1. The Contractor shall not allow water to accumulate in excavations or at subgrade level. Remove water to prevent softening of foundation bottoms and soil changes detrimental to stability of subgrades and foundations. Provide and maintain dewatering system components necessary to convey water from excavations.

3.3.2. Convey water removed from excavation and rainwater to collecting or runoff areas away from buildings and other structures. Establish and maintain temporary drainage ditches and other diversions outside excavation limits. Do not use trench excavations as temporary drainage ditches.

3.3.3. Dewatering devices shall be provided by the Contractor with filters to prevent the removal of fines from the soil. Should the pumping system draw fines from the soil, the Owner shall order immediate shutdown, and remedial measures will be the responsibility of the Contractor.

3.3.4. Upon completion of the dewatering work, the Contractor shall remove all equipment and leave the construction area in a neat, clean, condition that is acceptable to the Owner.

3.3.5. The Contractor shall maintain ground water table at least 12 inches below the finished excavation subgrade.

3.3.6. **Dewatering Performances.** Performances of the dewatering system for lowering ground water shall be measured by observation wells on piezometers installed in conjunction with the dewatering system, and these shall be documented at least daily. The Contractor shall maintain a log of these readings and submit them to the Owner.

No direct payment shall be made for costs associated with dewatering. All costs in connection therewith shall be included in the applicable contract price for the item to which the work pertains.

4. Backfilling Utility Line Trenches

4.1. General. Trenches shall not be backfilled until the construction structures or appurtenances, as installed, conform to the requirements specified. Where specified, only the secondary backfilling may incorporate excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel, soft shale or other approved materials, free from large clods of earth or stones. When work only involves utility improvements or repair, and is not part of a roadway reconstruction or proposed roadway project, flowable fill is required as secondary backfill in accordance with UC Item 408.

Utility line shall be installed with 14 gauge tracer wire and minimum 12” wide magnetic tape centered on utility in trench as shown on DET-900-01. For the magnetic tape, maintain a minimum depth of 18” below finished grade.

Where a trench has been improperly backfilled, or where settlement occurs, the identified section shall be excavated to a depth and length 50’ beyond the failed area, then refilled and compacted to the grade and compaction required or filled with flowable when required at no additional cost to the Owner. All compaction within the secondary backfill zone shall be such that the apparent dry density of each layer shall be not less than 98% within 2 feet of top pavement. These top 2 feet shall not be less than 98% for pavement areas of the maximum dry density at + or – 2% optimum moisture content as determined by tests on samples as outlined in TXDOT Testing Method Tex 113-E, unless otherwise shown on the plans. At the time of compaction, the water content shall be at optimum moisture content, + or - 2% points.

4.2. Backfilling. Backfilling for utility lines is divided into three (3) separate zones: (4.2.1) bedding: the material in trench bottom in direct contact with the bottom of the utility line; (4.2.2) initial backfill: the backfill zone extending from the surface of the bedding to a point 6 inches above the top of the utility line; and (4.2.3) secondary backfill: the backfill zone extending from the initial backfill surface to the top of the trench. Materials and placement for each of the zones shall be as described herein.

4.2.1. Bedding.

4.2.1.1. Stable Material. Existing stable material present during excavation include: Trench bottom free of water, muck, debris; Rock in boulder, ledge or coarse gravel (particle size not larger than 1- 3/4 inch) formations; Coarse sand and gravels with maximum particle size of 1- 3/4 inch, various graded sands and gravels containing small percentages of fines, generally granular and non-cohesive either wet or dry; and Fine sands and clayey gravels; fine sand, sand-clay mixtures, clay and gravel-clay mixtures.

4.2.1.2. Unstable Material. Existing unstable materials are: Silt, muck, trash or debris in the trench bottom bearing level; rock, in ledge or boulder, or coarse gravel (minimum particle size larger than 1- 3/4 inch) formations.

4.2.1.3. **Bedding Material.** The existing material at the bearing level shall be removed and replaced to a minimum depth of 4 inches below the utility line with bedding material. The bedding material shall extend up the sides of the utility line sufficient to embed the lower quadrant of the utility line. The bedding backfill materials for the utility line shall be composed of pit silica sand conforming to the following requirements unless modified by the Engineer.

Table 2
Gradation Requirements

Sieve Size	% Passing
3/8 inch	100
No. 4	95 - 100
No. 8	80 – 100
No. 16	50 – 85
No. 30	25 – 65
No. 50	10 – 35[1]
No. 100	0 – 10
No. 200	0 – 3[2]

1. 6 – 35 when sand equivalent value is greater than 85.
2. 0 – 6 for manufactured sand.

4.2.1.4. **Consolidating Backfill Material.** The Initial Bedding material shall be consolidated to assure it is incorporated from the bottom of the trench up to the utility line centerline.

4.2.2. **Initial Backfill.** Initial backfill is defined as backfill having a thickness in its compacted state from the surface of the bedding to a point 6 inches above the top of the utility line.

Initial backfill shall consist of pit silica sand which conforms to the requirements of Item No. 900.4.2.1.3.

Consolidate the Initial Backfill material as per section 900.4.2.1.4.

Placement of the first lift of initial backfill shall be subject to inspection and approval prior to placement of second lift, which shall extend from the spring line of the utility line to a minimum of 6 inches above the top of the pipe. The second lift shall be evenly spread in a similar manner as the first lift.

4.2.3. **Secondary Backfill.** Secondary backfill is defined as backfill from 6 inches above the top of the pipe to the top of the trench.

Secondary backfill shall be constructed in accordance with details shown on the plans and these specifications.

Secondary backfill shall generally consist of materials removed from the trench and shall be free of brush, debris and trash. Rock or stones having a dimension larger than 6 inches at the largest dimension shall be sifted out and removed before the material is used in the secondary backfilling zone. Secondary backfill material shall be primarily composed of compactable soil materials. The secondary backfill material

shall be placed in maximum 9 inch loose lifts or as directed by the Design Engineer and/or Inspector. The moisture content for the secondary backfill shall be as per section 900.4.1.General.

When work only involves utility improvements or repair, and is not part of a roadway reconstruction or proposed roadway project, flowable fill is required as secondary backfill in accordance with UC Item 408.

4.2.4. **Trench Surface Restoration.** The surface of the backfilled trench shall be restored to match the previous existing conditions. This shall include final grading, placement of topsoil and seeding, placement of sod (such as at homes or businesses that had maintained lawns), or other unprepared and prepared surfaces.

Trenches in alleys shall be restored with bedding material and flowable as shown on the "Utility Trench Repair Detail for Roadway and Alley Crossings," for the entire width of the trench.

Trenches in paved streets shall be covered with a temporary all weather surface to allow for vehicular traffic until the final asphalt/concrete paving is complete. This surface shall be a minimum of 12 inches compacted and rolled asphaltic black base, and hot-mix applied. It is the Contractor's responsibility to maintain this surface until the final street restoration is complete. Temporary street striping may also be required. This surface must be removed prior to final asphalting. All street work shall be done in accordance with the latest City of Universal City Public Works' requirements. Included in this requirement is replacement of any curbs or sidewalks damaged or removed during the construction.

No separate payment for the surface restoration is permitted. The cost for this work must be included in the appropriate bid item.

5. DISPOSAL OF EXCAVATED MATERIALS

Any excess excavated material, not utilized after all fill requirements have been met, shall become the responsibility of the Contractor. The Contractor shall haul away excess material for disposal at Contractor's expense.

6. QUALITY CONTROL

6.1. The Contractor shall procure, store, and place materials from either onsite or offsite sources which comply with the specified requirements.

6.2. **Quality Assurance Testing.** The Owner shall have such tests and inspections as he may desire performed by a City pre-approved, independent testing laboratory for his guidance and control of the work. Payment for such tests shall be the responsibility of the Owner, including the material proctor tests and density tests. The Contractor shall request testing work performed by the Owner by notifying the Owner of the areas available by Station Numbers or Dimensions and Lift Numbers. The Contractor shall provide access to the test area, associated trench excavation safety protection, and backfilling of the test areas. The frequency and location of testing shall be determined solely by the Owner. The Owner may test any lift of fill at any time, location, or elevation.

6.3. **Quality Control Testing.** The Contractor shall be responsible for compaction in accordance with the appropriate Specification. Compactions tests will be done at one location point randomly selected or as indicated by the Universal City Inspector/Test Administrator, per each 9 inch loose lift per 400 linear feet.

Note: Any failed test shall require the Contractor to remove and replace that layer of backfill to 50 feet from either side from the failed test location. The Contractor will also be required at no cost to Universal City to provide two additional tests at the replaced location where the initial test failed and at one location point, randomly selected or as indicated by the Universal City Inspector/Test Administrator.

The Contractor shall be responsible for all costs associated with supplying material for the proctor and density tests. These tests shall be performed by a nationally-accredited, independent testing laboratory. The Owner shall provide access to the results of the material proctor tests to the Contractor prior to performing any backfill operations.

The Contractor shall provide access to the test area, associated trench excavation safety protection, and backfilling of the test areas at the Contractor's expense. The Owner will determine in-place density and moisture content by any one or combination of the following methods: ASTM D2922 (density of soil and soil aggregate in-place by nuclear methods – shallow depth), D1556 (density and unit weight of soil in-place by sand cone method), D2216 (lab density of water content of soil and rock), D3017 (water content of soil and rock – shallow depth in-place by nuclear methods).

7. MEASUREMENT

Excavation, Trenching and Backfill will not be measured for payment.

8. PAYMENT

No direct payment shall be made for incidental costs associated with quality control testing, excavation, trenching and backfilling for utility lines, and all costs in connection therewith shall be included in the applicable contract price for the item to which the work pertains.