

BID COPY

CITY OF ROUND ROCK
Utilities and Environmental Services



Project Manual For:
West WWTP Force Main Relocation

August 2017

Prepared By:

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8/22/17

West WWTP Force Main Relocation

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00020 NOTICE TO BIDDERS

NOTICE TO BIDDERS

Sealed bids addressed to Jeff Bell, City of Round Rock, [Utilities and Environmental Services](#), [2008 Enterprise Drive, Round Rock, TX 78664](#), for furnishing all labor, material and equipment and performing all work required for the project titled, West WWTP Force Main Relocation (project includes approximately 600 LF of 8" force main and replacement of two (2) submersible pumps.), will be received until September 14, 2017 at 2:00 p.m., then publicly opened and read aloud at the same address. Bid envelopes shall state date and time of bid and "West WWTP Force Main Relocation". Bids must also be accompanied by a "Statement of Bidder's Safety Experience" included in Section 410 of the Project Manual. No bids may be withdrawn after the scheduled opening time. Any bids received after scheduled bid opening time will be returned unopened.

Bids must be submitted on City of Round Rock bid forms and must be accompanied by an acceptable bid security as outlined in the Instructions to Bidders, payable to the City of Round Rock, Texas equal to five percent (5%) of the total bid amount. Plans, Bid Forms, Specifications, and Instructions to Bidders may be obtained from the City of Round Rock website at the following web address: www.roundrocktexas.gov/utilitiescip. **Bidders shall be responsible for printing or obtaining prints of the aforementioned documents as necessary.** For questions please contact the City's Project Manager, Jeff Bell , (512) 218-7076.

In case of ambiguity, duplication, or obscurity in the bids, the City of Round Rock reserves the right to construe the meaning thereof. The City of Round Rock further reserves the right to reject any or all bids and to waive any informalities and irregularities in the bids received.

The successful bidder will be expected to execute the City of Round Rock's standard contract and to furnish performance and payment bonds, all as described in the bid documents. Contractors and subcontractors shall pay to laborers, workmen, and mechanics the prevailing wage rates as determined by the City of Round Rock.

Publish Dates:

Round Rock Leader:

August 24, 2017

August 31, 2017

Pflugerville Pflag:

August 23, 2017

August 30, 2017

00100 INSTRUCTIONS TO BIDDERS

INSTRUCTIONS TO BIDDERS

1. Prior to submitting any bid, bidders are required to read all drawings (plans), specifications, and all other Project Manual and/or Contract Documents carefully; to inform themselves by their independent research, test and investigation of the difficulties to be encountered and judge for themselves of the accessibility of the Work and all attending circumstances affecting the cost of doing the Work and the time required for its completion and obtain all information required to make a bid. **The aforementioned documents may only be obtained from the City's website at the following web address: www.roundrocktexas.gov/utilitiescip. Bidders shall be responsible for printing or obtaining prints of the aforementioned documents as necessary.**
2. Should the bidder find discrepancies in, or omissions from the drawings (plans), specifications, or other Project Manual and/or Contract Documents, or should he be in doubt as to their meaning, he should notify at once the City and obtain clarification or addendum prior to submitting any bid. **Any addenda issued will be posted with the documents at the web address mentioned in 1 above no later than two business days prior to the Bid Opening Date. Prior to submitting a bid, the bidder is responsible for determining if any addenda have been issued and for following any instructions required in any addenda issued.**
3. **It shall be the responsibility of the bidder to see that his bid is received at the place and time named in the Notice to Bidders in the Project Manual.** Bids received after the scheduled opening time will be returned unopened.
4. Bids shall be submitted in sealed envelopes plainly marked "Sealed Bid" and showing the name of the project, the job number if applicable, and the opening date and time.
5. **Bidders shall be responsible for submitting a copy of the City's Bid Form, Bid Bond Form, and Statement of Bidder's Safety Experience from the Project Manual documents posted at the web address as described in 1 above.**
6. Bids shall be accompanied by a bid security consisting of a certified cashier's check in an amount not less than five percent (5%) of the total maximum bid price, payable without recourse to the City of Round Rock, or a bid bond in the same amount from a reliable surety company, as a guarantee that the bidder will enter into a contract and execute performance and payment bonds, as stipulated by item 15 below, within ten (10) days after notice of award of contract to him. Bid securities must be submitted in the same sealed envelope with the bid. Bids submitted without a bid security may not be considered at the sole discretion of the City.

7. **If awarded the bid, the bidder must complete a Form 1295 electronically on the Texas Ethics Commission (TEC) Website at https://www.ethics.state.tx.us/whatsnew/elf_info_form1295.htm and submit the signed and notarized Form 1295 within ten (10) business days of notification of the award. Instructions for completing a Form 1295 are attached as Exhibit “A” to the Instructions to Bidders.**
8. No conditional bids will be accepted.
9. A bidder wishing to withdraw his submitted sealed bid prior to the scheduled bid opening time must do so by presenting in person a written request signed by an authorized representative of the bidder to a City employee at the location for which sealed bids are to be addressed. No telephone, facsimile, or email requests will be accepted. The City will expend the time and effort that the City in its sole discretion determines is necessary to investigate the authenticity of a request before complying with a request. The City shall in its sole discretion determine if the City will comply with a request and the City shall not be held liable for not complying with a request. If the City does not comply with a request, the request shall automatically become null and void.
10. A bidder wishing to revise his sealed bid after submittal but before the scheduled bid opening time must first withdraw his bid as provided for in the Instructions to Bidders and then submit a sealed bid in accordance with the Instructions to Bidders. No revisions to a bid will be allowed after the scheduled bid opening time. The bidder shall be responsible for ensuring the amount of the bid security is as specified in the Instructions to Bidders.
11. All bid securities will be returned to the respective bidders within twenty-five (25) days after bids are opened, except those which the City elects to hold until the successful bidder has executed the Agreement. Thereafter, all remaining securities, including security of the successful bidder, will be returned within sixty (60) days.
12. Until the award of the contract, the City reserves the right to reject any and all bids and to waive technicalities; to advertise for new bids; or to do the work otherwise when the best interest of the City will be thereby promoted.
13. In case of ambiguity or lack of clarity in the statement of prices in the bids, the City reserves the right to consider the most favorable analysis thereof, or to reject the bid. Unreasonable and/or unbalanced prices submitted in a bid may result in rejection of such bid or other bids.
14. Award of the contract, if awarded, will be made within sixty (60) days after opening of the bids, and no bidder may withdraw his bid within said sixty (60) day period of time unless a prior award is made. A Notice to Proceed will be issued within sixty (60) days after contract Execution Date as defined in the General Conditions.
15. Within ten (10) days after written notification of award of the contract, the successful bidder must furnish a performance bond and a payment bond in the amount of one hundred

percent (100%) of the total Contract Amount. Said performance bond and payment bond shall be from an approved surety company holding a permit from the State of Texas, indicating it is authorized and admitted to write surety bonds in this state. In the event the bond exceeds \$100,000.00, the surety must also (1) hold a certificate of authority from the United States secretary of the treasury to qualify as a surety on obligations permitted or required under federal law; or (2) have obtained reinsurance for any liability in excess of \$100,000.00 from a reinsurer that is authorized and admitted as a reinsurer in this state and is the holder of a certificate of authority from the United States secretary of the treasury to qualify as a surety or reinsurer on obligations permitted or required under federal law.

In determining whether the surety or reinsurer holds a valid certificate of authority, the City may rely on the list of companies holding certificates of authority as published in the Federal Register covering the date on which the bond is to be executed.

16. Failure to execute the Agreement within ten (10) days of written notification of award or failure to furnish the performance bond and payment bond as required by item 15 above, shall be just cause for the annulment of the award. In case of annulment of the award, the bid security shall become the property of the City, not as a penalty, but as liquidated damages.
17. No contract shall be binding upon the City until it has been signed by its Mayor after having been duly authorized to do so by the City Council.
18. The Contractor shall not commence Work under the Agreement until he has furnished certification of all insurance required and such has been approved by the City, nor shall the Contractor allow any Subcontractor to commence work on his subcontract until proof of all similar insurance that is required of the subcontractor has been furnished and approved. The Contractor's insurer shall use the certificate of insurance form included in the bid documents or the standard ACORD form.
19. If the bidder's insurance company is authorized, pursuant to its agreement with bidder, to arrange for the replacement of a loss, rather than by making a cash payment directly to the City, the insurance company must furnish or have furnished by bidder, a performance bond in accordance with Section 2253.021(b), Texas Government Code, and a payment bond in accordance with Section 2253.021(c).
20. Any quantities given in any portion of the Bid Documents, including the drawings (plans), are estimates only, and the actual amount of work required may differ somewhat from the estimates. The basis for payment shall be the actual amount of work done and/or material furnished as specified in the General Conditions.
21. Bids shall be submitted on a separated contract basis. No Texas sales tax shall be included in the prices bid for materials consumed or incorporated into the Work. This contract is issued by an organization which is qualified for exemption pursuant to the provisions of Section 151.309(5) of the Texas Tax Code. The City will issue an exemption certificate to the Contractor. The Contractor must then issue a resale certificate to the material supplier

for materials purchased. The Contractor must have a valid sales tax permit in order to issue a resale certificate.

Upon obtaining consumable materials, the Contractor will issue a resale certificate in lieu of payment of sales tax, and the following conditions shall be observed;

- 1) The Contractor will transfer title of consumable, but not incorporated, materials to the City at the time and point of receipt by the Contractor;
 - 2) The Contractor will be paid for these consumable materials by the City as soon as practicable. Payment will not be made directly but considered subsidiary to the pertinent bid item. The Contractor's monthly estimate will state that the estimate includes consumables that were received during the month covered by the estimate; and
 - 3) The designated representative of the City must be notified as soon as possible of the receipt of these materials so that an inspection can be made by the representative. Where practical, the materials will be labeled as the property of the City.
22. The Contractor, after execution of the contract and pursuant to Internal Revenue Service (IRS) regulations, shall furnish its Taxpayer Identification Number (TIN) to the City. The Contractor shall provide the appropriate information on a W-9 form (which can be provided by the City upon request). This form shall be submitted directly to the City's Accounts Payable Department to ensure security of the information.
23. If the Bid Form includes Add and/or Deduct Alternate bid items and/or otherwise provides for Alternate bids, the City will determine whether to select or not select one or more of the Add and/or Deduct Alternate bid items and/or Alternate bids at the City's sole discretion and for its greatest advantage. If the City selects any Add and/or Deduct Alternate bid items, the total bid amount will be determined by adding the amount of the selected Add Alternate(s) to, and deducting the amount of the selected Deduct Alternate(s) from the Base Bid or the selected Alternate bid.

EXHIBIT “A”
FORM 1295 INSTRUCTIONS

Pursuant to newly enacted Section 2252.90 of the Texas Government Code, as of January 1, 2016, any business entity entering into a contract with a local government that requires approval of the governing body must submit a disclosure of interested parties to the local governmental prior to the execution of the contract. The Texas Ethics Commission (TEC) has adopted a form for the disclosure of interested parties (Form 1295) and has created a website application for business entities to submit the required information.

The City of Round Rock may not enter into a contract that requires the approval of the City Council until the business entity that is a party to the contract files a Form 1295 with the City Clerk. The instructions to complete Form 1295 and file it with the City Clerk are as follows:

1. Upon being notified of a bid award, the award recipient (“business entity”) must go to the following website: https://www.ethics.state.tx.us/whatsnew/elf_info_form1295.htm and follow the login directions on the website application to complete a Form 1295. If this is a business entity’s first time logging on to the website application, the business entity must create a login Username and Password and then follow the application’s instructions to complete a Form 1295.
2. The City does not have a Contract ID Number System. Please insert the project name in this box.
3. Even if a business entity has no interested parties, Form 1295 still must be completed using the website application and filed with the City Clerk.
4. Once confirmation is received that the information has been submitted, the business entity MUST print, sign and notarize the printed out completed Form 1295.
5. **The signed and notarized Form 1295 must be filed with the Clerk of the City of Round Rock within ten (10) business days of the date of notification of the award. The signed and notarized Form 1295 may be scanned and e-mailed to swhite@roundrocktexas.gov OR mailed or hand-delivered to the address below.**
6. Once the City Clerk receives the signed and notarized Form 1295, the City Clerk will submit confirmation of receipt through the TEC website application within thirty (30) days of the filing of Form 1295.
7. This process must be followed for each contract a business entity enters into with the City of Round Rock.
8. A Form 1295 cannot be handwritten. It must be completed electronically through the TEC website application.
9. If you have any questions regarding the filing of Form 1295, please contact:

Sara White, City Clerk
221 East Main Street
Round Rock, Texas 78664
Phone: (512) 218-5404
Fax: (512) 218-7097
E-mail: swhite@roundrocktexas.gov

00200 BID BOND

BID BOND

THE STATE OF TEXAS §
 § KNOW ALL BY THESE PRESENTS:
COUNTY OF WILLIAMSON §

That _____ of the City of _____
County of _____ State of _____ as Principal,
and _____ authorized under the laws of the State of Texas to act as
surety on bonds for principals, are held and firmly bound unto the **CITY OF ROUND ROCK,
TEXAS (“Owner”)**, in the penal sum of Five Percent (5%) of the total amount of the Bid of the
Principal submitted to the Owner, for the Work described below; for the payment whereof, well and
truly to be made, and the said Principal and Surety do hereby bind themselves and their heirs,
administrators, executors, successors and assigns, jointly and severally, as follows:

In no case shall the liability of the Surety hereunder exceed the sum of (_____
_____ Dollars (\$_____).

THE CONDITIONS OF THIS OBLIGATION ARE SUCH that, whereas, the Principal has
submitted the above-referenced Bid to the Owner, for construction of the Work under the
“Specifications for Construction of West WWTP Force Main Relocation”
_____,”
for which Bids are to be opened at the office of Owner on the _____ 14th _____ day of
September, 2017.

NOW, THEREFORE, if the Principal is awarded the Contract, and within the time and
manner required under the “Instructions to Bidders,” after the prescribed forms are presented to
her/him for signature, enters into a written Agreement substantially in the form contained in the Bid
Documents, in accordance with the Bid, and files the two (2) bonds with the Owner, one to
guarantee faithful performance and the other to guarantee payment for labor and materials, then this
obligation shall be null and void; otherwise, it shall be and remain in full force and effect.

In the event that suit is brought upon this Bond by the Owner and judgment is recovered, said
Surety shall pay all costs incurred by the Owner in such suit, including a reasonable attorney’s fee to
be fixed by the Court.

IN WITNESS WHEREOF, the said Principal and Surety have signed this instrument on this
the _____ day of the month of _____ 20____.

Principal

Surety

Printed Name

Printed Name

By: _____

By: _____

Title: _____

Title: _____

Address: _____

Address: _____

Resident Agent of Surety:

Signature

Printed Name

Street Address

City, State, Zip

00300 BID FORM

BID FORM

PROJECT NAME: West WWTP Force Main Relocation

PROJECT LOCATION: Round Rock, Texas

OWNER: City of Round Rock, Texas

DATE: September 14, 2017

Gentlemen:

Pursuant to the foregoing Notice to Bidders and Instructions to Bidders, the undersigned bidder hereby proposes to do all the Work, to furnish all necessary superintendence, labor, machinery, equipment, tools, materials, insurance and miscellaneous items, to complete all the Work on which he bids as provided by the attached Bid Documents, and as shown on the plans for the construction of West WWTP Force Main Relocation

and binds himself on acceptance of this bid to execute the Agreement and bond for completing said Work within the time stated, for the following prices, to wit:

Any addenda issued will be posted with the Project Manual and/or Contract Documents on the City's website at roundrocktexas.gov/utilitiescip by the close of business on September 11, 2017. Prior to submitting a bid, the bidder is responsible for determining if any addenda have been issued and for following any instructions in any addenda issued.

Bidder acknowledges receipt of the following Addenda by listing Addendum "number" and "date".

BASE BID

Bid Item	Approx. Quantity	Unit	Item Description and Written Unit Price	Unit Price	Amount
<u>1</u>	<u>1</u>	<u>LS</u>	Mobilization (limit 5% of overall construction cost) complete in place per <u>Plans</u> for _____ dollars and _____ cents.	_____	_____
<u>2</u>	<u>1</u>	<u>LS</u>	Care of Water during Creek Crossing complete in place per <u>**Plans</u> for _____ dollars and _____ cents.	_____	_____

BASE BID

<u>Bid</u> <u>Item</u>	<u>Approx.</u> <u>Quantity</u>	<u>Unit</u>	<u>Item Description</u> <u>and Written Unit Price</u>	<u>Unit Price</u>	<u>Amount</u>
<u>3</u>	<u>600</u>	<u>LF</u>	Pipe - 8" HDPE Force Main complete in place per <u>15065</u> for _____ dollars and _____ cents.	_____	_____
<u>4</u>	<u>150</u>	<u>CY</u>	Flowable Fill for Creek Crossing complete in place per <u>Item 501</u> for _____ dollars and _____ cents.	_____	_____
<u>5</u>	<u>3300</u>	<u>SY</u>	Site Restoration at Pipeline Right-Of-Way complete in place per <u>Item 510</u> for _____ dollars and _____ cents.	_____	_____
<u>6</u>	<u>1</u>	<u>LS</u>	Tie In to Existing Line complete in place per <u>Item 510</u> for _____ dollars and _____ cents.	_____	_____
<u>7</u>	<u>1</u>	<u>EA</u>	Manhole complete in place per <u>Item 506</u> for _____ dollars and _____ cents.	_____	_____
<u>8</u>	<u>2</u>	<u>EA</u>	Remove Existing Power Pole and Foundation complete in place per <u>Plans</u> for _____ dollars and _____ cents.	_____	_____
<u>9</u>	<u>1</u>	<u>EA</u>	1" Air Release Valve complete in place per <u>Item 511</u> for _____ dollars and _____ cents.	_____	_____

BASE BID

<u>Bid</u> <u>Item</u>	<u>Approx.</u> <u>Quantity</u>	<u>Unit</u>	<u>Item Description</u> <u>and Written Unit Price</u>	<u>Unit Price</u>	<u>Amount</u>
<u>10</u>	<u>1</u>	<u>EA</u>	Side Mounted Pressure Gauge complete in place per <u>Plans</u> for _____ dollars and _____ cents.	_____	_____
<u>11</u>	<u>1</u>	<u>LS</u>	Demo Piping at Lift Station complete in place per <u>Plans</u> for _____ dollars and _____ cents.	_____	_____
<u>12</u>	<u>2</u>	<u>EA</u>	Lift Station Pumps complete in place per <u>15145</u> for _____ dollars and _____ cents.	_____	_____
<u>13</u>	<u>1</u>	<u>LS</u>	Grout Bottom of Sump complete in place per <u>Plans</u> for _____ dollars and _____ cents.	_____	_____
<u>14</u>	<u>60</u>	<u>LF</u>	Pipe - 8" D.I. Pipe complete in place per <u>Item 510</u> for _____ dollars and _____ cents.	_____	_____
<u>15</u>	<u>5</u>	<u>EA</u>	8" D.I. 90 Elbow complete in place per <u>Item 510</u> for _____ dollars and _____ cents.	_____	_____
<u>16</u>	<u>3</u>	<u>EA</u>	8" Restrained Coupling complete in place per <u>Item 510</u> for _____ dollars and _____ cents.	_____	_____

BASE BID

<u>Bid Item</u>	<u>Approx. Quantity</u>	<u>Unit</u>	<u>Item Description and Written Unit Price</u>	<u>Unit Price</u>	<u>Amount</u>
<u>17</u>	<u>2</u>	<u>EA</u>	8" Check Valve complete in place per <u>Item 511</u> for _____ dollars and _____ cents.	_____	_____
<u>18</u>	<u>2</u>	<u>EA</u>	8" Plug Valve complete in place per <u>Item 511</u> for _____ dollars and _____ cents.	_____	_____
<u>19</u>	<u>1</u>	<u>EA</u>	8" D.I. Tee complete in place per <u>Item 510</u> for _____ dollars and _____ cents.	_____	_____
<u>20</u>	<u>11</u>	<u>EA</u>	16" D.I. Flange complete in place per <u>Item 510</u> for _____ dollars and _____ cents.	_____	_____
<u>21</u>	<u>3</u>	<u>EA</u>	8" Core Hole with Link Seal complete in place per <u>Item 510</u> for _____ dollars and _____ cents.	_____	_____
<u>22</u>	<u>1</u>	<u>EA</u>	8" HDPE to D.I. Adapter complete in place per <u>Item 510</u> for _____ dollars and _____ cents.	_____	_____
<u>23</u>	<u>1</u>	<u>LS</u>	Paint Pipe complete in place per <u>Item 510</u> for _____ dollars and _____ cents.	_____	_____

BASE BID

<u>Bid</u> <u>Item</u>	<u>Approx.</u> <u>Quantity</u>	<u>Unit</u>	<u>Item Description</u> <u>and Written Unit Price</u>	<u>Unit Price</u>	<u>Amount</u>
<u>24</u>	<u>1</u>	<u>EA</u>	Concrete Pipe Support complete in place per <u>Item 510</u> for _____ dollars and _____ cents.	_____	_____
<u>25</u>	<u>1</u>	<u>EA</u>	8" Blind Flange complete in place per <u>Item 510</u> for _____ dollars and _____ cents.	_____	_____
<u>26</u>	<u>20</u>	<u>CY</u>	Excavation/Backfill between Vaults complete in place per <u>Item 510</u> for _____ dollars and _____ cents.	_____	_____
<u>27</u>	<u>1</u>	<u>LS</u>	Site Restoration at Vaults complete in place per <u>Item 510</u> for _____ dollars and _____ cents.	_____	_____
<u>28</u>	<u>1</u>	<u>LS</u>	Tree Protection complete in place per <u>Item 610</u> for _____ dollars and _____ cents.	_____	_____
<u>29</u>	<u>1</u>	<u>LS</u>	SWPPP complete in place per <u>1570</u> for _____ dollars and _____ cents.	_____	_____
<u>30</u>	<u>1</u>	<u>LS</u>	Electrical complete in place per <u>DIV 16</u> for _____ dollars and _____ cents.	_____	_____

BASE BID

<u>Bid Item</u>	<u>Approx. Quantity</u>	<u>Unit</u>	<u>Item Description and Written Unit Price</u>	<u>Unit Price</u>	<u>Amount</u>
<u>31</u>	<u>1</u>	<u>LS</u>	Start Up and Testing complete in place per <u>15145</u> for _____ dollars and _____ cents.	_____	_____

ADD ALTERNATE BID **1**

Bid Item	Approx. Quantity	Unit	Item Description and Written Unit Price	Unit Price	Amount
3	600	LF	Alternate 1 - Pipe 8" PVC per spec No. 510		

complete in place per Item 510
for _____ dollars
and _____ cents.

TOTAL ADD ALTERNATE BID:

STATEMENT OF SEPARATE CHARGES:

Materials: _____
All Other Charges: _____
*** Total:** _____

*** Note:** This total must be the same amount as shown above for "**Total Add Alternate Bid**"

BASE BID _____
ADD ALTERNATE BID _____
TOTAL _____

TOTAL BASE BID (Items 1 thru 31) _____

Materials: _____

All Other Charges: _____

*** Total:** _____

*** Note:** This total must be the same amount as shown above for "**Total Base Bid**"

If this bid is accepted, the undersigned agrees to execute the Agreement and provide necessary bonds and insurance certification as per the Instructions to Bidders.

The undersigned certifies that the bid prices contained in the bid have been carefully checked and are submitted as correct and final. The Owner reserves the right to reject any or all bids and may waive any informalities or technicalities.

Respectfully Submitted,

Signature

Print Name

Address

Title

Telephone

Name of Firm

Date

Secretary, if Bidder is a
Corporation

00410 STATEMENT OF BIDDER'S SAFETY EXPERIENCE

Solicitation Requirements, Contract Forms & Conditions of Contract
Statement of Bidder's Safety Experience Section 00410

Bidder must submit a signed Statement of Bidder's Safety Experience form with his Bid; failure to do so will constitute an incomplete Bid that may be rejected. In order to make a responsive Bid, Bidder must provide evidence that it meets minimum OSHA construction safety program requirements, has not been fined by OSHA for any willful safety violations in the past three years, and has a lost time injury rate that doesn't exceed the limits established below. All questions must be answered and data given must be clear and comprehensive. If necessary, questions may be answered on separate attached sheets.

Company Name: _____

Address: _____ Phone: _____

Completed by: _____ Date: _____

1. Does the company have a written construction Safety program? ☐ Yes ☐ No
2. Does the company conduct construction safety inspections? ☐ Yes ☐ No
3. Does the company have an active construction safety-training program? ☐ Yes ☐ No
4. Has the company been fined by OSHA for any willful safety violations in the past three years? ☐ Yes ☐ No
5. Does the company have a lost time injury rate of 7.8 for SIC 15, or 7.6 for SIC 16, or less over the past three years? ☐ Yes ☐ No

Attach the company's OSHA 200/300 logs for the past three years.

6. Does the company or affected subcontractors have competent persons in the following Areas?
 - A. Scaffolding ☐ Yes ☐ No ☐ N/A
 - B. Excavation ☐ Yes ☐ No ☐ N/A
 - C. Cranes ☐ Yes ☐ No ☐ N/A
 - D. Electrical ☐ Yes ☐ No ☐ N/A
 - E. Fall Protection ☐ Yes ☐ No ☐ N/A
 - F. Confined Spaces ☐ Yes ☐ No ☐ N/A

I hereby certify that the above information is true and correct.

Signature _____ Title _____

00500 AGREEMENT

City of Round Rock, Texas Contract Forms
Standard Form of Agreement: Section 00500

City of Round Rock, Texas
Standard Form of Agreement between
Owner and Contractor

AGREEMENT made as of the _____ () day of _____ in the year 20____.

BETWEEN the Owner: City of Round Rock, Texas (hereafter "Owner" or "City")
221 East Main Street
Round Rock, Texas 78664

and the Contractor _____ ("Contractor")

The Project is described as: West WWTP Force Main Relocation:
Project includes approximately 600 LF of 8" force main
and replacement of two (2) submersible pumps.

The Engineer is: Freese and Nichols, Inc.
Anne Hoskins, P.E.
10431 Morado Circle, Suite 300
Austin, Texas 78759

For and in consideration of the mutual terms, conditions and covenants of this Agreement and all accompanying documents between Owner and Contractor, the receipt and sufficiency of which are hereby acknowledged, Owner and Contractor agree as follows:

ARTICLE I THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement and Modifications issued after execution of this Agreement; these form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. An enumeration of the Contract Documents, other than Modifications, appears in Article 7.

ARTICLE 2 THE WORK OF THIS CONTRACT

Contractor shall fully execute the Work described in the Contract Documents, except to the extent specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 3 DATE OF COMMENCEMENT; DATE OF SUBSTANTIAL COMPLETION; DATE OF FINAL COMPLETION

3.1 The date of commencement of the Work shall be the date of this Agreement unless a different date is stated below or provision is made for the date to be fixed in a Notice to Proceed issued by Owner.

3.2 The Contract Time shall be measured from the date delineated in the Notice to Proceed.

3.3 Contractor shall commence Work within ten (10) calendar days from the date delineated in the Notice to Proceed.

3.4 Contractor shall achieve Substantial Completion of the items of Work listed on Attachment A to this Agreement no later than seventy-five (75) calendar days from issuance by Owner of Notice to Proceed, and Contractor shall achieve Substantial Completion of the entire Work no later than one-hundred twenty (120) calendar days from issuance by Owner of Notice to Proceed, subject to adjustments of this Contract Time as provided in the Contract Documents.

3.5 If Contractor fails to achieve Substantial Completion of the Work (or any portion thereof) on or before the date(s) specified for Substantial Completion in the Agreement, Contractor shall pay to Owner, as liquidated damages, the sum of two-hundred fifty and No/100 Dollars (\$250.00) for each calendar day that Substantial Completion is delayed after the date(s) specified for Substantial Completion. It is hereby agreed that the liquidated damages to which Owner is entitled hereunder are a reasonable forecast of just compensation for the harm that would be caused by Contractor's failure to achieve Substantial Completion of the Work (or any portion thereof) on or before the date(s) specified for Substantial Completion in the Agreement. It is agreed that the harm that would be caused by such failure, which includes loss of expected use of the Project areas, provision of alternative storage facilities and rescheduling of moving and occupancy dates, is one that is incapable or very difficult of accurate estimation. It is hereby agreed that if Substantial Completion of the Work (or any portion thereof) is not achieved on or before thirty (30) days after the date(s) specified for Substantial Completion in the Agreement, the Owner shall have the option to either collect liquidated damages as set forth herein or to thereafter rely on its remedies under the Contract Documents and at law and in equity, including without limitation, the recovery of actual damages. The date(s) specified for Substantial Completion of the Work (or any portion thereof) in the Agreement shall be subject to adjustment as provided in the Contract Documents.

3.6 Contractor shall achieve Final Completion of the entire Work no later than one-hundred fifty (150) calendar days from issuance by Owner of Notice to Proceed.

ARTICLE 4 CONTRACT SUM

4.1 Owner shall pay Contractor the Contract Sum in current funds for Contractor's performance of the Contract. The Contract Sum shall be _____

(\$ _____), subject to additions and deductions as provided in the Contract Documents.

4.2 Does the Contract Sum include alternates which are described in the Bid Form?
No _____. **Yes** X _____. **If yes, please provide details below:**

Alternate 1 - Pipe 8" PVC per spec No. 510.

N/A

ARTICLE 5 PAYMENTS

5.1 PROGRESS PAYMENTS

5.1.1 Based upon Applications for Payment submitted to Engineer and Owner by Contractor, and Certificates for Payment issued by Engineer and not disputed by Owner and/or Owner's lender, Owner shall make progress payments on account of the Contract Sum to Contractor as provided below, in Article 14 of the City of Round Rock General Conditions, and elsewhere in the Contract Documents.

5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month.

5.1.3 Provided that an Application for Payment is received by Engineer and Owner, and Engineer issues a Certificate of Payment not later than the tenth (10th) day of a month, Owner shall make payment to Contractor not later than the tenth (10th) day of the next month. If an Application for Payment is received by Engineer and Owner after the application date fixed above, payment shall be made by Owner not later than one month after the Engineer issues a Certificate for Payment.

5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form and supported by such data to substantiate its accuracy as Engineer and Owner may require. This schedule, unless objected to by Engineer or Owner, shall be used as a basis for reviewing Contractor's Applications for Payment.

5.1.5 Applications for Payment shall warrant the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

5.1.6 Subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as provided in Article 14 of the City of Round Rock General Conditions.

5.1.7 Except with Owner's prior written approval, Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

5.2 FINAL PAYMENT

5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by Owner to Contractor when:

- .1** Contractor has fully performed the Contract except for Contractor's responsibility to correct Work, and to satisfy other requirements, if any, which extend beyond final payment; and
- .2** a final Certificate for Payment has been issued by Engineer.

5.2.2 Owner's final payment to Contractor shall be made no later than thirty (30) days after the issuance of Engineer's final Certificate for Payment. In no event shall final payment be required to be made prior to thirty (30) days after all Work on the Contract has been fully performed. Defects in the Work discovered prior to final payment shall be treated as non-conforming Work and shall be corrected by Contractor prior to final payment, and shall not be treated as warranty items.

ARTICLE 6 TERMINATION OR SUSPENSION

6.1 The Contract may be terminated by Owner or Contractor as provided in Article 15 of the City of Round Rock General Conditions.

6.2 The Work may be suspended by Owner as provided in Article 15 of the City of Round Rock General Conditions.

ARTICLE 7 ENUMERATION OF CONTRACT DOCUMENTS

7.1 The Contract Documents, except for Modifications issued after execution of this Agreement, are enumerated as follows:

7.1.1 The Agreement is this executed version of the City of Round Rock, Texas Standard Form of Agreement between Owner and Contractor, as modified.

7.1.2 The General Conditions are the "City of Round Rock Contract Forms 00700," General Conditions, as modified.

7.1.3 The Supplementary, Special, and other Conditions of the Contract are those contained in the Project Manual dated August 2017.

7.1.4 The Specifications are those contained in the Project Manual dated August 2017.

7.1.5 The Drawings, if any, are those contained in the Project Manual dated August 2017.

7.1.6 The Insurance & Construction Bond Forms of the Contract are those contained in the Project Manual dated August 2017.

7.1.7 The Notice to Bidders, Instructions to Bidders, Bid Form, and Addenda, if any, are those contained in the Project Manual dated August 2017.

7.1.8 If this Agreement covers construction involving federal funds, thereby requiring inclusion of mandated contract clauses, such federally required clauses are those contained in the "City of Round Rock Contract Forms 03000," Federally Required Contract Clauses, as modified.

7.1.9 Other documents, if any, forming part of the Contract Documents are as follows:

00500 Attachment "A" & 01000 Attachment "A"

ARTICLE 8 MISCELLANEOUS PROVISIONS

8.1 Where reference is made in this Agreement to a provision of any document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

8.2 Owner's representative is: Jeff Bell
Senior Project Manager
2008 Enterprise Drive
Round Rock, Texas 78664

8.3 Contractor's representative is: _____

8.4 Neither Owner's nor Contractor's representative shall be changed without ten (10) days' written notice to the other party.

8.5 Waiver of any breach of this Agreement shall not constitute waiver of any subsequent breach.

8.6 Owner agrees to pay Contractor from available funds for satisfactory performance of this Agreement in accordance with the bid or proposal submitted therefor, subject to proper additions and deductions, all as provided in the General Conditions, Supplemental Conditions, and Special Conditions of this Agreement, and Owner agrees to make payments on account thereof as provided therein. Lack of funds shall render this Agreement null and void to the extent funds are not available. This Agreement is a commitment of City of Round Rock's current revenues only.

8.7 Although this Agreement is drawn by Owner, both parties hereto expressly agree and assert that, in the event of any dispute over its meaning or application, this Agreement shall be interpreted reasonably and fairly, and neither more strongly for nor against either party.

8.8 This Agreement shall be enforceable in Round Rock, Texas, and if legal action is necessary by either party with respect to the enforcement of any or all of the terms or conditions herein, exclusive venue for same shall lie in Williamson County, Texas. This Agreement shall be governed by and construed in accordance with the laws and court decisions of the State of Texas.

8.9 Both parties hereby expressly agree that no claims or disputes between the parties arising out of or relating to this Agreement or a breach thereof shall be decided by an arbitration proceeding, including without limitation, any proceeding under the Federal Arbitration Act (9 USC Section 1-14) or any applicable state arbitration statute.

8.10 The parties, by execution of this Agreement, bind themselves, their heirs, successors, assigns, and legal representatives for the full and faithful performance of the terms and provisions hereof.

This Agreement is entered into as of the day and year first written above and is executed in at least three (3) original copies, of which one is to be delivered to Contractor, one to Engineer for use in the administration of the Contract, and the remainder to Owner.

OWNER

CITY OF ROUND ROCK, TEXAS

Printed Name: _____

Title _____

Date Signed: _____

CONTRACTOR

Printed Name: _____

Title: _____

Date Signed: _____

ATTEST:

City Clerk

FOR CITY, APPROVED AS TO FORM:

City Attorney

ATTACHMENT A

All 8-inch discharge piping and appurtenances shall be approved, delivered and installed within 75 days of Notice to Proceed.

**00600 INSURANCE AND
CONSTRUCTION BOND FORMS**

BONDS AND INSURANCE INSTRUCTIONS

Instruction Sheet

1. Insurance Company must be licensed by State of Texas.
2. Agent signing bonds must be licensed in Texas.
3. Agent signing bonds must have Power of Attorney on behalf of insurance company.
4. If Agent signing bonds has Power of Attorney, but not licensed in Texas, then the bond must be counter-signed by Texas local recording agent.

**ALL THE ABOVE INFORMATION CAN BE FOUND AT
Texas Department of Insurance website –www.tdi.state.tx.us**

5. Make sure the dollar amount on both Performance and Payment Bonds match the amount of the Agreement & Bid Form Sheet.
6. Both Performance and Payment Bonds should be signed by Authorized Person. If the contractor is a corporation, then it should be signed by the President or the Vice-President. If the contractor is not incorporated, then it may be signed by the Owner. Please state the title of the authorized person.

CERTIFICATE OF LIABILITY INSURANCE

Instruction Sheet

1. **CERTIFICATE OF LIABILITY INSURANCE FORM**

The City of Round Rock's Certificate of Liability Insurance form provided herein or a standard ACORD form.

2. **PRODUCER** and **INSURED** - Please list name, address, phone number and e-mail.

3. **COMPANIES AFFORDING COVERAGE** – TDI number required. The TDI number can be obtained from the Texas Dept of Insurance Website: <http://www.tdi.state.tx.us/>. – Company Lookup.

Note: Exception to this rule. In certain instances where there is unusual risks involved, **Surplus Lines Insurance Carriers** can be used. Below are the guidelines:

a. **Insurance Company does not have to be “licensed in Texas”, but they do have to be “eligible for a Texas license.”**

Please verify with the Texas Dept of Insurance

Website: <http://www.tdi.state.tx.us/>. – Company Lookup

b. **Policy has to be written by licensed surplus lines Agent.**

Also verify with the Texas Dept of Insurance

Website: <http://www.tdi.state.tx.us/> - Agent Lookup

4. **TYPES OF INSURANCE COVERAGE** –

CONSTRUCTION CONTRACT: Please double check the **General Conditions and the Supplemental General Conditions** for the types and amounts of insurance required. The Supplemental General Conditions usually state the following:

a. **Business Automobile Liability Insurance**

b. **Workers' Compensation and Employers' Liability Insurance**

c. **Commercial General Liability Insurance**

d. **Builders' Risk Insurance** – (Generally required for all “vertical” construction. Check with Project Manager for requirements.)

FOR ALL OTHER CONTRACTS, PLEASE REFER TO THE INSURANCE SECTION FOR TYPE OF INSURANCE REQUIRED. (For example Engineering Service Contracts usually require “professional liability insurance”.)

5. **EFFECTIVE DATE & EXPIRATION DATE**

Please make sure dates are current.

6. City of Round Rock must be listed on the Certificate of Insurance as an additional insured (except Workers Compensation and Builders Risk).

7. Certificate must indicate that the insurance Company must give the City of Round Rock notice of any changes, cancellation, etc. at least thirty (30) days prior to date of change.

8. **Make sure Certificate is signed by an Agent Licensed in the State of Texas, this can also be found on the Texas Department of Insurance website –www.tdi.state.tx.us – Agent Lookup.**

PERFORMANCE BOND

THE STATE OF TEXAS §
 § KNOW ALL BY THESE PRESENTS:
COUNTY OF WILLIAMSON §

That _____ of the City of _____, County of _____, and State of _____, as Principal, and _____ authorized under the law of the State of Texas to act as surety on bonds for principals, are held and firmly bound unto **THE CITY OF ROUND ROCK, TEXAS, (Owner)**, in the penal sum of

_____ Dollars (\$ _____) for the payment whereof, well and truly to be made the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, by these presents:

WHEREAS, the Principal has entered into a certain written Agreement with the Owner dated the _____ day of _____, 20__ to which the Agreement is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein consisting of: West WWTP Force Main Relocation

(Name of the Project)

NOW, THEREFORE, THE CONDITIONS OF THIS OBLIGATION IS SUCH, that if the said Principal shall faithfully perform said Agreement and shall, in all respects, duly and faithfully observe and perform all and singular the covenants, conditions and agreements in and by said Agreement, agreed and covenanted by the Principal to be observed and performed, including but not limited to, the repair of any and all defects in said work occasioned by and resulting from defects in materials furnished by or workmanship of, the Principal in performing the Work covered by said Agreement and occurring within a period of twelve (12) months from the date of Final Completion and all other covenants and conditions, according to the true intent and meaning of said Agreement and the Plans and Specifications hereto annexed, then this obligation shall be void; otherwise to remain in full force and effect;

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Chapter 2253, Texas Government code, as amended, and all liabilities on this bond shall be determined in accordance with the provisions of said Chapter 2253 to the same extent as if it were copied at length herein.

PERFORMANCE BOND (continued)

Surety, for value received, stipulates and agrees that no change, extension of time, alteration or addition to the term of the Agreement, or to the Work performed thereunder, or the Plans, Specifications, or drawings accompanying the same, shall in anywise affect its obligation on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Agreement, or to the work to be performed thereunder.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this _____ day of _____, 20____.

Principal

Printed Name

By: _____

Title: _____

Address: _____

Surety

Printed Name

By: _____

Title: _____

Address: _____

Resident Agent of Surety:

Signature

Printed Name

Street Address

City, State & Zip Code

PAYMENT BOND

THE STATE OF TEXAS §
 § KNOW ALL MEN BY THESE PRESENTS:
COUNTY OF WILLIAMSON §

That _____, of the City of _____, County of _____, and State of _____ as Principal, and _____ authorized under the laws of the State of Texas to act as Surety on Bonds for Principals, are held and firmly bound unto **THE CITY OF ROUND ROCK, (OWNER)**, and all subcontractors, workers, laborers, mechanics and suppliers as their interest may appear, all of whom shall have the right to sue upon this bond, in the penal sum of _____ Dollars (\$ _____) for the payment whereof, well and truly be made the said Principal and Surety bind themselves and their heirs, administrators, executors, successors, and assigns, jointly and severally, by these presents:

WHEREAS, the Principal has entered into a certain written Agreement with the Owner, dated the _____ day of _____, 20____, to which Agreement is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein consisting of: West WWTP Force Main Relocation

_____(Name of the Project)

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall well and truly pay all subcontractors, workers, laborers, mechanics, and suppliers, all monies to them owing by said Principals for subcontracts, work, labor, equipment, supplies and materials done and furnished for the construction of the improvements of said Agreement, then this obligation shall be and become null and void; otherwise to remain in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Chapter 2253, Texas Government code, as amended, and all liabilities on this bond shall be determined in accordance with the provisions of said Chapter 2253 to the same extent as if it were copied at length herein.

PAYMENT BOND (continued)

Surety, for value received, stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Agreement, or to the Work performed thereunder, or the plans, specifications or drawings accompanying the same shall in anywise affect it's obligation on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract, or to the work to be performed thereunder.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this Instrument this _____ day of _____, 20____.

Principal

Printed Name

By: _____
Title: _____
Address: _____

Surety

Printed Name

By: _____
Title: _____
Address: _____

Resident Agent of Surety:

Signature

Printed Name

Street Address

CERTIFICATE OF LIABILITY INSURANCE

Date: _____

PRODUCER:

Phone: _____ E-mail: _____

INSURED:

Phone: _____ E-mail: _____

TDI number required. Please refer to the
Texas Dept of Insurance website: <http://www.tdi.state.tx.us/>

	COMPANIES AFFORDING COVERAGE	TDI
A		
B		
C		
D		

THIS IS TO CERTIFY THAT the Insured named above is insured by the Companies listed above with respect to the business operations hereinafter described, for the types of insurance and in accordance with the provisions of the standard policies used by the companies, and further hereinafter described. Exceptions to the policies are noted below.

CO LTR	TYPE OF INSURANCE	POLICY NUMBER	EFFECTIVE DATE	EXPIRATION DATE	LIMITS
	GENERAL LIABILITY				GENERAL AGGREGATE \$ PRODUCTS-COMP/OP AGG. \$ PERSONAL & ADV. INJURY \$ EACH OCCURRENCE \$ FIRE DAMAGE (Any one fire) \$ MED. EXPENSE (Any one person) \$
	AUTOMOBILE LIABILITY				COMBINED SINGLE LIMIT \$ BODILY INJURY (Per person) \$ BODILY INJURY (Per accident) \$ PROPERTY DAMAGE \$
	EXCESS LIABILITY				EACH OCCURRENCE \$ AGGREGATE \$
	WORKERS' COMPENSATION AND EMPLOYERS' LIABILITY				STATUTORY LIMITS \$ EACH ACCIDENT \$ DISEASE - POLICY LIMIT \$ DISEASE - EACH EMPLOYEE \$
	PROFESSIONAL LIABILITY				
	BUILDERS' RISK INSURANCE OR INSTALLATION INSURANCE				

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/SPECIAL ITEMS/EXCEPTIONS

The City of Round Rock is named as additional insured with respect to all policies except 'Workers' Compensation and Employers' Liability' and 'Professional Liability'. Should any of the above described policies be cancelled or changed before the expiration date thereof, the issuing company will mail thirty (30) days written notice to the certificate holder named below.

CERTIFICATE HOLDER: City Manager
City of Round Rock
221 E. Main Street
Round Rock, Texas 78664

SIGNATURE OF AGENT LICENSED IN STATE OF TEXAS

Typed Name: _____

License ID: _____

00700 GENERAL CONDITIONS

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GENERAL CONDITIONS

ARTICLE 1 - DEFINITIONS

Whenever used in these General Conditions or in the other Contract Documents the following terms have the meanings indicated which are applicable to both the singular and plural thereof:

1.1 Addenda - Written or graphic instruments issued prior to the receipt of Proposals or the opening of Bids that clarify, correct or change the proposal or bidding requirements or the Contract Documents.

1.2 Agreement - Prescribed form, referenced as Section 00500.

1.3 Alternative Dispute Resolution - The process by which a disputed Claim may be settled if the OWNER and the CONTRACTOR cannot reach an agreement between themselves, as an alternative to litigation.

1.4 Bid - Proposal of bidder on prescribed forms setting forth prices for performing the Work described in the Contract Documents.

1.5 Bid Documents - The advertisement or invitation for bids, instructions to bidders, the bid form, the Contract Documents and Addenda.

1.6 Calendar Day - Any day of the week; no days being excepted. Work on Saturdays, Sundays, and/or Legal Holidays shall only be conducted with prior express written consent of the OWNER.

1.7 Change Directive - A written directive to the CONTRACTOR, signed by the OWNER, ordering a change in the Work and stating a proposed basis for adjustment, if any, in the Contract Amount or Contract Time, or both. A Change Directive may be used in the absence of total agreement on the terms of a Change Order. A Change Directive does not change the Contract Amount or Contract Time, but is evidence that the parties expect that the change directed or documented by a Change Directive will be incorporated in a subsequently issued Change Order.

1.8 Change Orders - Written agreements entered into between the CONTRACTOR and the OWNER authorizing an addition, deletion, or revision to the Contract, issued on or after the Execution Date of the Agreement and within the Contract term.

1.9 Claim - A written demand seeking, as a matter of right, adjustment or interpretation of Contract terms, payment of money, extension of time or other relief with respect to the terms of the Contract.

1.10 Contract - The Contract represents the entire and integrated agreement between the OWNER and the CONTRACTOR for performance of the Work, as evidenced by the Contract Documents.

1.11 Contract Amount - The amount payable by the OWNER to the CONTRACTOR for completion of the Work in accordance with the Contract Documents.

1.12 Contract Documents - Invitation to Bid, Instructions to Bidders, General Conditions, Supplemental General Conditions, Special Conditions, Technical Specifications, Project Manual, Drawings, Addenda and Change Orders.

1.13 Contract Time - The number of days allowed for completion of the Work as defined by the Contract. When any period is referred to in days, it will be computed to exclude the first and include the last day of such period. A day of twenty-four (24) hours measured from midnight to the next midnight will constitute a day.

1.14 CONTRACTOR - The individual, firm, corporation, or other business entity with whom the OWNER has entered into the Contract.

1.15 Drawings - Those portions of the Contract Documents which are graphic representations of the scope, extent and character of the Work to be furnished and performed by the CONTRACTOR and which have been

approved by the OWNER. Drawings may include plans, elevations, sections, details, schedules and diagrams. Shop Drawings are not Drawings as so defined.

1.16 Engineer/Architect (E/A) - The OWNER's design professional identified as such in the Contract. The titles of "Architect/Engineer," "Architect" and "Engineer" used in the Contract Documents shall be read the same as Engineer/Architect (E/A). Nothing contained in the Contract Documents shall create any contractual or agency relationship between E/A and the CONTRACTOR.

1.17 Equal - The terms "equal" or "approved equal" shall have the same meaning.

1.18 Execution Date - Date of last signature of the parties to the Agreement.

1.19 Field Order - A written order issued by Owner's Representative which orders minor changes in the Work and which does not involve a change in the Contract Amount or the Contract Time.

1.20 Final Acceptance – The stage in the Contract process when, in the OWNER's opinion, Final Completion of the Work has been attained and a Certificate of Acceptance approved by the OWNER is issued.

1.21 Final Completion - The stage in the progress of the Work when, in the OWNER's opinion, the entire Work has been completed, the CONTRACTOR's obligations under the Contract Documents have been fulfilled, and the OWNER is processing or has made final payment to the CONTRACTOR, as evidenced by a Certificate of Acceptance approved by the OWNER.

1.22 Inspector - The authorized representative of any regulatory agency that has jurisdiction over any portion of the Work.

1.23 Legal Holidays

1.23.1 The following are recognized by the OWNER:

<i>Holiday</i>	<i>Date Observed</i>
New Year's Day	January 1
Martin Luther King, Jr.'s Birthday	Third Monday in January
President's Day	Third Monday in February
Memorial Day	Last Monday in May
Independence Day	July 4
Labor Day	First Monday in September
Veteran's Day	November 11
Thanksgiving Day	Fourth Thursday in November
Friday after Thanksgiving	Friday after Thanksgiving

Christmas Eve December 24

Christmas Day December 25

1.23.2 If a Legal Holiday falls on Saturday, it will be observed on the preceding Friday. If a Legal Holiday falls on Sunday, it will be observed on the following Monday.

1.23.3 If Christmas Eve falls on a Saturday or a Sunday, the preceding Friday is observed as the Christmas Eve holiday.

1.23.4 If Christmas Day falls on a Saturday or a Sunday, the following Monday is observed as the Christmas Day holiday.

1.24 Milestones - A significant event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

1.25 Notice to Proceed - A Written Notice given by the OWNER to the CONTRACTOR fixing the date on which the Contract Times will commence to run and on which the CONTRACTOR shall start to perform the CONTRACTOR's obligations under the Contract Documents.

1.26 OWNER – The City of Round Rock, Texas, a municipal corporation, home-rule city and political subdivision organized and existing under the laws of the State of Texas, acting through the City Manager or his/her designee, officers, agents or employees to administer design and construction of the Project.

1.27 Owner's Representative - The designated representative of the OWNER.

1.28 Partial Occupancy or Use - Use by the OWNER of a partially completed part of the Work for the purpose for which it is intended (or a related purpose) prior to Substantial Completion of all the Work.

1.29 Project - The total construction of which the Work to be provided under the Contract Documents may be the whole, or a part, as indicated elsewhere in the Contract Documents.

1.30 Project Manual - That portion of the Contract Documents which may include the following: introductory information; bidding requirements, Contract forms and General and Supplemental General Conditions; General Requirements; Specifications; Drawings; Project Safety Manual; and Addenda.

1.31 Proposal – Proposal of Offeror, under Local Government Code §271.113 providing for alternative project delivery methods, on prescribed forms setting forth prices for performing the Work described in the Contract Documents.

1.32 Proposal Documents – The advertisement or invitation for Proposals, Instruction to Offerors, the Proposal form, the Contract Documents and Addenda.

1.33 Resident Project Representative - The authorized representative of E/A who may be assigned to the site or any part thereof.

1.34 Shop Drawings - All drawings, diagrams, illustrations, schedules and other data or information which are specifically prepared or assembled by or for the CONTRACTOR and submitted by the CONTRACTOR as required by the Contract Documents.

1.35 Specifications - Those portions of the Contract Documents consisting of written technical descriptions as applied to the Work, which set forth to the CONTRACTOR, in detail, the requirements which must be met by all materials, equipment, construction systems, standards, workmanship, equipment and services in order to render a completed and useful project.

1.36 Substantial Completion - The stage in the progress of the Work when the Work, or designated portions thereof, may still require minor modifications or adjustments but, in the OWNER's opinion, the Work has progressed to the point such that all parts of the Work under consideration are fully operational, as evidenced by a Certificate of Substantial Completion approved by the OWNER.

1.37 Subcontractor - An individual, firm, or corporation having a direct contract with the CONTRACTOR for the performance of a part of the Work.

1.38 Sub-subcontractor - A person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work.

1.39 Superintendent - The representative of the CONTRACTOR authorized in writing to receive and fulfill instructions from Owner's Representative, and who shall supervise and direct construction of the Work.

1.40 Supplemental General Conditions - The part of the Contract Documents which either amends or supplements the General Conditions. All General Conditions which are not so amended or so supplemented shall be considered as remaining in full force and effect.

1.41 Supplier - An individual or entity having a direct contract with the CONTRACTOR or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by the CONTRACTOR or any Subcontractor.

1.42 Time Extension Request - An approved request for time extension on a form acceptable to the OWNER.

1.43 Work - The entire completed construction, or the various separately identifiable parts thereof, required to be furnished under the Contract Documents.

1.44 Working Day - Any day of the week, not including Saturdays, Sundays, or Legal Holidays, in which conditions not under the CONTRACTOR's control will permit work for at least seven (7) hours of the Working Times. Upon authorization by the Owner's Representative, work on Saturdays, Sundays and/or Legal Holidays may be allowed and in that event a Working Day will be counted for each such day.

1.45 Working Times - Times of day(s) during which work may be performed. Unless authorized by Owner's Representative, all Work shall be performed between 7:00 a.m. and 6:00 p.m. on weekdays and, if previously authorized as provided for in paragraph 1.44 or paragraph 1.6 herein, as applicable, between 9:00 a.m. and 6:00 p.m. on Saturdays, Sundays or Legal Holidays. When the CONTRACTOR has been authorized to perform Work during hours outside Working Times, such hours shall be considered time worked on Working Day contracts. Notwithstanding the preceding, emergency work may be done without prior permission only as provided in paragraph 6.11.5 herein.

1.46 Written Notice - Written communication between the OWNER and the CONTRACTOR. Written Notice shall be deemed to have been duly served if delivered in person to Owner's Representative or to the CONTRACTOR's duly authorized representative, or if such Written Notice is delivered to or sent by registered or certified mail to the attention of Owner's Representative or to the CONTRACTOR's duly authorized representative at the last business address known to the party giving notice.

ARTICLE 2 - PRELIMINARY MATTERS

2.1 Delivery of Agreement, Bonds, Insurance, and Other Documentation:

Within ten (10) Calendar Days after written notification of award of Contract, the CONTRACTOR shall deliver to the OWNER signed Agreement, Bond(s), Insurance Certificate(s) and other documentation required for execution of the Contract.

2.2 Copies of Documents:

The OWNER shall furnish to the CONTRACTOR two (2) copies of the Contract Documents unless otherwise specified.

2.3 Commencement of Contract Times; Notice to Proceed:

The Contract Time(s) will begin to run on the day indicated in the Notice to Proceed. Notice to Proceed will be given at any time within sixty (60) Calendar Days after the Execution Date of the Agreement, unless extended by written agreement of the parties.

2.4 Before Starting Construction:

2.4.1 No Work shall be done at the site prior to the preconstruction conference without the OWNER's approval. Before undertaking each part of the Work, the CONTRACTOR shall carefully study and compare the Contract Documents and check and verify pertinent figures shown thereon and all applicable field measurements. The CONTRACTOR shall promptly report in writing to Owner's Representative any conflict, error, ambiguity or discrepancy which the CONTRACTOR may discover and shall obtain a written interpretation or clarification from Owner's Representative before proceeding with any Work affected thereby. The CONTRACTOR shall be liable to the OWNER for failure to report any conflict, error, ambiguity or discrepancy in the Contract Documents of which the CONTRACTOR knew or reasonably should have known.

2.4.2 The CONTRACTOR shall submit the following to Owner's Representative for review and approval no later than the preconstruction conference:

- .1** a preliminary progress schedule indicating the times (number of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents, identifying when all Subcontractors will be utilized, and taking into consideration any limitations on Working Hours;
- .2** a preliminary schedule of Shop Drawing and sample submittals;
- .3** a preliminary schedule of values for all of the Work, subdivided into component parts in sufficient detail to serve as the basis for progress payments during construction. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work;
- .4** a letter designating CONTRACTOR's Superintendent;
- .5** a letter from the CONTRACTOR and Subcontractor(s) listing any salaried specialists;
- .6** if applicable, a letter designating the "Competent Person(s)" on general safety and trench safety measures;
- .7** if applicable, a trench safety system plan;
- .8** if applicable, a plan illustrating proposed locations of temporary facilities;
- .9** if applicable, a traffic control plan;
- .10** a completed Non-Use of Asbestos Affidavit (Prior to Construction); and
- .11** if applicable, a letter designating the Texas Registered Professional Land Surveyor for layout of the Work.

2.5 Preconstruction Conference:

Prior to commencement of Work at the site, a preconstruction conference attended by the CONTRACTOR, Owner's Representative and others will be held.

2.6 Initially Acceptable Schedules:

Unless otherwise provided in the Contract Documents, the CONTRACTOR shall obtain approval of Owner's Representative on final versions of the schedules submitted in accordance with paragraph 2.4.2 before the first progress payment will be made to the CONTRACTOR. The progress schedule must provide for an orderly progression of the Work to completion within any specified Milestones and Contract Times. Acceptance of the schedule by Owner's Representative will neither impose on Owner's Representative responsibility for the sequencing, scheduling or progress of the Work nor interfere with or relieve the CONTRACTOR from the CONTRACTOR's full responsibility therefor. The CONTRACTOR's schedule of Shop Drawings and sample submissions must provide an arrangement agreeable to the parties for reviewing and processing the required submittals.

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.1 Intent:

3.1.1 The intent of the Contract Documents is to include all information necessary for the proper execution and completion of the Work by the CONTRACTOR. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all. In cases of disagreement, the following order of precedence shall govern (top item receiving priority of interpretation):

- Signed Agreement
- Addenda to the Contract Documents
- Special Conditions
- Supplemental General Conditions
- General Conditions
- Other Bidding Requirements and Contract Forms
- Special Provisions to the Standard Technical Specifications
- Special Specifications
- Standard Technical Specifications
- Drawings (figured dimensions shall govern over scaled dimensions)
- Project Safety manual, if applicable

3.1.2 Unless otherwise stated in the Contract Documents, words which have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

3.2 Reporting and Resolving Discrepancies:

If, during the performance of the Work, the CONTRACTOR discovers any conflict, error, ambiguity or discrepancy within the Contract Documents or between the Contract Documents and any provisions of any such law or regulation applicable to the performance of the Work or of any such standard, specification, manual or code or instructions of any Supplier, the CONTRACTOR shall immediately report it to Owner's Representative in writing, and the CONTRACTOR shall not proceed with the Work affected thereby until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in paragraph 3.3.1 or paragraph 3.3.2. The CONTRACTOR shall be liable to the OWNER for failure to report any such conflict, error, ambiguity or discrepancy of which the CONTRACTOR knew or reasonably should have known.

3.3 Amending and Supplementing Contract Documents:

3.3.1 The Contract Documents may be amended to provide for additions, deletions and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways:

- .1 Change Order.
- .2 Change Directive.
- .3 Time Extension Request.

3.3.2 In addition, the requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, in one or more of the following ways:

- .1 Field Order.
- .2 Review of a Shop Drawing or sample.
- .3 Written interpretation or clarification.

3.4 Reuse of Documents Prohibited:

The CONTRACTOR and any Subcontractor or Supplier or other person or organization performing or furnishing any of the Work under a direct or indirect contract with the OWNER: (i) shall not have or acquire any title to or ownership rights in any of the Drawings, Specifications or other documents (or copies of any thereof) prepared by or bearing the seal of E/A or E/A's consultants, and (ii) shall not reuse any of such Drawings, Specifications, other documents or copies on extensions of the Project or any other project without written consent of the OWNER and E/A.

ARTICLE 4 - AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; REFERENCE POINTS

4.1 Availability of Lands:

The OWNER shall furnish, as indicated in the Contract Documents, all required rights to use the lands upon which the Work is to be performed, rights-of-way and easements for access thereto, and such other lands which are designated for the use of the CONTRACTOR. The OWNER shall identify any encumbrances or restrictions not of general application but specifically related to use of lands so furnished with which the CONTRACTOR will have to comply in performing the Work. Easements for permanent structures or permanent changes in existing facilities will be obtained and paid for by the OWNER, unless otherwise provided in the Contract Documents. If the OWNER fails to furnish these lands, rights-of-way or easements in a timely manner, the CONTRACTOR may make a Claim for adjustments in the Contract Times. The CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.2 Subsurface and Physical Conditions:

4.2.1 The CONTRACTOR hereby covenants that it has examined the site of the proposed Work and is familiar with all of the conditions surrounding construction of the Project, having conducted all inquiries, tests and investigations deemed necessary and proper.

4.2.2 If conditions are encountered at the site which are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature, that differ materially from those normally encountered in the type of work being performed under this Contract, then notice by the observing party shall be given to the other party promptly before conditions are disturbed and in no event later than seven (7) calendar days after first observance of the conditions. Owner's Representative will promptly investigate such conditions with E/A and, if they differ materially and cause an increase or decrease in the CONTRACTOR's cost of, or time required for, performance of any part of the Work, will

recommend an equitable adjustment in the Contract Amount or Contract Time, or both. If Owner's Representative determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the CONTRACTOR shall be notified in writing, stating the reasons. Any disputes arising from Owner's Representative's determination shall be resolved in accordance with Article 16.

4.2.3 Notwithstanding any other provision of this Contract, the CONTRACTOR shall be solely responsible for the location and protection of any and all public lines and utility customer service lines in the Work area. For the purposes of this section, "public lines" means the utility distribution and supply system within public rights-of-way or easements, and "utility customer service lines" (service) means any utility line connecting a utility customer to the utility distribution system. Generally, existing service connections within right-of-way or easements are not shown on the Drawings. The CONTRACTOR shall notify the OWNER and "One Call" and exercise due care to locate and to mark, uncover or otherwise protect all such lines in the construction zone and any of the CONTRACTOR's work or storage areas. The CONTRACTOR's obligation hereunder shall be primary and nondelegable. The CONTRACTOR shall indemnify or reimburse such expenses or costs (including fines that may be levied against the OWNER) that may result from unauthorized or accidental damage to all public lines and utility customer service lines in the Work area. The OWNER reserves the right to repair such damage the CONTRACTOR may cause, at the CONTRACTOR's expense.

4.2.4 The CONTRACTOR shall take reasonable precaution to avoid disturbing primitive records and antiquities of archaeological, paleontological or historical significance. No objects of this nature shall be disturbed without written permission of the OWNER and the Texas Department of Antiquities Protection. When such objects are uncovered unexpectedly, the CONTRACTOR shall stop all Work in close proximity and notify Owner's Representative and the Texas Department of Antiquities Protection of their presence and shall not disturb them until written permission and permit to do so is granted. All primitive rights and antiquities uncovered on the OWNER's property shall remain property of the State of Texas, the Texas Department of Antiquities Protection conforming to the Texas Natural Resources Code. If it is determined by the OWNER, in consultation with the Texas Department of Antiquities Protection, that exploration or excavation of primitive records or antiquities on Project site is necessary to avoid loss, the CONTRACTOR shall cooperate in salvage work attendant to preservation. If the Work stoppage or salvage work causes an increase in the CONTRACTOR's cost of, or time required for, performance of the Work, the Contract Amount and/or Contract Time may be equitably adjusted.

4.3 Reference Points:

Unless otherwise specified, the OWNER will furnish all reference points, benchmarks, survey monuments, and control points which, in the OWNER's opinion, are suitable for laying out the Work. Such benchmarks and reference points will be placed at intervals not to exceed 1,500 feet.

All reference points, benchmarks, survey monuments and control points shall be carefully preserved by the CONTRACTOR by use of flags, laths or other appropriate measures and, in case of destruction or removal by the CONTRACTOR or its employees, such reference points, benchmarks, survey monuments, and control points shall be replaced by a Registered Professional Land Surveyor at the CONTRACTOR's expense. When reference points, benchmarks, survey monuments, or control points are in conflict with the Work, then reestablishment will be the OWNER's responsibility during or upon completion of the Work.

4.4 Hazardous Materials:

4.4.1 The OWNER shall be responsible for any hazardous material uncovered or revealed at the site which was not shown, indicated or identified in the Contract Documents to be within the scope of the Work and which may present a substantial danger to persons or property exposed thereto in connection with the Work at the site. The CONTRACTOR shall immediately notify Owner's Representative of any suspected hazardous materials encountered before or during performance of the Work and shall take all necessary precautions to avoid further disturbance of the materials.

4.4.2 The CONTRACTOR shall be responsible for any hazardous materials brought to the site by the CONTRACTOR, Subcontractor, Suppliers or anyone else for whom the CONTRACTOR is responsible.

4.4.3 No asbestos-containing materials shall be incorporated into the Work or brought on the Project site without prior approval of the OWNER.

ARTICLE 5 - BONDS AND INSURANCE

5.1 Surety and Insurance Companies:

All bonds and insurance required by the Contract Documents shall be obtained from solvent surety or insurance companies that are duly licensed by the State of Texas and authorized to issue bonds or insurance policies for the limits and coverages required by the Contract Documents. The bonds shall be in a form acceptable to the OWNER and shall be issued by a surety which complies with the requirements of Art. 7.19-1, Texas Insurance Code (1997) and which is otherwise acceptable to the OWNER.

OWNER may require the surety to obtain reinsurance for any portion of the risk that exceeds 10% of the surety's capital and surplus. For bonds exceeding \$100,000, the surety must also hold a certificate of authority from the U.S. Secretary of the Treasury or have obtained reinsurance from a reinsurer that is authorized as a reinsurer in Texas and holds a certificate of authority from the U.S. Secretary of the Treasury.

5.2 Workers' Compensation Insurance Coverage:

5.2.1 Definitions:

- .1** Certificate of coverage ("certificate") - A copy of a certificate of insurance, a certificate of authority to self-insure issued by the commission, or a coverage agreement showing statutory workers' compensation insurance coverage for the person's or entity's employees providing services on the Project, for the duration of the Project.
- .2** Duration of the Project - includes the time from the beginning of the Work on the Project until the CONTRACTOR's/ person's Work on the Project has been completed and accepted by the OWNER.
- .3** Persons providing services on the Project ("subcontractor" herein) - includes all persons or entities performing all or part of the services the CONTRACTOR has undertaken to perform on the Project, regardless of whether that person contracted directly with the CONTRACTOR and regardless of whether that person has employees. This includes, by way of illustration and not of limitation, independent contractors, Subcontractors, leasing companies, motor carriers, owner-operators, employees of any such entity, or employees of any entity which furnishes persons to provide services on the Project. "Services" include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to a project. "Services" does not include activities unrelated to the Project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.

5.2.2 The CONTRACTOR shall provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011(44) for all employees of the CONTRACTOR providing services on the Project, for the duration of the Project.

5.2.3 The OWNER will not execute the Contract prior to the CONTRACTOR providing all required certificates of coverage.

5.2.4 If the coverage period shown on the CONTRACTOR's current certificate of coverage ends during the duration of the Project, the CONTRACTOR must, prior to the end of the coverage period, file a new certificate of coverage with the OWNER showing that coverage has been extended.

5.2.5 The CONTRACTOR shall obtain from each person providing services on the Project, and provide to the OWNER:

- .1 a certificate of coverage, prior to that person beginning Work on the Project, so the OWNER will have on file certificates of coverage showing coverage for all persons providing services on the Project; and
- .2 no later than seven (7) days after receipt by the CONTRACTOR, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the Project.

5.2.6 The CONTRACTOR shall retain all required certificates of coverage for the duration of the Project and for one (1) year thereafter.

5.2.7 The CONTRACTOR shall notify the OWNER in writing by certified mail or personal delivery within ten (10) days after the CONTRACTOR knew or should have known of any change that materially affects the provision of coverage of any person providing services on the Project.

5.2.8 The CONTRACTOR shall post at its office or on each Project site a notice, in the text, form and manner prescribed by the Texas Workers' Compensation Commission, informing all persons providing services on the Project that they are required to be covered, and stating how a person may verify coverage and report lack of coverage.

5.2.9 The CONTRACTOR shall contractually require each person with whom it contracts to provide services on a Project to:

- .1 provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011(44) for all of its employees providing services on the Project, for the duration of the Project;
- .2 provide to the CONTRACTOR, prior to that person beginning Work on the Project, a certificate of coverage showing that coverage is being provided for all employees of the person providing services on the Project, for the duration of the Project;
- .3 provide the CONTRACTOR, prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the Project;
- .4 obtain from each other person with whom it contracts, and provide to the CONTRACTOR:
 - a) a certificate of coverage, prior to the other person beginning Work on the Project; and
 - b) a new certificate of coverage showing extension of coverage, prior to the end of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the Project;
- .5 retain all required certificates of coverage on file for the duration of the Project and for one (1) year thereafter;
- .6 notify the OWNER in writing by certified mail or personal delivery within ten (10) days after the person knew or should have known of any change that materially affects the provision of coverage of any person providing services on the Project; and
- .7 contractually require each person with whom it contracts, to perform as required by paragraphs 5.2.9.1 - 5.2.9.7, with the certificates of coverage to be provided to the person for whom they are providing services.

5.2.10 By signing this Contract or providing or causing to be provided a certificate of coverage, the CONTRACTOR is representing to the OWNER that all employees of the CONTRACTOR who will provide services

on the Project will be covered by workers' compensation coverage for the duration of the Project, that the coverage will be based on proper reporting of classification codes and payroll amounts, and that all coverage agreements will be filed with the appropriate insurance carrier or, in the case of a self-insured, with the commission's Division of Self-Insurance Regulation. Providing false or misleading information may subject the CONTRACTOR to administrative penalties, criminal penalties, civil penalties, or other civil actions.

5.2.11 The CONTRACTOR's failure to comply with any of these provisions is a breach of Contract by the CONTRACTOR which entitles the OWNER to declare the Contract void if the CONTRACTOR does not remedy the breach within ten (10) days after receipt of notice of breach from the OWNER.

5.3 Contractor Insurance Requirements:

For specific bond requirements and additional insurance requirements, refer to the Supplemental General Conditions.

5.3.1.1 General Requirements:

- .1** CONTRACTOR shall carry insurance in the types and amounts indicated below for the duration of the Contract, which shall include items owned by OWNER in the care, custody and control of CONTRACTOR prior to and during construction and warranty period.
- .2** CONTRACTOR must complete and forward the required Certificates of Insurance to OWNER before the Contract is executed as verification of coverage required below. CONTRACTOR shall not commence Work until the required insurance is obtained and until such insurance has been reviewed by OWNER. Approval of insurance by OWNER shall not relieve or decrease the liability of CONTRACTOR hereunder and shall not be construed to be a limitation of liability on the part of CONTRACTOR. CONTRACTOR must also complete and forward the required Certificates of Insurance to OWNER whenever a previously identified policy period has expired as verification of continuing coverage.
- .3** CONTRACTOR's insurance coverage is to be written by companies licensed to do business in the State of Texas at the time the policies are issued and shall be written by companies with A.M. Best ratings of B+VII or better, except for hazardous material insurance which shall be written by companies with A.M. Best ratings of A- or better.
- .4** All endorsements naming the OWNER as additional insured, waivers, and notices of cancellation endorsements as well as the Certificate of Insurance shall indicate: City of Round Rock, 221 E. Main St., Round Rock, Texas 78664.
- .5** The "other" insurance clause shall not apply to the OWNER where the OWNER is an additional insured shown on any policy. It is intended that policies required in the Contract, covering both OWNER and CONTRACTOR, shall be considered primary coverage as applicable.
- .6** If insurance policies are not written for amounts specified below, CONTRACTOR shall carry Umbrella or Excess Liability Insurance for any differences in amounts specified. If Excess Liability Insurance is provided, it shall follow the form of the primary coverage.
- .7** OWNER shall be entitled, upon request and without expense, to receive certified copies of policies and endorsements thereto and may make any reasonable requests for deletion or revision or modification of particular policy terms, conditions, limitations, or exclusions except where policy provisions are established by law or regulations binding upon either of the parties hereto or the underwriter on any such policies.
- .8** OWNER reserves the right to review the insurance requirements set forth during the effective period of this Contract and to make reasonable adjustments to insurance coverage, limits, and exclusions when deemed necessary and prudent by OWNER based upon changes in statutory law,

court decisions, the claims history of the industry or financial condition of the insurance company as well as CONTRACTOR.

- .9 CONTRACTOR shall not cause any insurance to be canceled nor permit any insurance to lapse during the term of the Contract or as required in the Contract.
- .10 CONTRACTOR shall be responsible for premiums, deductibles and self-insured retentions, if any, stated in policies. All deductibles or self-insured retentions shall be disclosed on the Certificate of Insurance.
- .11 CONTRACTOR shall provide OWNER thirty (30) days written notice of erosion of the aggregate limits below occurrence limits for all applicable coverages indicated within the Contract.
- .12 If OWNER-owned property is being transported or stored off-site by CONTRACTOR, then the appropriate property policy will be endorsed for transit and storage in an amount sufficient to protect OWNER's property.
- .13 The insurance coverages required under this contract are required minimums and are not intended to limit the responsibility or liability of CONTRACTOR.

5.3.1.2 Business Automobile Liability Insurance.

Provide coverage for all owned, non-owned and hired vehicles. The policy shall contain the following endorsements in favor of OWNER:

- a) Waiver of Subrogation endorsement TE 2046A;
- b) 30 day Notice of Cancellation endorsement TE 0202A; and
- c) Additional Insured endorsement TE 9901 B.

Provide coverage in the following types and amounts:

- .1 A minimum combined single limit of \$500,000 per occurrence for bodily injury and property damage. Alternate acceptable limits are \$250,000 bodily injury per person, \$500,000 bodily injury per occurrence and at least \$100,000 property damage liability each accident.

5.3.1.3 Workers' Compensation and Employers' Liability Insurance:

Coverage shall be consistent with statutory benefits outlined in the Texas Workers' Compensation Act (Section 401). CONTRACTOR shall assure compliance with this Statute by submitting two (2) copies of a standard certificate of coverage (e.g. ACCORD form) to Owner's Representative for every person providing services on the Project as acceptable proof of coverage. The required Certificate of Insurance must be presented as evidence of coverage for CONTRACTOR. Workers' Compensation Insurance coverage written by the Texas Workers Compensation Fund is acceptable to OWNER. CONTRACTOR's policy shall apply to the State of Texas and include these endorsements in favor of OWNER:

- a) Waiver of Subrogation, form WC 420304; and
- b) 30 day Notice of Cancellation, form WC 420601.

The minimum policy limits for Employers' Liability Insurance coverage shall be as follows:

- .1 \$100,000 bodily injury per accident, \$500,000 bodily injury by disease policy limit and \$100,000 bodily injury by disease each employee.

5.3.1.4 Commercial General Liability Insurance.

The Policy shall contain the following provisions:

- a) Blanket contractual liability coverage for liability assumed under the Contract and all contracts relative to this Project.
- b) Completed Operations/Products Liability for the duration of the warranty period.
- c) Explosion, Collapse and Underground (X, C & U) coverage.
- d) Independent Contractors coverage.
- e) Aggregate limits of insurance per project, endorsement CG 2503.
- f) OWNER listed as an additional insured, endorsement CG 2010.
- g) 30 day notice of cancellation in favor of OWNER, endorsement CG 0205.
- h) Waiver of Transfer of Recovery Against Others in favor of OWNER, endorsement CG 2404.

Provide coverages A&B with minimum limits as follows:

- .1 A combined bodily injury and property damage limit of \$500,000 per occurrence.

5.3.1.5 Builders' Risk Insurance.

CONTRACTOR shall maintain Builders' Risk Insurance or Installation Insurance on an all risk physical loss form in the Contract Amount. Coverage shall continue until the Work is accepted by OWNER. OWNER shall be a loss payee on the policy. If off site storage is permitted, coverage shall include transit and storage in an amount sufficient to protect property being transported or stored.

5.4 Bonds:

5.4.1 General.

- .1 Bonds, when required, shall be executed on forms furnished by or acceptable to OWNER. All bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.
- .2 If the surety on any bond furnished by CONTRACTOR is declared bankrupt or becomes insolvent or its right to do business is terminated in the State of Texas or it ceases to meet the requirements of the preceding paragraph, CONTRACTOR shall within ten (10) days thereafter substitute another bond and surety, both of which must be acceptable to OWNER.
- .3 When Performance Bonds and/or Payment Bonds are required, each shall be issued in an amount of one hundred percent (100%) of the Contract Amount as security for the faithful performance and/or payment of all CONTRACTOR's obligations under the Contract Documents. Performance Bonds and Payment Bonds shall be issued by a solvent surety company authorized to do business in the State of Texas, and shall meet any other requirements established by law or by OWNER pursuant to applicable law. Any surety duly authorized to do business in Texas may write Performance and Payment Bonds on a project without reinsurance to the limit of 10 percent of its capital and surplus. Such a surety must reinsure any obligations over 10 percent.

5.4.2 Performance Bond.

- .1 If the Contract Amount exceeds \$100,000, CONTRACTOR shall furnish OWNER with a Performance Bond in the form set out by OWNER.
- .2 If the Contract Amount exceeds \$25,000 but is less than or equal to \$100,000, CONTRACTOR shall furnish OWNER with a Performance Bond in the form set out by OWNER, unless the original Contract Time is 60 Calendar Days/40 Working Days or less, in which case CONTRACTOR can agree to the following terms and conditions for payment in lieu of providing a Performance Bond: no money will be paid to CONTRACTOR until completion and acceptance of the Work by OWNER; CONTRACTOR shall be entitled to receive 95% of the Contract Amount following Final Completion, and the remaining 5% of the Contract Amount following the one year warranty period.
- .3 If the Contract Amount is less than or equal to \$25,000, CONTRACTOR will not be required to furnish a Performance Bond; provided that no money will be paid to CONTRACTOR until completion and acceptance of the Work by OWNER under the following terms and conditions: CONTRACTOR shall be entitled to receive 95% of the Contract Amount following Final Completion, and the remaining 5% of the Contract Amount following the one year warranty period.
- .4 If a Performance Bond is required to be furnished, it shall extend for the one year warranty period.

5.4.3 Payment Bond.

- .1 If the Contract Amount exceeds \$25,000, CONTRACTOR shall furnish OWNER with a Payment Bond in the form set out by OWNER.
- .2 If the Contract Amount is less than or equal to \$25,000, CONTRACTOR will not be required to furnish a Payment Bond; provided that no money will be paid to CONTRACTOR until completion and acceptance of the Work by OWNER under the terms and conditions specified in paragraph 5.4.2.3.

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

6.1 Supervision and Superintendence:

6.1.1 The CONTRACTOR shall supervise, inspect and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Unless otherwise directed by the OWNER in the Contract Documents, the CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences and procedures of construction. The CONTRACTOR shall be responsible to see that the completed Work complies accurately with the Contract Documents.

6.1.2 The CONTRACTOR shall have an English-speaking, competent Superintendent on the Work at all times that work is in progress. Upon request of Owner's Representative, the CONTRACTOR shall present the resume of the proposed Superintendent to Owner's Representative showing evidence of experience and successful superintendence and direction of work of a similar scale and complexity. If, in the opinion of Owner's Representative, the proposed Superintendent does not indicate sufficient experience in line with the Work, he/she will not be allowed to be the designated Superintendent for the Work. The Superintendent shall not be replaced without Written Notice to Owner's Representative. If the CONTRACTOR deems it necessary to replace the Superintendent, the CONTRACTOR shall provide the necessary information for approval, as stated above, on the proposed new Superintendent. A qualified substitute Superintendent may be designated in the event that the designated Superintendent is temporarily away from the Work, but not to exceed a time limit acceptable to Owner's Representative. The CONTRACTOR shall replace the Superintendent upon the OWNER's request in the event the Superintendent is unable to perform to the OWNER's satisfaction. The Superintendent will be the CONTRACTOR's representative on the Work and shall have the authority to act on behalf of the CONTRACTOR. All communications given to the Superintendent shall be as binding as if given to the CONTRACTOR. Either the CONTRACTOR or the

Superintendent shall provide an emergency and home telephone number at which one or the other may be reached if necessary when work is not in progress.

6.2 Labor, Materials and Equipment:

6.2.1 The CONTRACTOR agrees to employ only orderly and competent workers, skillful in performance of the type of Work required under this Contract. The CONTRACTOR, Subcontractors, Sub-subcontractors, and their employees may not use or possess any firearms, alcoholic or other intoxicating beverages, illegal drugs or controlled substances while on the job or on the OWNER's property, nor may such workers be intoxicated, or under the influence of alcohol or drugs, on the job. If the OWNER or Owner's Representative notifies the CONTRACTOR that any worker is incompetent, disorderly or disobedient, has knowingly or repeatedly violated safety regulations, has possessed any firearms, or has possessed or was under the influence of alcohol or drugs on the job, the CONTRACTOR shall immediately remove such worker from performing Contract Work, and may not employ such worker again on Contract Work without the OWNER's prior written consent. The CONTRACTOR shall at all times maintain good discipline and order on or off the site in all matters pertaining to the Project. The CONTRACTOR shall pay workers no less than the wage rates established in Section 00900, and maintain weekly payroll reports as evidence thereof.

6.2.2 Unless otherwise specified, the CONTRACTOR shall provide and pay for all materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities and all other facilities and incidentals necessary for the furnishing, performance, re-testing of defective work, start-up and completion of the Work.

6.2.3 All materials and equipment shall be of good quality and new (including new products made of recycled materials), except as otherwise provided in the Contract Documents. If required by Owner's Representative, the CONTRACTOR shall furnish satisfactory evidence (reports of required tests, manufacturer's certificates of compliance with material requirements, mill reports, etc.) as to the kind, quantity and quality of materials and equipment. All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with instructions of the applicable Supplier, except as otherwise provided in the Contract Documents.

6.2.4 Substitutes and "Approved Equal" Items:

6.2.4.1 Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function and quality required. Unless the specification or description contains words reading that no like, equivalent or "approved equal" item or no substitution is permitted, other items of material or equipment of other Suppliers may be submitted to Owner's Representative under the following circumstances:

- .1 "Approved Equal":** If, in the OWNER's sole discretion, an item of material or an item of equipment proposed by the CONTRACTOR is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by the OWNER as an "approved equal" item, in which case review of the proposed item may, in the OWNER's sole discretion, be accomplished without compliance with some or all of the requirements for evaluation of proposed substitute items. The CONTRACTOR shall provide the OWNER with the documentation required for the OWNER to make its determination.
- .2 Substitute Items:** If, in the OWNER's sole discretion, an item of material or an item of equipment proposed by the CONTRACTOR does not qualify as an "approved equal" item under paragraph 6.2.4.1.1, then it will be considered a proposed substitute item. The CONTRACTOR shall submit sufficient information to allow the OWNER to determine that the item of material or item of equipment proposed is essentially equivalent to that named and a substitute therefor.

6.2.4.2 Substitute Construction Methods and Procedures: If a specific means, method, technique, sequence or procedure of construction is shown or indicated in and expressly required by the Contract Documents, the CONTRACTOR may with prior approval of the OWNER furnish or utilize a substitute means, method, technique,

sequence, or procedure of construction. The CONTRACTOR shall submit sufficient information to Owner's Representative to allow the OWNER, in the OWNER's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents.

6.2.4.3 OWNER's Evaluation: The OWNER will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to paragraph 6.2.4.1.1 and paragraph 6.2.4.1.2. The OWNER will be the sole judge of acceptability. No "approved equal" or substitute shall be ordered, installed, or utilized until the OWNER's review is complete, which will be evidenced by either a Change Order or completion of the Shop Drawing review procedure. The OWNER may require the CONTRACTOR to furnish at the CONTRACTOR's expense a special performance guarantee or other surety bond with respect to any "approved equal" or substitute. The OWNER shall not be responsible for any delay due to review time for any "approved equal" or substitute.

6.2.4.4 CONTRACTOR's Expense: All data to be provided by the CONTRACTOR in support of any proposed "approved equal" or substitute item will be at the CONTRACTOR's expense.

6.2.5 The CONTRACTOR agrees to assign to the OWNER any rights it may have to bring antitrust suits against its Suppliers for overcharges on materials incorporated in the Project growing out of illegal price fixing agreements. The CONTRACTOR further agrees to cooperate with the OWNER should the OWNER wish to prosecute suits against Suppliers for illegal price fixing.

6.3 Progress Schedule:

Unless otherwise directed, the CONTRACTOR shall adhere to the progress schedule established in accordance with paragraph 2.6 as it may be adjusted from time to time as provided below:

- .1** The CONTRACTOR shall submit to Owner's Representative for acceptance proposed adjustments in the progress schedule that will not change the Contract Times or Milestones. Such adjustments will conform generally to the progress schedule then in effect.
- .2** Proposed adjustments in the progress schedule that will change the Contract Times or Milestones shall be submitted in accordance with the requirements of Article 12. Such adjustments may only be made by a Change Order or Time Extension Request in accordance with Article 12.

6.4 Concerning Subcontractors, Suppliers and Others:

6.4.1 Assignment: The CONTRACTOR agrees to retain direct control of and give direct attention to the fulfillment of this Contract. The CONTRACTOR agrees not to, by Power of Attorney or otherwise, assign said Contract without the prior written consent of the OWNER.

6.4.2 Award of Subcontracts for Portions of the Work: The CONTRACTOR shall not employ any Subcontractor, Supplier or other person or organization, whether initially or as a substitute, against whom the OWNER may have reasonable objection. The CONTRACTOR must provide the OWNER with a list of all Subcontractors, Suppliers, or other persons or organizations it will use in the Work, and such list must be provided prior to the preconstruction conference. Should the OWNER have objections, the OWNER will communicate such objections by Written Notice. If the OWNER requires a change without good cause of any Subcontractor, person or organization previously accepted by OWNER, the Contract Amount may be increased or decreased by the difference in the cost occasioned by any such change, and an appropriate Change Order shall be issued. The CONTRACTOR shall not substitute any Subcontractor, person or organization that has been accepted by the OWNER, unless the substitute has been accepted in writing by the OWNER. No acceptance by the OWNER of any Subcontractor, Supplier or other person or organization shall constitute a waiver of any right of the OWNER to reject defective Work.

6.4.3 The CONTRACTOR shall enter into written agreements with all Subcontractors and Suppliers which specifically bind the Subcontractors or Suppliers to the applicable terms and conditions of the Contract Documents for the benefit of the OWNER and E/A. The OWNER reserves the right to specify that certain requirements shall be adhered to by all Subcontractors and Sub-subcontractors as indicated in other portions of the Contract

Documents and these requirements shall be made a portion of the agreement between the CONTRACTOR and Subcontractor or Supplier.

6.4.4 The CONTRACTOR shall be fully responsible to the OWNER for all acts and omissions of the Subcontractors, Suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with the CONTRACTOR just as the CONTRACTOR is responsible for the CONTRACTOR's own acts and omissions. Nothing in the Contract Documents shall create for the benefit of any such Subcontractor, Supplier or other person or organization any contractual relationship between the OWNER and any such Subcontractor, Supplier or other person or organization, nor shall it create any obligation on the part of the OWNER or E/A to pay or to see to the payment of any amounts due any such Subcontractor, Supplier or other person or organization except as may otherwise be required by laws and regulations.

6.4.5 The CONTRACTOR shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with the CONTRACTOR. The CONTRACTOR shall require all Subcontractors, Suppliers and such other persons and organizations performing or furnishing any of the Work to communicate with Owner's Representative through the CONTRACTOR.

6.4.6 The divisions and sections of the Specifications and the identifications of any Drawings shall not control the CONTRACTOR in dividing or delineating the Work to be performed by any specific trade.

6.4.7 The CONTRACTOR shall pay each Subcontractor and Supplier their appropriate share of payments made to the CONTRACTOR not later than ten (10) Calendar Days after the CONTRACTOR's receipt of payment from the OWNER.

6.5 Patent Fees and Royalties:

6.5.1 The CONTRACTOR shall be responsible at all times for compliance with applicable patents or copyrights encompassing, in whole or in part, any design, device, material, or process utilized, directly or indirectly, in the performance of the Work or the formulation or presentation of its Bid.

6.5.2 The CONTRACTOR shall pay all royalties and license fees and shall provide, prior to commencement of Work hereunder and at all times during the performance of same, for lawful use of any design, device, material or process covered by letters, patent or copyright by suitable legal agreement with the patentee, copyright holder, or their duly authorized representative whether or not a particular design, device, material, or process is specified by the OWNER.

6.5.3 The CONTRACTOR shall defend all suits or claims for infringement of any patent or copyright and shall save the OWNER harmless from any loss or liability, direct or indirect, arising with respect to the CONTRACTOR's process in the formulation of its bid or the performance of the Work or otherwise arising in connection therewith. The OWNER reserves the right to provide its own defense to any suit or claim of infringement of any patent or copyright in which event the CONTRACTOR shall indemnify and save harmless the OWNER from all costs and expenses of such defense as well as satisfaction of all judgments entered against the OWNER.

6.5.4 The OWNER shall have the right to stop the Work and/or terminate this Agreement at any time in the event the CONTRACTOR fails to disclose to the OWNER that the CONTRACTOR's work methodology includes the use of any infringing design, device, material or process.

6.6 Permits, Fees:

Unless otherwise provided in the Supplemental General Conditions, the CONTRACTOR shall obtain and pay for all construction permits, licenses and fees required for prosecution of the Work.

OWNER will obtain and pay for the following permits, licenses and/or fees, if required:

- .1** Site Development Permit.

- .2 Building Permit(s).
- .3 Texas Department of Transportation permit for work in State rights-of-way.
- .4 Railroad Utility License Agreement.

6.7 Laws and Regulations:

6.7.1 The CONTRACTOR shall give all notices and comply with all laws and regulations applicable to furnishing and performing the Work. Except where otherwise expressly required by applicable laws and regulations, neither the OWNER nor E/A shall be responsible for monitoring the CONTRACTOR's compliance with any laws and regulations.

6.7.2 The CONTRACTOR shall plan and execute its operations in compliance with all applicable Federal, State and local laws and regulations, including those concerning control and abatement of water pollution and prevention and control of air pollution.

6.7.3 If the CONTRACTOR performs any Work knowing or having reason to know that it is contrary to laws or regulations, then the CONTRACTOR shall bear all claims, costs, losses and damages arising therefrom; however, it shall not be the CONTRACTOR's primary responsibility to make certain that the Specifications and Drawings are in accordance with laws and regulations, but this does not relieve the CONTRACTOR of the CONTRACTOR's obligations under Article 3.

6.8 Taxes:

6.8.1 The CONTRACTOR shall pay all sales, consumer, use and other similar taxes required to be paid by the CONTRACTOR in accordance with the laws and regulations of the State of Texas.

6.8.2 The OWNER is an exempt organization as defined by Chapter 11 of the Property Tax Code of Texas and is thereby exempt from payment of Sales Tax under Chapter 151, Limited Use Sales, Excise and Use Tax, Texas Tax Code, and Article 1066 (C), Local Sales and Use Tax Act, Revised Civil Statutes of Texas.

6.9 Use of Premises:

6.9.1 The CONTRACTOR shall confine construction equipment, the storage of materials and equipment and the operations of workers to the site and land and areas identified in and permitted by the Contract Documents and other land and areas permitted by laws and regulations, rights-of-way, permits and easements, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment. The CONTRACTOR shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof or of any adjacent land or areas, resulting from the performance of the Work. Should any claim be made by any such owner or occupant because of the performance of the Work, the CONTRACTOR shall promptly settle with such other party by negotiation or otherwise resolve the claim by dispute resolution proceeding or at law. The CONTRACTOR shall indemnify, defend and hold harmless the OWNER, E/A, E/A's consultants and anyone directly or indirectly employed by any of them from and against all claims, costs, losses and damages (including court costs and reasonable attorneys' fees) arising out of or resulting from any claim or action, legal or equitable, brought by any such owner or occupant against the OWNER, E/A or any other party indemnified hereunder to the extent caused by or based upon performance of the Work or failure to perform the Work.

6.9.2 During the progress of the Work and on a daily basis, the CONTRACTOR shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work. At the completion of the Work, the CONTRACTOR shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, appliances, construction equipment and machinery and surplus materials. The CONTRACTOR shall leave the site clean and ready for occupancy by the OWNER at Substantial Completion of the Work. The CONTRACTOR shall, at a minimum, restore to original condition all property not designated for alteration by the Contract Documents.

6.9.3 The CONTRACTOR shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall the CONTRACTOR subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

6.10 Record Documents:

The CONTRACTOR shall maintain in a safe place at the site, or other location acceptable to the OWNER, one (1) record copy of all Drawings, Specifications, Addenda, Change Orders, Change Directives, Field Orders and written interpretations and clarifications (issued pursuant to paragraph 9.5) in good order and annotated to show all changes made during construction. These record documents, together with all final samples and all final Shop Drawings, will be available to the OWNER and E/A for reference during performance of the Work. Upon Substantial Completion of the Work, these record documents, samples and Shop Drawings shall be promptly delivered to Owner's Representative.

6.11 Safety and Protection:

6.11.1 The CONTRACTOR shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Upon request, and prior to installation of measures, the CONTRACTOR shall submit a site security plan for approval by the OWNER. By reviewing the plan or making recommendations or comments, the OWNER will not assume liability nor will the CONTRACTOR be relieved of liability for damage, injury or loss. The CONTRACTOR shall take all necessary precautions for the safety of and shall provide the necessary protection to prevent damage, injury or loss to:

- .1** all persons on the Work site or who may be affected by the Work;
- .2** all the Work and materials and equipment to be incorporated therein, whether in storage on or off the site; and
- .3** other property at the site or adjacent thereto, including but not limited to, trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and underground facilities not designated for removal, relocation or replacement in the course of construction.

6.11.2 The CONTRACTOR shall comply with all applicable laws and regulations of any public body having jurisdiction for safety of persons or property or to protect them from damage, injury or loss; and shall erect and maintain all necessary safeguards for such safety and protection. The CONTRACTOR shall notify owners of adjacent property and of underground facilities, and utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation and replacement of their property. All damage, injury or loss to any property referred to in paragraph 6.11.1.2 and paragraph 6.11.1.3 caused, directly or indirectly, in whole or in part, by the CONTRACTOR, Subcontractor, Supplier or any person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, shall be remedied by the CONTRACTOR (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of the OWNER, or E/A, or E/A's consultant or anyone employed by any of them or anyone whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the faults or negligence of the CONTRACTOR or any Subcontractor, Supplier or other person or organization directly or indirectly employed by any of them). The CONTRACTOR's duties and responsibilities for safety and protection of the Work shall continue until such time as all the Work is completed and Owner's Representative has issued a notice to the OWNER and the CONTRACTOR in accordance with Article 14 that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.11.3 Safety Representative: The CONTRACTOR shall designate a qualified and experienced safety representative at the site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs. Upon request of the OWNER, the CONTRACTOR shall provide certifications or other documentation of the safety representative's qualifications.

6.11.4 Hazard Communication Programs: The CONTRACTOR shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the site in accordance with laws and regulations.

6.11.5 Emergencies:

6.11.5.1 In emergencies affecting the safety or protection of persons or the Work at the site or adjacent thereto, the CONTRACTOR, without special instruction or authorization from the OWNER or E/A, is obligated to act reasonably to prevent threatened damage, injury or loss and to mitigate damage or loss to the Work. The CONTRACTOR shall give Owner's Representative prompt written notice if the CONTRACTOR believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby. If Owner's Representative determines that a change in the Contract Documents is required because of the action taken by the CONTRACTOR in response to such an emergency, a Change Directive or Change Order will be issued to document the consequences of such action; otherwise the OWNER will not be responsible for the CONTRACTOR's emergency action.

6.11.5.2 Authorized agents of the CONTRACTOR shall respond immediately to call-out at any time of any day or night when circumstances warrant the presence on Project site of the CONTRACTOR or its agent to protect the Work or adjacent property from damage, restriction or limitation or to take such action or measures pertaining to the Work as may be necessary to provide for the safety of the public. Should the CONTRACTOR and/or its agent fail to respond and take action to alleviate such an emergency situation, the OWNER may direct other forces to take action as necessary to remedy the emergency condition, and the OWNER will deduct any cost of such remedial action from the funds due to the CONTRACTOR under this Contract.

6.11.5.3 In the event there is an accident involving injury to any individual on or near the Work, the CONTRACTOR shall notify Owner's Representative within twenty-four (24) hours of the event and shall be responsible for recording the location of the event and the circumstances surrounding the event through photographs, interviewing witnesses, obtaining medical reports and other documentation that describes the event. Copies of such documentation shall be provided to Owner's Representative, for the OWNER's and E/A's records, within forty-eight (48) hours of the event.

6.12 Continuing the Work:

The CONTRACTOR shall carry on the Work and adhere to the progress schedule during all disputes or disagreements with the OWNER. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as the OWNER and the CONTRACTOR may agree in writing.

6.13 CONTRACTOR's General Warranty and Guarantee:

6.13.1 The CONTRACTOR warrants and guarantees to the OWNER that all Work will be performed in a good and workmanlike manner in accordance with the Contract Documents and will not be defective. The CONTRACTOR's warranty and guarantee hereunder excludes defects or damage caused by:

- .1 abuse, modification or improper maintenance or operation by persons other than the CONTRACTOR, Subcontractors or Suppliers; or
- .2 normal wear and tear under normal usage.

6.13.2 The CONTRACTOR's obligation to perform and complete the Work in a good and workmanlike manner in accordance with the Contract Documents shall be absolute. None of the following will constitute acceptance of Work not in accordance with the Contract Documents or a release of the CONTRACTOR's obligation to perform the Work in accordance with the Contract Documents:

- .1 observations by Owner's Representative and/or E/A;
- .2 recommendation of any progress or final payment by Owner's Representative;

- .3 the issuance of a certificate of Substantial Completion or any payment by the OWNER to the CONTRACTOR under the Contract Documents;
- .4 use or occupancy of the Work or any part thereof by the OWNER;
- .5 any acceptance by the OWNER or any failure to do so;
- .6 any review of a Shop Drawing or sample submittal;
- .7 any inspection, test or approval by others; or
- .8 any correction of defective Work by the OWNER.

6.14 Indemnification:

6.14.1 The CONTRACTOR shall defend, indemnify and hold harmless the OWNER, E/A, E/A's consultants and subconsultants and their respective officers, directors, partners, employees, agents and other consultants and any of them from and against all claims, costs, losses and damages (including but not limited to all fees and charges of engineers, architects, attorneys and other professionals and all court or other dispute resolution costs) arising out of or resulting from the performance of the Work, provided that any such claim, cost, loss or damage:

- .1 is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, and
- .2 is caused in whole or in part by any negligent act or omission of the CONTRACTOR, any Subcontractor, any Supplier, any person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, regardless of whether or not caused in part by any negligence or omission of a person or entity indemnified hereunder or whether liability is imposed upon such indemnified party by laws and regulations regardless of the negligence of any such person or entity.

6.14.2 The indemnification obligation under paragraph 6.14.1 shall not be limited in any way by any limitation on the amount or type of damages, or compensation or benefits payable by or for the CONTRACTOR or any such Subcontractor, Supplier or other person or organization under workers' compensation acts, disability benefit acts or other employee benefit acts.

6.14.3 The obligations of the CONTRACTOR under paragraph 6.14.1 shall not extend to the liability of the OWNER, E/A, E/A's consultants, and their officers, directors, partners, employees or agents caused primarily by negligent preparation of maps, drawings, surveys, designs or specifications upon which is placed the applicable state-authorized design professional seal of the OWNER's, E/A's or E/A's consultant's officers, directors, partners, employees or agents.

6.14.4 In the event the CONTRACTOR fails to follow the OWNER's directives concerning use of the site, scheduling or course of construction, or engages in other conduct which proximately causes damage to property based on inverse condemnation or otherwise, then and in that event, the CONTRACTOR shall indemnify the OWNER against all costs resulting from such claims.

6.14.5 In the event the CONTRACTOR unreasonably delays progress of the work being done by others on the site so as to cause loss for which the OWNER becomes liable, then the CONTRACTOR shall reimburse the OWNER for such loss.

6.15 Survival of Obligations:

All representations, indemnifications, warranties and guarantees made in, required by or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion and acceptance of the Work and termination or completion of the Agreement.

6.16 Losses from Natural Causes:

Unless otherwise specified, all loss or damage to the CONTRACTOR arising out of the nature of the Work to be done or from action of the elements, floods or from unforeseeable circumstances in prosecution of the Work or from unusual obstructions or difficulties which may be encountered in prosecution of the Work, shall be sustained and borne by the CONTRACTOR at its own cost and expense.

6.17 Notice of Claim:

Should the CONTRACTOR suffer injury or damage to person or property because of any error, omission or act of the OWNER or of any of the OWNER's employees or agents or others for whose acts the OWNER is liable, a Claim will be made to the other party within thirty (30) calendar days of the event giving rise to such injury or damage. The provisions of this paragraph 6.17 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitations or statute of repose.

6.18 Liquidated Damages:

At set forth in the Agreement, paragraph 1.2, the CONTRACTOR or its Surety shall be liable for Liquidated Damages for the CONTRACTOR's failure to timely complete the Work or any portion thereof within the Contract Time. See Supplemental Conditions for amount of Liquidated Damages.

ARTICLE 7 - OTHER WORK

7.1 The OWNER may perform other work related to the Project at the site by the OWNER's own forces, or let other contracts therefor, or have other work performed by utility owners. If the CONTRACTOR believes that delay or additional cost is involved because of such action by the OWNER, the CONTRACTOR may make a Claim as provided in Article 11 or Article 12.

7.2 The CONTRACTOR shall afford other contractors who are in a contract with the OWNER and each utility owner (and the OWNER, if the OWNER is performing the additional work with the OWNER's employees) proper and safe access to the site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work and shall properly connect and coordinate the Work with theirs. Unless otherwise provided in the Contract Documents, the CONTRACTOR shall do all cutting, fitting and patching of the Work that may be required to make its several parts come together properly and integrate with such other work. The CONTRACTOR shall not endanger any work of others by cutting, excavating or otherwise altering their work and will only cut or alter their work with the written consent of Owner's Representative and the other contractors whose work will be affected. The CONTRACTOR shall promptly remedy damage wrongfully caused by the CONTRACTOR to completed or partially completed construction or to property of the OWNER or separate contractors.

7.3 If the proper execution or results of any part of the CONTRACTOR's Work depends upon work performed by others under this Article 7, the CONTRACTOR shall inspect such other work and promptly report to Owner's Representative in writing any delays, defects or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of the CONTRACTOR's Work. The CONTRACTOR's failure to report will constitute an acceptance of such other work as fit and proper for integration with the CONTRACTOR's Work except for latent or non-apparent defects and deficiencies in such other work.

7.4 The OWNER shall provide for coordination of the activities of the OWNER's own forces and of each separate contractor with the Work of the CONTRACTOR, who shall cooperate with them. The CONTRACTOR shall participate with other separate contractors and Owner's Representative in reviewing their construction schedules when directed to do so. The CONTRACTOR shall make any revisions to the construction schedule

deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the CONTRACTOR, separate contractors and the OWNER until subsequently revised.

7.5 Unless otherwise stated herein, costs caused by delays or by improperly timed activities or defective construction shall be borne by the party responsible therefor.

ARTICLE 8 - OWNER'S RESPONSIBILITIES

8.1 Prior to the start of construction, the OWNER will designate in writing a person or entity to act as Owner's Representative during construction. Except as otherwise provided in these General Conditions, the OWNER shall issue all communications to the CONTRACTOR through Owner's Representative.

8.2 The OWNER will not supervise, direct, control or have authority over or be responsible for the CONTRACTOR's means, methods, techniques, sequences or procedures of construction or the safety precautions and programs incident thereto. The OWNER is not responsible for any failure of the CONTRACTOR to comply with laws and regulations applicable to furnishing or performing the Work. The OWNER is not responsible for the CONTRACTOR's failure to perform or furnish the Work in accordance with the Contract Documents. Failure or omission of the OWNER to discover, or object to or condemn any defective Work or material shall not release the CONTRACTOR from the obligation to properly and fully perform the Contract.

8.3 The OWNER is not responsible for the acts or omissions of the CONTRACTOR, or of any Subcontractor, any Supplier, or of any other person or organization performing or furnishing any of the Work.

8.4 Information or services under the OWNER's control shall be furnished by the OWNER with reasonable promptness to avoid delay in the orderly progress of the Work.

8.5 The foregoing are in addition to other duties and responsibilities of the OWNER enumerated herein and especially those in respect to Article 4 (Availability of Lands; Subsurface and Physical Conditions; Reference Points), Article 7 (Other Work) and Article 14 (Payments to the CONTRACTOR and Completion).

8.6 Notice of Claim:

Should the OWNER suffer injury or damage to person or property because of any error, omission or act of the CONTRACTOR or of any of the CONTRACTOR's employees or agents or others for whose acts the CONTRACTOR is liable, a Claim will be made to the other party within thirty (30) calendar days of the event giving rise to such injury or damage. The provisions of this paragraph 8.6 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitations or statute of repose.

ARTICLE 9 - ENGINEER/ARCHITECT'S STATUS DURING CONSTRUCTION

9.1 E/A's Authority and Responsibilities:

9.1.1 The duties and responsibilities and the limitations of authority of E/A during construction are set forth in the Contract Documents and shall not be extended without written consent of the OWNER and E/A. The assignment of any authority, duties or responsibilities to E/A under the Contract Documents, or under any agreement between the OWNER and E/A, or any undertaking, exercise or performance thereof by E/A, is intended to be for the sole and exclusive benefit of the OWNER and is not for the benefit of the CONTRACTOR, Subcontractor, Sub-subcontractor, Supplier, or any other person or organization, or for any surety or employee or agent of any of them.

9.1.2 E/A will not supervise, direct, control or have authority over or be responsible for the CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto. E/A is not responsible for any failure of the CONTRACTOR to comply with laws and regulations applicable to the furnishing or performing the Work. E/A is not responsible for the CONTRACTOR's failure to perform or furnish the Work in accordance with the Contract Documents. Failure or omission of E/A to discover, or

object to or condemn any defective Work or material shall not release the CONTRACTOR from the obligation to properly and fully perform the Contract.

9.1.3 E/A is not responsible for the acts or omissions of the CONTRACTOR, or of any Subcontractor, any Supplier, or of any other person or organization performing or furnishing any of the Work.

9.1.4 If the OWNER so directs, E/A will review the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds and certificates of inspection, tests and approvals and other documentation required to be delivered by Article 14, but only to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests and approvals that the results certified indicate compliance with, the Contract Documents.

9.1.5 The limitations upon authority and responsibility set forth in this paragraph 9.1 shall also apply to E/A's Consultants, Resident Project Representative and assistants.

9.2 E/A as Owner's Representative:

9.2.1 E/A may be designated as Owner's Representative under paragraph 8.1.

9.3 Visits to Site:

If the OWNER so directs, E/A will make visits to the site at intervals appropriate to the various stages of construction as is necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of the CONTRACTOR's executed Work. Based on information obtained during such visits and observations, E/A will endeavor for the benefit of the OWNER to determine if the Work is proceeding in accordance with the Contract Documents. E/A will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. E/A's efforts will be directed toward providing for the OWNER a greater degree of confidence that the completed Work will conform to the Contract Documents. On the basis of such visits and on-site observations, E/A will keep the OWNER informed of the progress of the Work and will endeavor to guard the OWNER against defective Work. E/A's visits and on-site observations are subject to all the limitations on E/A's authority and responsibility set forth in paragraph 9.1.

9.4 Project Representative:

If the OWNER and E/A agree, E/A will furnish a Resident Project Representative to assist E/A in providing more continuous observation of the Work. The responsibilities and authority and limitations of any such Resident Project Representative and assistants will be as provided in paragraph 9.1 and in the Supplemental General Conditions. The OWNER may designate another representative or agent to represent the OWNER at the site who is not E/A, E/A's consultant, agent or employee.

9.5 Clarifications and Interpretations:

E/A may determine that written clarifications or interpretations of the requirements of the Contract Documents (in the form of drawings or otherwise) are necessary. Such written clarifications or interpretations will be consistent with the intent of and reasonably inferable from the Contract Documents, will be issued with reasonable promptness by Owner's Representative and will be binding on the OWNER and the CONTRACTOR. If the OWNER or the CONTRACTOR believes that a written clarification or interpretation justifies an adjustment in the Contract Amount or the Contract Times, the OWNER or the CONTRACTOR may make a Claim therefor as provided in Article 11 or Article 12.

9.6 Rejecting Defective Work:

E/A will recommend that the OWNER disapprove or reject Work which E/A believes to be defective, or believes will not produce a completed Project that conforms to the Contract Documents or will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

ARTICLE 10 - CHANGES IN THE WORK

10.1 Changes:

10.1.1 Without invalidating the Contract and without notice to any surety, the OWNER may, at any time or from time to time, order additions, deletions or revisions in the Work. Such changes in the Work will be authorized by Change Order, Change Directive or Field Order.

10.1.2 Changes in the Work shall be performed under applicable provisions of the Contract Documents, and the CONTRACTOR shall proceed promptly, unless otherwise provided in the Change Order, Change Directive or Field Order.

10.1.3 The CONTRACTOR shall not be entitled to an increase in the Contract Amount or an extension of the Contract Times with respect to any Work performed that is not required by the Contract Documents as amended, modified and supplemented as provided in paragraph 3.3.1 and paragraph 3.3.2, except in the case of an emergency as provided in paragraph 6.11.5 or in the case of uncovering Work as provided in paragraph 13.4.

10.1.4 Except in the case of an emergency as provided in paragraph 6.11.5, a Change Order or Change Directive is required before the CONTRACTOR commences any activities associated with a change in the Work which, in the CONTRACTOR's opinion, will result in a change in the Contract Amount and/or Contract Times.

10.1.5 If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Amount or Contract Times) is required by the provisions of any Bond to be given to a surety, the giving of any such notice will be the CONTRACTOR's responsibility, and the amount of each applicable Bond will be adjusted accordingly.

10.2 Change Orders:

10.2.1 The OWNER and the CONTRACTOR shall execute appropriate written Change Orders covering:

- .1** a change in the Work;
- .2** the amount of the adjustment in the Contract Amount, if any; and
- .3** the extent of the adjustment in the Contract Time, if any.

10.2.2 An executed Change Order shall represent the complete, equitable, and final amount of adjustment in the Contract Amount and/or Contract Time owed to the CONTRACTOR or the OWNER as a result of the occurrence or event causing the change in the Work encompassed by the Change Order.

10.3 Change Directives:

10.3.1 The OWNER may by written Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Amount and Contract Time being adjusted as necessary. A Change Directive shall be used in the absence of complete and prompt agreement on the terms of a Change Order.

10.3.2 If the Change Directive provides for an adjustment to the Contract Amount, the adjustment shall be based on the method provided for in paragraph 11.5.

10.3.3 A Change Directive shall be recorded later by preparation and execution of an appropriate Change Order.

10.3.4 Upon receipt of a Change Directive, CONTRACTOR shall promptly proceed with the change in the Work involved.

10.4 Field Order:

10.4.1 Owner's Representative may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Amount or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These shall be accomplished by written Field Order and shall be binding on the OWNER and on the CONTRACTOR who shall perform the Work involved promptly.

10.4.2 If the CONTRACTOR believes that a Field Order would require an adjustment in the Contract Amount and/or Contract Times, the CONTRACTOR shall make written request to Owner's Representative for a Change Order. Any request by the CONTRACTOR for an adjustment in Contract Amount and/or Contract Times shall be made in writing prior to beginning the work covered by the Field Order.

10.5 No Damages for Delay:

The CONTRACTOR shall receive no compensation for delays or hindrances to the Work. If delay is caused by specific orders given by the OWNER to stop work or by performance of extra Work or by failure of the OWNER to provide information, access to the work, material or necessary instructions for carrying on the Work, then such delay will entitle the CONTRACTOR to an equivalent extension of time, the CONTRACTOR's application for which shall, however, be subject to approval of the OWNER. No such extension of time shall release the CONTRACTOR or surety on its performance bond from all the CONTRACTOR's obligations hereunder which shall remain in full force until discharge of the Contract.

ARTICLE 11 - CHANGE OF CONTRACT AMOUNT

11.1 The Contract Amount is stated in the Agreement and, including authorized adjustments, is the total amount payable by the OWNER to the CONTRACTOR for performance of the Work under the Contract Documents.

11.2 The original Contract Amount may not be increased by more than twenty-five percent (25%) and it may not be decreased more than twenty-five percent (25%) without the consent of the CONTRACTOR to such decrease.

11.3 The Contract Amount shall only be changed by a Change Order. Any claim for an adjustment in the Contract Amount shall be made by Written Notice delivered by the party making the Claim to the other party promptly (but in no event later than thirty (30) calendar days) after the start of the occurrence or event giving rise to the Claim and stating the general nature of the Claim. Notice of the amount of the Claim with supporting data shall be delivered within thirty (30) calendar days after Written Notice of Claim is delivered by claimant, and shall represent that the adjustment claimed covers all known amounts to which claimant is entitled as a result of said occurrence or event. If the OWNER and the CONTRACTOR cannot otherwise agree, all Claims for adjustment in the Contract Amount shall be determined as set out in Article 16.

11.4 Determination of Value of Work:

11.4.1 The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Amount will be determined by one or more of the following methods:

- .1** by application of unit prices contained in the Contract Documents to the quantities of the items involved.
- .2** by a mutually agreed lump sum properly itemized and supported by sufficient substantiating data to permit evaluation.
- .3** by cost of Work plus the CONTRACTOR's fee for all overhead costs and profit (determined as provided in paragraph 11.5).

11.4.2 Before using the method described in paragraph 11.4.1.3, the OWNER and the CONTRACTOR agree to negotiate a Change Order using the methods identified in paragraph 11.4.1.1 and paragraph 11.4.1.2, as appropriate, to determine the adjustment in the Contract Amount.

11.5 Cost of Work:

If neither of the methods defined in paragraph 11.4.1.1 or paragraph 11.4.1.2 can be agreed upon before a change in the Work is commenced which will result in an adjustment in the Contract Amount, then the change in the Work will be performed by Change Directive and payment will be made as follows:

- .1** For all personnel, the CONTRACTOR will receive the rate or wage specified in the prevailing wage rates established in Section 00900 for each hour that said personnel are actually engaged in such Work, to which will be added an amount equal to twenty-five percent (25%) of the sum thereof as compensation for the CONTRACTOR's and any affected Subcontractor's total overhead and profit. No separate charge will be made by the CONTRACTOR for organization or overhead expenses. For the cost of premiums on public liability insurance, workers' compensation insurance, social security and unemployment insurance, an amount equal to fifty-five percent (55%) of the wages paid personnel, excluding the twenty-five (25%) compensation provided above, will be paid to the CONTRACTOR. The actual cost of the CONTRACTOR's bond(s) on the extra Work will be paid based on invoices from surety. No charge for superintendence will be made unless considered necessary and ordered by the OWNER.
- .2** The CONTRACTOR will receive the actual cost, including freight charges, of the materials used on such Work, to which costs will be added a sum equal to twenty-five percent (25%) thereof as compensation for the CONTRACTOR's and any affected Subcontractor's total overhead and profit. In case material invoices indicate a discount may be taken, the actual cost will be the invoice price minus the discount.
- .3** For machinery, trucks, power tools, or other similar equipment agreed to be necessary by the OWNER and the CONTRACTOR, the OWNER will allow the CONTRACTOR the rate as given in the latest edition of the Associated General Contractors of America "Contractor's Equipment Cost Guide" as published by Dataquest for each hour that said tools or equipment are in use on such work, which rate includes the cost of fuel, lubricants and repairs. No additional compensation will be allowed on the equipment for the CONTRACTOR's overhead and profit.
- .4** The compensation, as herein provided for, shall be received by the CONTRACTOR and any affected Subcontractor as payment in full for work done by Change Directive and will include use of small tools, and total overhead expense and profit. The CONTRACTOR and the Owner's Representative shall compare records of work done by Change Directive at the end of each day. Copies of these records will be made upon forms provided for this purpose by the OWNER and signed by both Owner's Representative and the CONTRACTOR, with one (1) copy being retained by the OWNER and one (1) by the CONTRACTOR. Refusal by the CONTRACTOR to sign these records within two (2) working days of presentation does not invalidate the accuracy of the record.

11.6 Unit Price Work:

11.6.1 Where the Contract Documents provide that all or part of the Work is to be unit price Work, initially the Contract Amount will be deemed to include for all unit price work an amount equal to the sum of the established unit price for each separately identified item of unit price work times the estimated quantity of each item as indicated in the Bid. The estimated quantities of items of unit price work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Amount. Determinations of the actual quantities and classifications of unit price work performed by the CONTRACTOR will be made by Owner's Representative. Owner's Representative will review with the CONTRACTOR the preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise).

11.6.2 When "plan quantity" is indicated for a bid item, the CONTRACTOR shall be paid the amount specified in the Contract Documents without any measurements.

11.6.3 Each unit price will be deemed to include an amount considered by the CONTRACTOR to be adequate to cover the CONTRACTOR's overhead and profit for each separately identified item.

11.6.4 A Major Item is any individual bid item in the Bid that has a total cost equal to or greater than five percent (5%) of the original Contract Amount or \$50,000, whichever is greater, computed on the basis of bid quantities and Contract unit prices.

11.6.5 The OWNER or the CONTRACTOR may make a Claim for an adjustment in the Contract Amount in accordance with Article 11 if:

- .1** the actual quantity of any Major Item should become as much as twenty percent (20%) more than or twenty percent (20%) less than in the Bid; or
- .2** The CONTRACTOR presents proper documentation contesting the accuracy of "plan quantity," and Owner's Representative verifies quantity and determines original quantity is in error by five percent (5%) or more.

11.6.6 Right to Verify Information: The CONTRACTOR agrees that any designated representative of the OWNER shall have the right to examine the CONTRACTOR's records to verify the accuracy and appropriateness of the pricing data used to price change proposals. Even after a Change Order Proposal has been approved, the CONTRACTOR agrees that if the OWNER later determines the cost and pricing data submitted was inaccurate, incomplete, not current or not in compliance with the terms of this Agreement regarding pricing of change orders, then an appropriate contract price reduction will be made.

11.6.7 Pricing Information Requirements: The CONTRACTOR agrees to provide and require all subcontractors to provide a breakdown of allowable labor and labor burden cost information as outlined herein. This information will be used to evaluate the potential cost of labor and labor burden related to change order work. It is intended that this information represent an accurate estimate of the CONTRACTOR's actual labor and labor burden cost components. This information is not intended to establish fixed billing or change order pricing labor rates. However, at the time change orders are priced the submitted cost data for labor rates may be used to price change order work. The accuracy of any such agreed-upon labor cost components used to price change orders will be subject to later audit. Approved change order amounts may be adjusted later to correct the impact of inaccurate labor cost components if the agreed-upon labor cost components are determined to be inaccurate.

ARTICLE 12 - CHANGE OF CONTRACT TIMES

12.1 Working Day and Calendar Day Contracts:

12.1.1 The Contract Times (or Milestones) shall only be changed by Change Order or Time Extension Request duly executed by both the CONTRACTOR and Owner's Representative. Any claim for an adjustment of the Contract Times (or Milestones) shall be made by Written Notice delivered by the party making the Claim to the other party promptly (but in no event later than thirty (30) calendar days) after the start of the occurrence or event giving rise to the delay and stating the general nature of the delay. Notice of the extent of the delay with supporting data shall be delivered within thirty (30) calendar days after Written Notice of Claim is delivered by claimant, and shall represent that the adjustment claimed is the entire adjustment to which claimant is entitled as a result of said occurrence or event. If the OWNER and the CONTRACTOR cannot otherwise agree, all Claims for adjustment in the Contract Times (or Milestones) shall be determined as set out in Article 16. No Claim for an adjustment in the Contract Times (or Milestones) will be valid if not submitted in accordance with the requirements of this paragraph.

12.1.2 When the CONTRACTOR is at fault and the OWNER stops the Work so that corrections in the Work can be made by the CONTRACTOR, then no extension in time will be allowed.

12.1.3 When the CONTRACTOR is prevented from completing any part of the Work within the Contract Times (or Milestones) due to delay not caused by the CONTRACTOR, an extension of the Contract Times (or Milestones) in an amount equal to the time lost due to such delay shall be the CONTRACTOR's sole and exclusive remedy for such delay. However, adverse weather shall not be considered justification for extension of Contract Times on Calendar Day contracts except as provided for in paragraph 12.2.

12.1.4 The OWNER will consider time extension requests and may grant the CONTRACTOR an extension of time because of:

- .1 Changes ordered in the work which justify additional time.
- .2 Failure of materials or products being at the Project site due to delays in transportation or failures of Suppliers, which are not the result of the CONTRACTOR's, Subcontractor's or Supplier's negligence. The request for an extension of time shall be supported by a recitation of acts demonstrating that such delays were beyond the control of the CONTRACTOR, including but not limited to, the CONTRACTOR's efforts to overcome such delays documented as follows:
 - a) Copy of purchase order for delayed item(s) indicating date ordered by the CONTRACTOR/Subcontractor and date purchase order received by Supplier.
 - b) If item(s) require Shop Drawings or other submittal information in accordance with the Contract Documents, provide record of date submittal(s) forwarded to Owner's Representative, date submittal(s) returned to the CONTRACTOR, and date submittal(s) forwarded to Supplier.
 - c) Copy of document(s) from Supplier, on Supplier's letterhead, indicating date(s) item(s) would be ready for shipment and/or actual shipment date(s).
 - d) Copies of all correspondence between the CONTRACTOR/ Subcontractor and Supplier indicating the CONTRACTOR/ Subcontractor's efforts to expedite item(s).
 - e) If item(s) are being purchased by a Subcontractor, provision of meeting notes, correspondence, and the like which reflect the CONTRACTOR's efforts with the Subcontractor to expedite delivery of the item(s).
- .3 When acts of the OWNER, E/A, utility owners or other contractors employed by the OWNER delay progress of work through no fault of the CONTRACTOR.
- .4 When the CONTRACTOR is delayed by strikes, lockouts, fires, losses from natural causes, or other unavoidable cause or causes beyond the CONTRACTOR's control.

12.2 Calendar Day Contracts:

Under a Calendar Day Contract, the CONTRACTOR may also be granted an extension of time because of unusual inclement weather that is beyond the normal weather expected for the Williamson and Travis Counties, Texas area. Normal weather which prevents the CONTRACTOR from performing Work is expected during a Calendar Day Contract, and is not a justification for an extension of time. The following delineates the number of days per month for which, for purposes of Calendar Day Contracts, expected normal weather will prevent performance of Work:

January.....	7 days
February.....	7 days
March.....	7 days
April.....	7 days
May.....	8 days
June.....	6 days
July.....	6 days
August.....	5 days
September.....	7 days
October.....	7 days

November.....	7 days
December.....	7 days

Days per month exceeding the number shown above may be credited as Rain Days if a Claim is made in accordance with paragraph 12.1.1 and meets the following definition: a "Rain Day" is any day in which a weather event occurs at the site and is sufficient to prevent the CONTRACTOR from performing units of Work critical to maintaining the project schedule.

ARTICLE 13 - TESTS AND INSPECTIONS; AND CORRECTION OR REMOVAL OF DEFECTIVE WORK

13.1 Notice of Defects:

Prompt notice of all defective Work of which the OWNER or E/A has actual knowledge will be given to the CONTRACTOR. All defective Work may be rejected or corrected as provided for in Article 13.

13.2 Access to Work:

The OWNER, E/A, E/A's Consultants, other representatives and personnel of the OWNER, independent testing laboratories and governmental agencies having jurisdiction will have unrestricted physical access to the Work site for observing, inspecting and testing. The CONTRACTOR shall provide them proper and safe conditions for such access, and advise them of the CONTRACTOR's site safety procedures and programs so that they may comply therewith as applicable.

13.3 Tests and Inspections:

13.3.1 The CONTRACTOR shall give timely notice of readiness of the Work for all required inspections, tests or approvals, and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

13.3.2 The OWNER shall employ and pay for services of an independent testing laboratory to perform all inspections, tests or approvals required by the Contract Documents except:

- .1 for inspections, tests or approvals covered by paragraph 13.3.3 below;
- .2 for reinspecting or retesting defective Work; and
- .3 as otherwise specifically provided in the Contract Documents.

All testing laboratories shall be those selected by the OWNER.

13.3.3 If laws or regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested or approved by an employee or other representative of such public body, the CONTRACTOR shall assume full responsibility for arranging and obtaining such inspections, tests or approvals, pay all costs in connection therewith and furnish Owner's Representative the required certificates of inspection or approval. The CONTRACTOR shall also be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests or approvals required for the OWNER's and E/A's review of materials or equipment to be incorporated in the Work, or of materials, mix designs or equipment submitted for review prior to the CONTRACTOR's purchase thereof for incorporation in the Work.

13.4 Uncovering Work:

13.4.1 If any Work (or the work of others) that is to be inspected, tested or approved is covered by the CONTRACTOR without concurrence of Owner's Representative, or if any Work is covered contrary to the written request of Owner's Representative, it must, if requested by Owner's Representative, be uncovered and recovered at the CONTRACTOR's expense.

13.4.2 If Owner's Representative considers it necessary or advisable that covered Work be observed, inspected or tested, the CONTRACTOR shall uncover, expose or otherwise make available for observation, inspection or testing that portion of the Work in question, furnishing all necessary labor, material and equipment. If it is found that such Work is defective, the CONTRACTOR shall pay all claims, costs, losses and damages caused by, arising out of or resulting from such uncovering, exposure, observation, inspection and testing and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and the OWNER shall be entitled to an appropriate decrease in the Contract Amount, and may make a Claim therefor as provided in Article 11. If, however, such Work is not found to be defective, the CONTRACTOR shall be allowed an increase in the Contract Amount or an extension of the Contract Times (or Milestones), or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement and reconstruction; and the CONTRACTOR may make a Claim therefor as provided in Article 11 and Article 12.

13.5 OWNER May Stop the Work:

13.5.1 If the Work is defective, or the CONTRACTOR fails to supply sufficient skilled workers or suitable materials or equipment, or fails to furnish or perform the Work in such a way that the completed Work will conform to the Contract Documents, the OWNER may order the CONTRACTOR to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of the OWNER to stop the Work shall not give rise to any duty on the part of the OWNER to exercise this right for the benefit of the CONTRACTOR or any surety or other party.

13.5.2 If the CONTRACTOR persistently fails to correct defective Work or submit a satisfactory plan to take corrective action, with procedure and time schedule, the OWNER may order the CONTRACTOR to stop the Work, or any portion thereof, until cause for such order has been eliminated, or take any other action permitted by this Contract. A notice to stop the Work, based on defects, shall not stop calendar or working days charged to the Project.

13.6 Correction or Removal of Defective Work:

If required by the OWNER, the CONTRACTOR shall promptly, as directed, either correct all defective Work, whether or not fabricated, installed or completed, or, if the Work has been rejected by Owner's Representative, remove it from the site and replace it with Work that is not defective. The CONTRACTOR shall correct or remove and replace defective Work, or submit a plan of action detailing how the deficiency will be corrected, within the time frame identified in the notice of defective Work. The CONTRACTOR shall pay all claims, costs, losses and damages caused by or resulting from such correction or removal (including but not limited to all costs of repair or replacement of work of others).

13.7 Warranty period:

13.7.1 If, at any time after the date of Substantial Completion or such longer period of time as may be prescribed by laws or regulations or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any Work is found to be defective, the CONTRACTOR shall promptly, without cost to the OWNER and in accordance with the OWNER's written instructions:

- (i) correct such defective Work, or, if it has been rejected by the OWNER, remove it from the site and replace it with Work that is not defective, and
- (ii) satisfactorily correct or remove and replace any damage to other Work or the work of others resulting therefrom.

If the CONTRACTOR does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, the OWNER may have the defective Work corrected or the rejected Work removed and replaced, and all claims, costs, losses and damages caused by or resulting from such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by the CONTRACTOR.

13.7.2 In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the warranty period for that item may start to run from an earlier date if so provided in the Contract Documents.

13.8 OWNER May Correct Defective Work:

If the CONTRACTOR fails within a reasonable time after Written Notice of the OWNER to correct defective Work, or to remove and replace rejected Work, or if the CONTRACTOR fails to perform the Work in accordance with the Contract Documents, or if the CONTRACTOR fails to comply with any other provision of the Contract Documents, the OWNER may, after seven (7) calendar days' Written Notice to the CONTRACTOR, correct and remedy any such deficiency. If, in the opinion of Owner's Representative, significant progress has not been made during this seven (7) calendar day period to correct the deficiency, the OWNER may exercise any actions necessary to remedy the deficiency. In exercising the rights and remedies under this paragraph, the OWNER shall proceed expeditiously. In connection with such corrective and remedial action, the OWNER may exclude the CONTRACTOR from all or part of the site, take possession of all or part of the Work, and suspend the CONTRACTOR's services related thereto, and incorporate in the Work all materials and equipment stored at the site or for which the OWNER has paid the CONTRACTOR but which are stored elsewhere. The CONTRACTOR shall allow the OWNER, its agents and employees, the OWNER's other contractors, E/A and E/A's consultants access to the site to enable the OWNER to exercise the rights and remedies under this paragraph. All claims, costs, losses and damages incurred or sustained by the OWNER in exercising such rights and remedies will be charged against the CONTRACTOR and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work. Such claims, costs, losses and damages will include but not be limited to all costs of repair or replacement of work of others destroyed or damaged by correction, removal or replacement of the CONTRACTOR's defective Work. The CONTRACTOR shall not be allowed an extension of the Contract Times (or Milestones), or claims of damage because of any delay in the performance of the Work attributable to the exercise by the OWNER of the OWNER's rights and remedies hereunder.

ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

14.1 Application for Progress Payment:

14.1.1 Not more than once per month, the CONTRACTOR shall submit to Owner's Representative for review an Application for Payment, in a form acceptable to the OWNER, filled out and signed by the CONTRACTOR covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents.

14.1.2 Such applications shall not include requests for payment on account of changes in the Work which have been properly authorized by Change Directives but not yet included in Change Orders.

14.1.3 Such applications shall not include requests for payment of amounts the CONTRACTOR does not intend to pay to a Subcontractor or Supplier because of a dispute or other reason.

14.1.4 Owner will not pay for materials or equipment not incorporated in the work but delivered and suitably stored at the site or at another location. Payment will be made by Owner only for work completed in accordance with the plans and contract documents.

14.1.5 Where the original Contract Amount is less than \$400,000, the OWNER will pay to the CONTRACTOR the total amount of approved Application for Payment, less ten percent (10%) of the amount thereof, which ten percent (10%) will be retained until final payment, less all previous payments and less all sums that may be retained by the OWNER under the terms of this Agreement. Where the original Contract Amount is \$400,000 or more, the OWNER will pay to the CONTRACTOR the total amount of approved Application for Payment, less five percent (5%) of the amount thereof, which five percent (5%) will be retained until final payment, less all previous payments and less all sums that may be retained by the OWNER under the terms of this Agreement. In either case, if the Work is near completion and delay occurs due to no fault or neglect of the CONTRACTOR, the OWNER may pay a portion of the retained amount to the CONTRACTOR. The CONTRACTOR, at the OWNER's option, may be relieved of the

obligation to complete the Work and, thereupon, the CONTRACTOR shall receive payment of the balance due under the Contract subject to the conditions stated under paragraph 15.2.

14.1.6 Applications for Payment shall include the following documentation:

- .1 updated progress schedule;
- .2 monthly subcontractor report; and
- .3 any other documentation required under the Supplemental General Conditions.

14.2 CONTRACTOR's Warranty of Title:

The CONTRACTOR warrants and guarantees that title to all Work, materials and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to the OWNER not later than the time of payment to the CONTRACTOR free and clear of all liens.

14.3 Review of Applications for Progress Payment:

14.3.1 Owner's Representative will, within seven (7) calendar days after receipt of each Application for Payment, either indicate a recommendation for payment and forward the Application for processing by the OWNER, or return the Application to the CONTRACTOR indicating Owner's Representative's reasons for refusing to recommend payment. In the latter case, the CONTRACTOR may make the necessary corrections and resubmit the Application.

14.3.2 Owner's Representative's recommendation of any payment requested in an Application for Payment will constitute a representation by Owner's Representative, based upon Owner's Representative's on-site observations of the executed Work and on Owner's Representative's review of the Application for Payment and the accompanying data and schedules, that to the best of Owner's Representative's knowledge, information and belief:

- .1 the Work has progressed to the point indicated; and
- .2 the quality of the Work is in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for unit price Work, and to any other qualifications stated in the recommendation).

14.3.3 By recommending any such payment, Owner's Representative will not thereby be deemed to have represented that:

- .1 exhaustive or continuous on-site inspections have been made to check the quality or the quantity of the Work;
- .2 examination has been made to ascertain how or for what purpose the CONTRACTOR has used money previously paid on account of the Contract Amount;
- .3 the CONTRACTOR's construction means, methods, techniques, sequences or procedures have been reviewed; or
- .4 that there may not be other matters or issues between the parties that might entitle the CONTRACTOR to be paid additionally by the OWNER or entitle the OWNER to withhold payment to the CONTRACTOR.

14.4 Decisions to Withhold Payment:

14.4.1 The OWNER may withhold or nullify the whole or part of any payment to such extent as may be necessary on account of:

- .1 defective Work not remedied;
- .2 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Amount;
- .3 damage to the OWNER or another contractor;
- .4 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay;
- .5 failure of the CONTRACTOR to submit a schedule of values in accordance with the Contract Documents;
- .6 failure of the CONTRACTOR to submit a submittal schedule in accordance with the Contract Documents;
- .7 failure of the CONTRACTOR to submit or update construction schedules in accordance with the Contract Documents;
- .8 failure of the CONTRACTOR to maintain a record of changes on drawings and documents;
- .9 failure of the CONTRACTOR to maintain weekly payroll reports;
- .10 failure of the CONTRACTOR to submit monthly subcontractor reports;
- .11 the CONTRACTOR's neglect or unsatisfactory prosecution of the Work, including failure to clean up; or
- .12 failure of the CONTRACTOR to comply with any provision of the Contract Documents.

14.4.2 When the above reasons for withholding payment are removed, the CONTRACTOR shall resubmit a statement for the value of Work performed. Payment will be made within thirty (30) calendar days of receipt of approved Application for Payment.

14.5 Delayed Payments:

Should the OWNER fail to make payment to the CONTRACTOR of a sum named in any Application for Payment within thirty (30) calendar days after the day on which the OWNER received the mutually acceptable Application for Payment, then the OWNER will pay to the CONTRACTOR, in addition to the sum shown as due by such Application for Payment, interest thereon at the rate of one percent (1%) per month from date due until fully paid, which shall fully liquidate any injury to the CONTRACTOR growing out of such delay in payment.

14.6 Arrears:

No money shall be paid by the OWNER upon any claim, debt, demand or account whatsoever, to any person, firm or corporation who is in arrears to the OWNER; and the OWNER shall be entitled to counterclaim and offset against any such debt, claim, demand or account so in arrears and no assignment or transfer of such debt, claim, demand or account, shall affect the right of the OWNER to so offset said amounts, and associated penalties and interest if applicable, against the same.

14.7 Substantial Completion:

14.7.1 If a Certificate of Occupancy is required by public authorities having jurisdiction over the Work, said certificate shall be issued before the Work or any portion thereof is considered substantially complete. When the CONTRACTOR considers that the Work, or a portion thereof which the OWNER agrees to accept separately, is

substantially complete, the CONTRACTOR shall notify Owner's Representative and request a determination as to whether the Work or designated portion thereof is substantially complete. If Owner's Representative does not consider the Work substantially complete, Owner's Representative will notify the CONTRACTOR giving reasons therefor. Failure on the OWNER's part to list a reason does not alter the responsibility of the CONTRACTOR to complete all Work in accordance with the Contract Documents. After satisfactorily completing items identified by Owner's Representative, the CONTRACTOR shall then submit another request for Owner's Representative to determine substantial completion. If Owner's Representative considers the Work substantially complete, Owner's Representative will prepare and deliver a certificate of Substantial Completion which shall establish the date of Substantial Completion, shall include a punch list of items to be completed or corrected before final payment, shall establish the time within which the CONTRACTOR shall finish the punch list, and shall establish responsibilities of the OWNER and the CONTRACTOR for security, maintenance, heat, utilities, damage to the Work, warranty and insurance. Failure to include an item on the punch list does not alter the responsibility of the CONTRACTOR to complete all Work in accordance with the Contract Documents. The certificate of Substantial Completion shall be signed by the OWNER and the CONTRACTOR to evidence acceptance of the responsibilities assigned to them in such certificate.

14.7.2 The OWNER shall have the right to exclude the CONTRACTOR from the Work after the date of Substantial Completion, but the OWNER will allow the CONTRACTOR reasonable access to complete or correct items on the punch list.

14.8 Partial Utilization:

The OWNER, at the OWNER's sole option, shall have the right to take possession of and use any completed or partially completed portion of the Work regardless of the time for completing the entire Work. The OWNER's exercise of such use and possession shall not be construed to mean that the OWNER acknowledges that any part of the Work so possessed and used is substantially complete or that it is accepted by OWNER, and the OWNER's exercise of such use and possession shall not relieve the CONTRACTOR of its responsibility to complete all Work in accordance with the Contract Documents.

14.9 Final Inspection:

Upon Written Notice from the CONTRACTOR that the entire Work or an agreed portion thereof is complete, Owner's Representative will make a final inspection with the CONTRACTOR and provide Written Notice of all particulars in which this inspection reveals that the Work is incomplete or defective. The CONTRACTOR shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.10 Final Application for Payment:

The CONTRACTOR may make application for final payment following the procedure for progress payments after the CONTRACTOR has completed all such corrections to the satisfaction of Owner's Representative and delivered the following documents:

- .1 Three (3) complete operating and maintenance manuals, each containing maintenance and operating instructions, schedules, guarantees, and other documentation required by the Contract Documents;
- .2 Record documents (as provided in paragraph 6.10);
- .3 Consent of surety, if any, to final payment. If surety is not provided, complete and legally effective releases or waivers (satisfactory to the OWNER) of all claims arising out of or filed in connection with the Work;
- .4 Certificate evidencing that insurance required by the Supplemental General Conditions will remain in force after final payment and through any warranty period;
- .5 Non-Use of Asbestos Affidavit (After Construction); and

- .6 Any other documentation called for in the Contract Documents.

14.11 Final Payment and Acceptance:

14.11.1 If, on the basis of observation of the Work during construction, final inspection, and review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Owner's Representative is satisfied that the Work has been completed and the CONTRACTOR's other obligations under the Contract Documents have been fulfilled, Owner's Representative will recommend the final Application for Payment and thereby notify the OWNER, who will pay to the CONTRACTOR the balance due the CONTRACTOR under the terms of the Contract.

14.11.2 As Contract Time is measured to Final Completion, Owner's Representative will issue a letter of final acceptance to the CONTRACTOR which establishes the Final Completion date and initiates any warranty period.

14.11.3 Final payment is considered to have taken place when the CONTRACTOR or any of its representatives negotiates the OWNER's final payment check, whether labeled final or not, for cash or deposits check in any financial institution for its monetary return.

14.12 Waiver of Claims:

The making and acceptance of final payment will constitute:

- .1 a waiver of claims by the OWNER against the CONTRACTOR, except claims arising from unsettled claims, from defective Work appearing after final inspection, from failure to comply with the Contract Documents or the terms of any warranty specified therein, or from the CONTRACTOR's continuing obligations under the Contract Documents; and
- .2 a waiver of all claims by the CONTRACTOR against the OWNER other than those previously made in writing and still unsettled.

ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

15.1 OWNER May Suspend Work Without Cause and for Convenience:

At any time and without cause and for convenience, the OWNER may suspend the Work or any portion thereof for a period of not more than ninety (90) calendar days by written agreement or by Written Notice to the CONTRACTOR which will fix the date on which the Work will be resumed. The CONTRACTOR shall resume the Work on the date so fixed. The CONTRACTOR may be allowed an adjustment in the Contract Amount or an extension of the Contract Times, or both, directly attributable to any such suspension if the CONTRACTOR makes an approved Claim therefor as provided in Article 11 and Article 12.

15.2 OWNER May Terminate Without Cause:

Upon seven (7) calendar days' Written Notice to the CONTRACTOR, the OWNER may, without cause and without prejudice to any right or remedy of the OWNER, elect to terminate the Agreement. In such case, the CONTRACTOR shall be paid (without duplication of any items):

- .1 for completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination;
- .2 for all claims incurred in settlement of terminated contracts with Suppliers, Subcontractors, and others. The CONTRACTOR agrees to negotiate in good faith with Subcontractors, Suppliers and others to mitigate the OWNER's cost; and
- .3 for anticipated profits on entire Contract not previously paid.

15.3 OWNER May Terminate With Cause:

15.3.1 Upon the occurrence of any one or more of the following events:

- .1** if the CONTRACTOR persistently fails to perform the Work in accordance with the Contract Documents;
- .2** if the CONTRACTOR disregards laws or regulations of any public body having jurisdiction;
- .3** if the CONTRACTOR disregards the authority of Owner's Representative;
- .4** if the CONTRACTOR makes fraudulent statements;
- .5** if the CONTRACTOR fails to maintain a work force adequate to accomplish the Work within the Contract Time;
- .6** if the CONTRACTOR fails to make adequate progress and endangers successful completion of the Contract; or
- .7** if the CONTRACTOR otherwise violates in any substantial way any provisions of the Contract Documents;

The OWNER may, after giving the CONTRACTOR (and the surety, if any) seven (7) calendar days' Written Notice terminate the services of the CONTRACTOR. The OWNER, at its option, may proceed with negotiation with surety for completion of the Work. Alternatively, the OWNER may under these circumstances exclude the CONTRACTOR from the site and take possession of the Work (without liability to the CONTRACTOR for trespass or conversion), incorporate in the Work all materials and equipment stored at the site or for which the OWNER has paid the CONTRACTOR but which are stored elsewhere, and finish the Work as the OWNER may deem expedient. In such case the CONTRACTOR shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Amount exceeds all claims, costs, losses and damages sustained by the OWNER arising out of or resulting from completing the Work, such excess will be paid to the CONTRACTOR. If such claims, costs, losses and damage exceed such unpaid balance, the CONTRACTOR or surety shall pay the difference to the OWNER.

15.3.2 Where the CONTRACTOR's services have been so terminated by the OWNER, the termination will not affect any rights or remedies of the OWNER against the CONTRACTOR and surety then existing or which may thereafter accrue. Any retention or payment of amounts due the CONTRACTOR by the OWNER will not release the CONTRACTOR from liability. In the event the OWNER terminates the Contract with cause, the OWNER may reject any and all bids submitted by the CONTRACTOR for up to three (3) years.

15.4 CONTRACTOR May Stop Work or Terminate:

If through no act or fault of the CONTRACTOR, the Work is suspended for a period of more than ninety (90) calendar days by the OWNER or under an order of court or other public authority, or (except during disputes) Owner's Representative fails to forward for processing any mutually acceptable Application for Payment within thirty (30) calendar days after it is submitted, or (except during disputes) the OWNER fails for sixty (60) calendar days after it is submitted to pay the CONTRACTOR any sum finally determined by the OWNER to be due, then the CONTRACTOR may, upon seven (7) calendar days' Written Notice to the OWNER, and provided the OWNER does not remedy such suspension or failure within that time, terminate the Agreement and recover from the OWNER payment on the same terms as provided in paragraph 15.2. In lieu of terminating the Agreement and without prejudice to any other right or remedy, if (except during disputes) Owner's Representative has failed to forward for processing any mutually acceptable Application for Payment within thirty (30) calendar days after it is submitted, or (except during disputes) the OWNER has failed for sixty (60) calendar days after it is submitted to pay the CONTRACTOR any sum finally determined by the OWNER to be due, the CONTRACTOR may upon seven (7) calendar days' Written Notice to the OWNER stop the Work until payment of all such amounts due the CONTRACTOR, including interest thereon. The provisions of this paragraph 15.4 are not intended to preclude the CONTRACTOR from making a Claim under Article 11 and Article 12 for an increase in Contract Amount or Contract Times or otherwise for expenses or damage directly attributable to the CONTRACTOR's stopping Work as permitted by this paragraph.

ARTICLE 16 - DISPUTE RESOLUTION

16.1 Filing of Claims:

16.1.1 Claims arising from the circumstances identified in paragraphs 3.2, 4.1, 4.2.2, 4.2.4, 6.4.2, 6.11.5.2, 6.17, 7.5, 8.6, 9.5, 10.4.2, 13.8, 15.1, 15.2, 15.3, or 15.4, or other occurrences or events, shall be made by Written Notice delivered by the party making the Claim to the other party within thirty (30) calendar days after the start of the occurrence or event giving rise to the Claim and stating the general nature of the Claim. Notice of the amount of the Claim with supporting data shall be delivered within thirty (30) calendar days after Written Notice of Claim is delivered by claimant and shall represent that the adjustment claimed covers all known amounts to which claimant is entitled.

16.1.2 Within thirty (30) calendar days of receipt of notice of the amount of the Claim with supporting data, Owner's Representative and the CONTRACTOR shall meet to discuss the Claim, after which an offer of settlement or notification of no settlement offer will be made to claimant. If claimant is not satisfied with the proposal presented, claimant shall have thirty (30) calendar days in which to:

- .1 submit additional supporting data requested by the other party;
- .2 modify the initial Claim; or
- .3 request Alternative Dispute Resolution.

16.2 Alternative Dispute Resolution:

16.2.1 If a dispute exists concerning a Claim, the parties agree to use the following procedure prior to pursuing any other available remedies. The OWNER reserves the right to include E/A as a party.

16.2.2 Negotiating with Previously Uninvolved Personnel: Either party may make a written request for a meeting to be held between representatives of each party within fourteen (14) calendar days of the request or such later period that the parties may agree to. Each party shall endeavor to include, at a minimum, one (1) previously uninvolved senior level decision maker empowered to negotiate on behalf of their organization. The purpose of this and subsequent meetings will be good faith negotiations of the matters constituting the dispute. Negotiations shall be concluded within thirty (30) calendar days of the first meeting, unless mutually agreed otherwise. This step may

be waived by written agreement of both parties, in which event the parties may proceed directly to mediation as described below.

16.2.3 Mediation:

16.2.3.1 If the procedure described in paragraph 16.2.2 proves unsuccessful or is waived pursuant to its terms, the parties shall initiate the mediation process. The parties agree to select within thirty (30) calendar days one (1) mediator trained in mediation skills, to assist with resolution of the dispute. The OWNER and the CONTRACTOR agree to act in good faith in the selection of the mediator and to give consideration to qualified individuals nominated to act as mediator. Nothing in this agreement prevents the parties from relying on the skills of a person who also is trained in the subject matter of the dispute and/or a contract interpretation expert.

16.2.3.2 Mediation is a forum in which an impartial person, the mediator, facilitates communication between parties to promote reconciliation, settlement, or understanding among them. The parties hereby agree that mediation, at a minimum, shall provide for 1) conducting an on-site investigation, if appropriate, by the mediator for fact-gathering purposes, 2) a meeting of all parties for the exchange of points of view and 3) separate meetings between the mediator and each party to the dispute for the formulation of resolution alternatives. The parties agree to participate in mediation in good faith for up to thirty (30) calendar days from the date of the first mediation session, unless mutually agreed otherwise. Should the parties fail to reach a resolution of the dispute through mediation, then each party is released to pursue other remedies available to them.

ARTICLE 17 – RIGHT TO AUDIT

17.1 Right to Audit:

Whenever the OWNER enters into any type of contractual arrangement with the CONTRACTOR, then the CONTRACTOR's "records" shall upon reasonable notice be open to inspection and subject to audit and/or reproduction during normal business working hours. The OWNER's representative, or an outside representative engaged by the OWNER, may perform such audits. The CONTRACTOR shall maintain all records relating to this Agreement for four (4) years from the date of final payment under this Agreement, or until pending litigation has been completely and fully resolved, whichever occurs later.

17.1.1 The OWNER shall have the exclusive right to examine the records of the CONTRACTOR. The term "records" as referred to herein shall include any and all information, materials and data of every kind and character, including without limitation records, books, papers, documents, contracts, schedules, commitments, arrangements, notes, daily diaries, reports, drawings, receipts, vouchers and memoranda, and any and all other agreements, sources of information and matters that may, in the OWNER's judgment, have any bearing on or pertain to any matters, rights, duties or obligations under or covered by any contract document. Such records shall include (hard copy, as well as computer-readable data if it can be made available), written policies and procedures, time sheets, payroll registers, cancelled checks, personnel file data, correspondence, general ledger entries, and any other record in the CONTRACTOR's possession which may have a bearing on matters of interest to the OWNER in connection with the CONTRACTOR's dealings with the OWNER (all of the foregoing are hereinafter referred to as "records"). In addition, the CONTRACTOR shall permit interviews of employees as well as agents, representatives, vendors, subcontractors and other third parties paid by the CONTRACTOR to the extent necessary to adequately permit evaluation and verification of the following:

- a) The CONTRACTOR's compliance with contract requirements;
- b) The CONTRACTOR's compliance with the OWNER'S business ethics policies; and
- c) If necessary, the extent of the Work performed by the CONTRACTOR at the time of contract termination.

17.1.2 The CONTRACTOR shall require all payees (examples of payees include subcontractors, insurance agents, material suppliers, etc.) to comply with the provisions of this Article 17 by securing the requirements hereof in a

written agreement between the CONTRACTOR and payee. Such requirements include a flow-down right of audit provision in contracts with payees that also apply to subcontractors and sub-subcontractors, material suppliers, etc. The CONTRACTOR shall cooperate fully and shall require Related Parties and all of the CONTRACTOR's subcontractors to cooperate fully in furnishing or in making available to the OWNER from time to time whenever requested, in an expeditious manner, any and all such information, materials, and data.

17.1.3 The OWNER's authorized representative or designee shall have reasonable access to the CONTRACTOR's facilities, shall be allowed to interview all current or former employees to discuss matters pertinent to the performance of this Agreement, and shall be provided adequate and appropriate work space in order to conduct audits in compliance with this Article 17.

17.1.4 If an audit inspection or examination in accordance with this Article 17 discloses overpricing or overcharges of any nature by the CONTRACTOR to the OWNER in excess of one-half of one percent (.5%) of the total contract billings, then the reasonable actual cost of the OWNER's audit shall be reimbursed to the OWNER by the CONTRACTOR. Any adjustments and/or payments, which must be made as a result of any such audit or inspection of the CONTRACTOR's invoices and/or records, shall be made within a reasonable amount of time (not to exceed 90 days) from presentation of the OWNER's findings to the CONTRACTOR.

17.1.5 The CONTRACTOR shall take reasonable actions to prevent any actions or conditions which could result in a conflict with the OWNER's best interests. These obligations shall apply to the activities of the CONTRACTOR's employees, agents, subcontractors, etc. in their dealings and relations with the OWNER's current and former employees and their relatives. For example, the CONTRACTOR's employees, agents or subcontractors should not make or provide to be made any employment, gifts, extravagant entertainment, payments, loans or other considerations to the OWNER's representatives, employees or their relatives.

17.1.6 It is also understood and agreed by the CONTRACTOR that any solicitation of gifts or any other item of value by anyone representing the OWNER is to be reported within two (2) business working days to the OWNER at the following telephone number: 512-218-5401. Failure to report any such solicitations or offers shall be deemed a material breach of contract entitling the OWNER to pursue damages resulting from the failure to comply with this provision.

ARTICLE 18 – MISCELLANEOUS

18.1 Venue:

In the event of any suit at law or in equity involving the Contract, venue shall be in Williamson County, Texas and the laws of the state of Texas shall apply to Contract interpretation and enforcement.

18.2 Extent of Agreement:

This Contract represents the entire and integrated agreement between the OWNER and the CONTRACTOR and supersedes all prior negotiations, representations or agreements, either written or oral.

18.3 Cumulative Remedies:

The rights and remedies available to the parties are not to be construed in any way as a limitation of any rights and remedies available to any or all of them which are otherwise imposed or available by laws or regulations, by special warranty or guarantees or by other provisions of the Contract Documents, and the provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right and remedy to which they apply.

18.4 Severability:

If any word, phrase, clause, sentence or provision of the Contract, or the application of same to any person or set of circumstances is for any reason held to be unconstitutional, invalid or unenforceable, that finding shall only effect such word, phrase, clause, sentence or provision, and such finding shall not effect the remaining portions of this Contract; this being the intent of the parties in entering into the Contract; and all provisions of the Contract are declared to be severable for this purpose.

18.5 Independent Contractor

The Contract shall not be construed as creating an employer/employee relationship, a partnership, or a joint venture. The CONTRACTOR's services shall be those of an independent contractor. The CONTRACTOR agrees and understands that the Contract does not grant any rights or privileges established for employees of the OWNER.

18.6 Prohibition of Gratuities

The OWNER may, by Written Notice to the CONTRACTOR, terminate the Contract without liability if it is determined by the OWNER that gratuities were offered or given by the CONTRACTOR or any agent or representative of the CONTRACTOR to any officer or employee of the OWNER with a view toward securing the Contract or securing favorable treatment with respect to the awarding or amending or the making of any determinations with respect to the performing of such Contract. In the event the Contract is terminated by the OWNER pursuant to this provision, the OWNER shall be entitled, in addition to any other rights and remedies, to recover or withhold the amount of the cost incurred by the CONTRACTOR in providing such gratuities.

18.7 Prohibition Against Personal Interest in Contracts

No officer, employee, independent consultant, or elected official of the OWNER who is involved in the development, evaluation, or decision-making process of the performance of any solicitation shall have a financial interest, direct or indirect, in the Contract resulting from that solicitation. Any violation of this provision, with the knowledge, expressed or implied, of the CONTRACTOR shall render the Contract voidable by the OWNER.

End of General Conditions

00800 SUPPLEMENTAL GENERAL CONDITIONS

**SUPPLEMENTAL GENERAL CONDITIONS TO
AGREEMENT FOR CONSTRUCTION SERVICES**

The Supplemental General Conditions contained herein shall amend or supplement the General Conditions, Section 00700.

ARTICLE 1 - DEFINITIONS

1.16 Engineer/Architect (E/A):

Add the following:

Name (Representative): Anne Hoskins, P.E.
Firm: Freese & Nichols, Inc.
Address: 10431 Morado Circle, Suite 300
City, State, Zip: Austin, Texas 78759
Telephone: (512) 617-3125
Facsimile: (512) 617-3101
Email: anne.hoskins@freese.com

1.27 Owner's Representative:

Add the following:

Name: Jeff Bell Title: Senior Project Manager
Address: 2008 Enterprise Drive
City, State, Zip: Round Rock, Texas 78664
Telephone: (512) 218-7076
Facsimile: (512) 218-5536
Email: jbell@roundrocktexas.gov

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

6.18 Liquidated Damages

Add the following:

1. CONTRACTOR SHALL PAY LIQUIDATED DAMAGES IN THE AMOUNT OF two-hundred fifty AND NO/100 DOLLARS \$ 250.00 PER DAY FOR EACH DAY BEYOND THE DATE ESTABLISHED THEREFOR THAT THE CONTRACTOR FAILS TO ACHIEVE SUBSTANTIAL COMPLETION, AND FOR WHICH OWNER IS UNABLE TO UTILIZE THE IMPROVEMENTS AND FACILITIES DUE TO THE FAILURE OF CONTRACTOR TO HAVE ACHIEVED SUBSTANTIAL COMPLETION IN ACCORDANCE WITH THE CONTRACT.

END OF SUPPLEMENTAL GENERAL CONDITIONS

00900 SPECIAL CONDITIONS

SECTION 01-INFORMATION

01-01 COPIES OF PLANS AND SPECIFICATIONS FURNISHED

The Agreement will be prepared in not less than five (5) counterpart (original signed) sets. The City will furnish to the Contractor two (2) sets of conforming Contract Documents and Specifications unless otherwise specified.

01-02 GOVERNING CODES

All construction as provided for under these Plans and Specifications shall be governed by any existing Resolutions, Codes and Ordinances, and any subsequent amendments or revisions thereto as set forth by the City.

01-03 LOCATION

The location of work shall be as set forth in the Notice to Bidders and as indicated on the Plans.

01-04 USAGE OF WATER

All water used during construction shall be provided by the City and shall be metered. The City shall specify the location from which the Contractor is to procure water. The Contractor shall be responsible for obtaining a bulk water permit from the City and providing all apparatus necessary for procuring, storing, transporting and using water during construction. The Contractor shall strive to use no more water than reasonable to perform the work associated with this Contract and shall avoid waste. The Contractor will be required to pay for all water used if it is found that waste is occurring during construction.

SECTION 02-SPECIAL CONSIDERATIONS

02-01 CROSSING UTILITIES

Prior to commencing the Work associated with this Contract, it shall be the Contractor's responsibility to make arrangements with the Owners of utility companies to uncover their particular utility lines or otherwise confirm their location. Certain utility companies perform such services at their own expense, however, where such is not the case, the Contractor will cause such work to be done at his own expense.

02-02 UTILITY SERVICES FOR CONSTRUCTION

The Contractor will be responsible for providing his own utility services while performing the Work associated with this Contract. Provision of said utility services shall be subsidiary to the various bid items and no additional payment will be made for this item.

WAGE RATES**Wage Rates (Information From Chapter 2258, Texas Government Code Title 10)****2288.021. Duty of Government Entity to Pay Prevailing Wage Rates**

- a. The State or any political subdivision of the State shall pay a worker employed by it or on behalf of it:
 - (1) not less than the general prevailing rate of per diem wages for work of a similar character in the locality in which the work is performed; and
 - (2) not less than the general prevailing rate of per diem wages for legal holiday and overtime work.
- b. Subsection (a) does not apply to maintenance work.
- c. A worker is employed on a public work for the purposes of this section if a Contractor or Subcontractor in the execution of a contract for the public work with the State, a political subdivision of the State or any officer or public body of the State or a political subdivision of the State, employs the worker.

2258.023. Prevailing Wage Rates to be Paid by Contractor and Subcontractor; Penalty

- a. The contractor who is awarded a contract by a public body, or a Subcontractor of the Contractor, shall pay not less than the rates determined under Section 2258.022 to a worker employed by it in the execution of the contract.
- b. A Contractor or Subcontractor who violates this section shall pay to the state or a political subdivision of the state on whose behalf the contract is made, \$60 for each worker employed for each calendar day or part of the day that the worker is paid less than the wage rates stipulated in the contract. A public body awarding a contract shall specify this penalty in the contract.
- c. A contractor or subcontractor does not violate this section if a public body awarding a contract does not determine the prevailing wage rates, and specify the rates in the contract as provided by Section 2258.022.
- d. The public body shall use any money collected under this section to offset the costs incurred in the administration of this chapter.
- e. A municipality is entitled to collect a penalty under this section only if the municipality has a population of more than 10,000.

2258.051. Duty of Public Body to Hear Complaints and Withhold Payment

A public body awarding a contract, and an agent or officer of the public body, shall:

1. take cognizance of complaints of all violations of this chapter committed in the execution of the contract; and
2. withhold money forfeited or required to be withheld under this Chapter from the payments to the Contractor under the contract, except that the public body may not withhold money from other than the final payment without determination by the public body that there is good cause to believe that the Contractor has violated this chapter.

Applicable wage rates to be used in Williamson and/or Travis County may be obtained from the U.S. Department of Labor website at the following web addresses:

Construction Types: Heavy (Sewer/Water Treating Plant and Sewer/Incidental to Highway)

<http://www.wdol.gov/wdol/scafiles/davisbacon/TX33.dvb?v=0>

Construction Types: Heavy and Highway

<http://www.wdol.gov/wdol/scafiles/davisbacon/TX16.dvb?v=0>

Construction Type: Building

<http://www.wdol.gov/wdol/scafiles/davisbacon/TX76.dvb?v=1>

02-04

LIMIT OF FINANCIAL RESOURCES

The City has a limited amount of financial resources committed to this Project; therefore, it shall be understood by all bidders that the City may be required to change and/or delete any items which it may feel is necessary to accomplish all or part of the scope of work within its limit of financial resources. Contractor shall be entitled to no claim for damages or anticipated profits on any portion of work that may be omitted. At any time during the duration of this contract, the City reserves the right to omit any work from this contract. Unit prices for all items previously approved in this contract shall be used to delete or add work per change order.

02-05

CONSTRUCTION REVIEW

The City shall provide a project representative to review the quality of materials and workmanship.

02-06

LIMITS OF WORK AND PAYMENT

It shall be the obligation of the Contractor to complete all work included in this Contract, so authorized by the City, as described in the contract documents and technical specifications. All items of work not specifically paid for in the bid proposal

shall be included in the unit price bids. Any question arising as to the limits of work shall be left up to the interpretation of the Engineer.

02-07 LAND FOR WORK

Owner provides, as indicated on Drawings, land upon which work is to be done, right-of-way for access to same and such other lands that are designated for the use of the Contractor. Contractor provides, at his expense and without liability of Owner, any additional land and access thereto that may be required for his construction operations, temporary construction facilities, or for storage of materials.

02-08 DEVIATIONS OCCASIONED BY UTILITY STRUCTURES

Whenever existing utilities, not indicated on Plans, present obstructions to grade and alignment of proposed improvements immediately notify engineer, who without delay, will determine if existing utilities are to be relocated, or grade and alignment of proposed improvements changed. Where necessary to move existing utilities and appurtenances as determined by the Engineer, the Engineer and Contractor will make relocation arrangements with the utility owner. The Owner will not be liable for delay costs or damages due to relocations of utilities which hinder progress of the work.

02-09 CONSTRUCTION STAKING

All construction staking required to complete the work associated with this contract shall be provided by the Contractor. The Contractor shall be responsible for determining the layout and extent of staking necessary to construct the improvements to the lines and grades shown in the Plans and such staking shall be satisfactory to the Engineer. The Contractor shall consult with the Engineer and Owners representative in the field for assistance as necessary. Sufficient staking materials and equipment shall be provided by the Contractor including but not limited to: paint, flagging, laths, hubs, blue tops, nails, hammers, measuring chains or tapes, transits and levels. The Contractor shall be responsible for setting and marking control and off-set points for measuring distances and angles, for shooting levels, and for any other items pertaining to construction staking. This item shall not be paid for separately and shall be considered subsidiary to other bid items.

SECTION 03-ACCESS AND TRAFFIC CONTROL

Access shall be provided for the public and emergency vehicles at all possible times. When it becomes necessary to restrict access, the Contractor shall notify the Owner and coordinate with the Owner, all applicable agencies (i.e. Fire Department, E.M.S., Public Works, etc.), residents, and affected parties. If emergency access is required during the work and such access is being hindered by the work, the Contractor will suspend the work if necessary, and otherwise endeavor to assist emergency personnel in accessing a location restricted by the work. Unless otherwise approved by the Engineer, at the end of each day all lanes of traffic shall be opened to the public. The Contractor shall ensure compliance at all times with the accepted Traffic Control Plan for the project and shall be responsible for all maintenance, signing and safety precautions necessary for traffic control. These items shall be included in the bid item Traffic Control.

01000 TECHNICAL SPECIFICATIONS

ITEM 1 **GENERAL DESCRIPTION**

1.01 **SCOPE OF WORK**

The Work covered by these Specifications consists of furnishing all labor, equipment, appliances, materials and performing all operations in connection with the inspection and testing, complete in accordance with the Plans, and subject to the terms and conditions of the Contract Documents.

1.02 **GOVERNING TECHNICAL SPECIFICATIONS**

STREET, WATER, SEWER AND DRAINAGE IMPROVEMENTS

The Round Rock Standard Specification Criteria Manual is hereby referred to and included in this contract as fully and to the same extent as if copied at length herein, and shall be applied to this project unless modified elsewhere as discussed below. The aforementioned Criteria Manual is the "Standard Specifications" section of the City of Round Rock Design and Construction Standards. The Standard Specifications may be accessed from the City of Round Rock website (www.roundrocktexas.gov) at the following web address: www.roundrocktexas.gov/dacs.

Any adjustments, alterations, or additional information regarding Governing Technical Specifications are contained in the Plans (Drawings), Details and Notes described in Section 02000 of the Project Manual or are included in Attachment A at the end of this Technical Specifications Section.

ITEM 2 **CONTROL OF WORK**

2.01 **CLEAN-UP**

2.01.1 **CONSTRUCTION SITE**

During construction the Contractor shall keep the site free and clean from all rubbish and debris and shall clean-up the site promptly when notified to do so by the Engineer.

The Contractor shall, at his own expense, maintain the streets and roads free from dust, mud, excess earth or debris which constitutes a nuisance or danger to the public using the thoroughfare, or the occupants of adjacent properties.

Care shall be taken to prevent spillage on streets and roads over which hauling is done, and any such spillage or debris deposited on streets, due to the Contractor's operations, shall be immediately removed.

2.01.2 BACKWORK

The Contractor shall coordinate his operations in such a manner as to prevent the amount of clean-up and completion of back works from becoming excessive. Should such a condition exist, the Engineer may order all or portions of the work to cease and refuse to allow any work to commence until the back work is done to the Engineer's satisfaction.

2.02 GRADING

The Contractor shall do such grading in and adjacent to the construction area associated with this contract as may be necessary to leave such areas in a neat and satisfactory condition approved by the Engineer.

ITEM 3 EXAMINATION AND REVIEW

3.01 EXAMINATION OF WORK

The work covered under this Contract shall be examined and reviewed by the Engineer, representatives of all governmental entities which have jurisdiction, and the City's authorized representative. The quality of material and the quality of installation of the improvements shall be to the satisfaction of the Engineer. It shall be the Contractor's responsibility for the construction methods and safety precautions in the undertaking of this Contract.

3.02 NOTIFICATION

The Engineer and City must be notified a minimum of 24-hours in advance of beginning construction, testing, or requiring presence of the Engineer, project representative, or City's representative.

3.03 CONSTRUCTION STAKING

The Engineer shall furnish the Contractor reference points and benchmarks that, in the Engineer's opinion, provide sufficient information for the Contractor to perform construction staking.

3.04 PROTECTION OF STAKES, MARKS, ETC.

All engineering and surveyor's stakes, marks, property comers, etc., shall be carefully preserved by the Contractor, and in case of destruction or removal during the course of this project, such stakes, marks, property comers, etc., shall be replaced by the Contractor at the Contractor's sole expense.

ITEM 4 **PROTECTION AND PRECAUTION**

4.01 **WORK IN FREEZING WEATHER**

Portions of the work may continue as directed by the Engineer.

4.02 **PROTECTION OF TREES, PLANTS AND SHRUBS**

The Contractor shall take necessary precautions to preserve all existing trees, plants and shrubs but where it is justifiable and necessary the Contractor may remove trees and plants for construction right-of-way but only with approval of the Engineer.

4.03 **TRAFFIC CONTROL MEASURES AND BARRICADES**

Traffic control measures and barricades shall be installed in accordance with the **Texas Manual of Uniform Traffic Control Devices** and in other locations deemed necessary by the Engineer, for the protection life and property. Under no circumstances will any existing road be permitted to remain closed over a weekend. No separate pay will be made for this item. Costs for this item shall be subsidiary to other items of work.

4.04 **PROPERTY LINES AND MONUMENTS**

The Contractor shall be responsible for the protection, reference and resetting of property corner monuments if disturbed.

4.05 **DISPOSAL OF SURPLUS MATERIAL**

The Contractor shall at his own expense, make arrangement for the disposal of surplus material, such as rock, trees, brush and other unwanted backfill materials.

4.06 **CONTRACTOR'S USE OF PREMISES**

The Contractor shall, at his own expense, provide additional space as necessary for his operations and storage of materials.

ITEM 5 **MATERIALS**

5.01 **TRADE NAMES**

Except as specified otherwise, wherever in the specifications an article or class of material is designated by a trade name or by the name or catalog number of any maker, patentee, manufacturer, or dealer, such designations shall be taken as intending to mean and specify the articles described or another equal thereto in quality, finish, and serviceability for the purpose intended, as may be determined and judged by the Engineer in his sole discretion.

5.02 **MATERIALS AND WORKMANSHIP**

No material which has been used by the Contractor for any temporary purpose whatever is to be incorporated in the permanent structure without the written consent of the Engineer. Where materials or equipment are specified by a trade or brand name, it is not the intention of the City to discriminate against an equal product of another manufacturer, but rather to set a definite standard of quality for performance, and to

establish an equal basis for the evaluation of bids. Where the words "equivalent", "proper" or "equal to" are used, they shall be understood to mean that the item referred to shall be "proper", the "equivalent" of, or "equal to" some other item, in the opinion or judgment of the Engineer. Unless otherwise specified, all materials shall be the best of their respective kinds and shall be in all cases fully equal to approved samples. Notwithstanding that the words "or equal to" or other such expressions may be used in the specifications in connection with a material, manufactured article or process, the material, article or process specifically designated shall be used, unless a substitute is approved in writing by the Engineer, and the Engineer will have the right to require the use of such specifically designated material, article or process.

WEST WWTP FORCE MAIN RELOCATION
ATTACHMENT A
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01000 TECHNICAL SPECIFICATIONS

ITEM 1 **GENERAL DESCRIPTION**

1.01 **SCOPE OF WORK**

The Work covered by these Specifications consists of furnishing all labor, equipment, appliances, materials and performing all operations in connection with the inspection and testing, complete in accordance with the Plans, and subject to the terms and conditions of the Contract Documents.

1.02 **GOVERNING TECHNICAL SPECIFICATIONS**

STREET, WATER, SEWER AND DRAINAGE IMPROVEMENTS

The Round Rock Standard Specification Criteria Manual is hereby referred to and included in this contract as fully and to the same extent as if copied at length herein, and shall be applied to this project except as modified in these Specifications and on the Plans.

Any adjustments, alterations, or additional information regarding Governing Technical Specifications are included in Attachment A at the end of this Technical Specifications Section.

ITEM 2 **CONTROL OF WORK**

2.01 **CLEAN-UP**

2.01.1 **CONSTRUCTION SITE**

During construction the Contractor shall keep the site free and clean from all rubbish and debris and shall clean-up the site promptly when notified to do so by the Engineer.

The Contractor shall, at his own expense, maintain the streets and roads free from dust, mud, excess earth or debris which constitutes a nuisance or danger to the public using the thoroughfare, or the occupants of adjacent properties.

Care shall be taken to prevent spillage on streets and roads over which hauling is done, and any such spillage or debris deposited on streets, due to the Contractor's operations, shall be immediately removed.

2.01.2 BACKWORK

The Contractor shall coordinate his operations in such a manner as to prevent the amount of clean-up and completion of back works from becoming excessive. Should such a condition exist, the Engineer may order all or portions of the work to cease and refuse to allow any work to commence until the back work is done to the Engineer's satisfaction.

2.02 GRADING

The Contractor shall do such grading in and adjacent to the construction area associated with this contract as may be necessary to leave such areas in a neat and satisfactory condition approved by the Engineer.

ITEM 3 EXAMINATION AND REVIEW

3.01 EXAMINATION OF WORK

The work covered under this Contract shall be examined and reviewed by the Engineer, representatives of all governmental entities which have jurisdiction, and the City's authorized representative. The quality of material and the quality of installation of the improvements shall be to the satisfaction of the Engineer. It shall be the Contractor's responsibility for the construction methods and safety precautions in the undertaking of this Contract.

3.02 NOTIFICATION

The Engineer and City must be notified a minimum of 24-hours in advance of beginning construction, testing, or requiring presence of the Engineer, project representative, or City's representative.

3.03 CONSTRUCTION STAKING

The Engineer shall furnish the Contractor reference points and benchmarks that, in the Engineer's opinion, provide sufficient information for the Contractor to perform construction staking.

3.04 PROTECTION OF STAKES, MARKS, ETC.

All engineering and surveyor's stakes, marks, property corners, etc., shall be carefully preserved by the Contractor, and in case of destruction or removal during the course of this project, such stakes, marks, property corners, etc., shall be replaced by the Contractor at the Contractor's sole expense.

ITEM 4 **PROTECTION AND PRECAUTION**

4.01 **WORK IN FREEZING WEATHER**

Portions of the work may continue as directed by the Engineer.

4.02 **PROTECTION OF TREES, PLANTS AND SHRUBS**

The Contractor shall take necessary precautions to preserve all existing trees, plants and shrubs but where it is justifiable and necessary the Contractor may remove trees and plants for construction right-of-way but only with approval of the Engineer.

4.03 **TRAFFIC CONTROL MEASURES AND BARRICADES**

Traffic control measures and barricades shall be installed in accordance with the **Texas Manual of Uniform Traffic Control Devices** and in other locations deemed necessary by the Engineer, for the protection life and property. Under no circumstances will any existing road be permitted to remain closed over a weekend. No separate pay will be made for this item. Costs for this item shall be subsidiary to other items of work.

4.04 **PROPERTY LINES AND MONUMENTS**

The Contractor shall be responsible for the protection, reference and resetting of property corner monuments if disturbed.

4.05 **DISPOSAL OF SURPLUS MATERIAL**

The Contractor shall at his own expense, make arrangement for the disposal of surplus material, such as rock, trees, brush and other unwanted backfill materials.

4.06 **CONTRACTOR'S USE OF PREMISES**

The Contractor shall, at his own expense, provide additional space as necessary for his operations and storage of materials.

ITEM 5 **MATERIALS**

5.01 **TRADE NAMES**

Except as specified otherwise, wherever in the specifications an article or class of material is designated by a trade name or by the name or catalog number of any maker, patentee, manufacturer, or dealer, such designations shall be taken as intending to mean and specify the articles described or another equal thereto in

quality, finish, and serviceability for the purpose intended, as may be determined and judged by the Engineer in his sole discretion.

5.02

MATERIALS AND WORKMANSHIP

No material which has been used by the Contractor for any temporary purpose whatever is to be incorporated in the permanent structure without the written consent of the Engineer. Where materials or equipment are specified by a trade or brand name, it is not the intention of the City to discriminate against an equal product of another manufacturer, but rather to set a definite standard of quality for performance, and to establish an equal basis for the evaluation of bids. Where the words "equivalent", "proper" or "equal to" are used, they shall be understood to mean that the item referred to shall be "proper", the "equivalent" of, or "equal to" some other item, in the opinion or judgment of the Engineer. Unless otherwise specified, all materials shall be the best of their respective kinds and shall be in all cases fully equal to approved samples. Notwithstanding that the words "or equal to" or other such expressions may be used in the specifications in connection with a material, manufactured article or process, the material, article or process specifically designated shall be used, unless a substitute is approved in writing by the Engineer, and the Engineer will have the right to require the use of such specifically designated material, article or process.

ATTACHMENT A

01300 SUBMITTAL PROCEDURES

1.00 GENERAL

1.01 WORK INCLUDED

- A. Submit documentation as required by the Contract Documents and as reasonably requested by the Owner and Engineer to:
 - 1. Record the products incorporated into the Project for the Owner.
 - 2. Provide information for operation and maintenance of the Project.
 - 3. Provide information for the administration of the Contract.
 - 4. Allow the Engineer to advise the Owner if products proposed for the Project by the Contractor conform, in general, to the design concepts of the Contract Documents.
- B. Contractor's responsibility for full compliance with the Contract Documents is not relieved by the Engineer's review of submittals. Contract modifications can only be approved by Change Order or Field Order.

1.02 CONTRACTOR'S RESPONSIBILITIES

- A. Review and certify all submittals prior to submission.
- B. Determine and verify:
 - 1. Field measurements.
 - 2. Field construction requirements.
 - 3. Location of all existing structures, utilities and equipment related to the submittals.
 - 4. Submittals are complete for their intended purpose.
 - 5. Conflicts between the submittals related to the various Subcontractors and Suppliers have been resolved.
 - 6. Quantities and dimensions shown on the submittals.
- C. Submit information per the procedures described in this section and the Specifications.
- D. Furnish the following submittals:
 - 1. As specified in the individual Specification Sections, including the City of Round Rock Standard Specifications.
 - 2. Schedules, data and other documentation as described in detail in this section or referenced in the General Conditions and Contract Documents.
 - 3. Shop Drawings required for consideration of a contract modification per Paragraph 1.08.
 - 4. Submittals as required in the Specifications.
 - 5. Submittals not required will be returned without Engineer's review.
- E. Submit a schedule indicating the date submittals will be sent to the Engineer and proposed dates that the product will be incorporated into the Project. Make submittals promptly in accordance with the schedule to cause no delay in the Project.

1. Send submittals to the Engineer allowing a reasonable time for delivery, review and marking submittals. Include time for review of a resubmission if necessary. Allow adequate time for the submittal review process, ordering, fabrication, and delivery of the product to not delay progress on the Project.
 2. Schedule submittal to provide all information for interrelated Work at one time. No review will be performed on submittals requiring coordination with other submittals. Engineer will return submittals for resubmission as a complete package.
- F. Submit information for all of the components and related equipment required for a complete and operational system in the same submittal.
1. Include electrical, mechanical, and other information required to indicate how the various components of the system function.
 2. Provide certifications, warranties, and written guarantees with the submittal package for review when they are required.
 3. Fabrication or installation of any products prior to the approval of Shop Drawings is done at the Contractor's risk. Products not meeting the requirements of Contract Documents are defective and may be rejected at the Owner's option.
- G. Payment will not be made for products for which submittals are required until the submittals have been received. Payment will not be made for products for which Shop Drawings or Samples are required until these are approved by the Engineer.

1.03 QUALITY ASSURANCE

- A. Submit legible, accurate, complete documents presented in a clear, easily understood manner. Submittals not meeting these criteria will be returned without review.
- B. Demonstrate that the proposed products are in full and complete compliance with the design criteria and requirements of the Contract Documents including Drawings and Specifications as modified by Addenda, Field Orders, and Change Orders.
- C. Furnish and install products that fully comply with the information included in the submittal.

1.04 SUBMITTAL PROCEDURES

- A. Submit an electronic copy of each submittal to the Engineer and Owner.
 1. The complete contents of each submittal, including associated drawings product data, etc., shall be submitted in Portable Document Format (PDF.) Submit PDF document with adequate resolution to allow documents to be printed in a format equivalent to the document original. Documents are to be scalable to allow printing on standard 8-1/2 x 11 or 11 x 17 papers.
 2. Create and submit color PDF documents where color is important to the evaluation of the submittal and / or where comments will be lost if only black and white PDF documents are provided. Submit Samples and color charts per Paragraph **[1.04.H]**.
- B. Transmit all submittals, with a properly completed Submittal Transmittal Form as provided by the Engineer.

1. Use a separate transmittal form for each specific product, class of material, and equipment system.
 2. Submit items specified in different sections of the Specifications separately unless they are part of an integrated system.
- C. Assign a submittal number to the documents originated to allow tracking of the submittal during the review process.
1. Assign the number consisting of a prefix, a sequence number, and a letter suffix. Prefixes shall be as follows:

Prefix	Description	Originator
AP	Application for Payment	Contractor
CO	Change Order	Engineer
CMR	Contract Modification Request	Contractor
CTR	Certified Test Report	Contractor
EIR	Equipment Installation Report	Contractor
FO	Field Order	Engineer
NBC	Notification by Contractor	Contractor
O&M	Operation & Maintenance Manuals	Contractor
PD	Photographic Documentation	Contractor
RD	Record Data	Contractor
RFI	Request for Information	Contractor
SAM	Sample	Contractor
SD	Shop Drawing	Contractor
SCH	Schedule of Progress	Contractor

2. Issue sequence numbers in chronological order for each type of submittal.
 3. Issue numbers for resubmittals that have the same number as the original submittal followed by an alphabetical suffix indicating the number of times the same submittal has been sent to the Engineer for processing. For example: SD 025 A represents shop drawing number 25 and the letter "A" designates this is the second time this submittal has been sent for review.
 4. Clearly note the submittal number on each page or sheet of the submittal.
 5. Correct assignment of numbers is essential since different submittal types are processed in different ways.
- D. Submit documents with uniform markings.
1. Mark submittals to:
 - a. Highlight Contractor's corrections in green.

- b. Highlight items pertinent to the products being furnished in yellow and delete items that are not when the Supplier's standard drawings or information sheets are provided.
 - c. Cloud items and highlight in yellow where selections by the Engineer or Owner are required.
 - d. Mark dimensions with the prefix FD to indicate field verified dimensions on the Shop Drawings.
 - e. Provide an 8-by-3-inch blank space for Contractor's and Engineer's stamp. Contractor may use a digital certification if this is preferred. The certification must bear a digital signature.
- 2. Define abbreviations and symbols used in Shop Drawings.
 - a. Use terms and symbols in Shop Drawings consistent with the Contract Drawings.
 - b. Provide a list of abbreviations and their meaning as used in the Shop Drawings.
 - c. Provide a legend for symbols used on Shop Drawings.
- E. Mark submittals to reference the Drawing number and/or section of the Specifications, detail designation, schedule or location that corresponds with the data submitted. Other identification may also be required, such as layout drawings or schedules to allow the reviewer to determine where a particular product is to be used.
- F. Deliver Samples required by the Specifications to the Site. Provide a minimum of two Samples.
- G. Construct mock-ups from the actual products to be used in construction per detailed Specifications.
- H. Submit color charts and Samples for every product requiring color, texture or finish selection.
 - 1. Submit all color charts and Samples at one time.
 - 2. Do not submit color charts and Samples until all record data have been submitted or Shop Drawings for the products have been approved.
 - 3. Submit color charts and Samples not less than 30 days prior to when these products are to be ordered or released for fabrication to comply with the schedule for construction of the Project.
- I. Submit Contract Modification Request to request modifications to the Contract Documents.

1.05 REVIEW PROCEDURES

- A. Shop drawings are reviewed in the order received, unless Contractor request that a different priority be assigned.
- B. Mark a submittal as "Priority" to place the review for this submittal ahead of submittals previously delivered. Priority submittals will be reviewed before other submittals for this Project which have been received but not reviewed. Use discretion in the use of "Priority" submittals as this may delay the review of submittals previously submitted. Revise the Schedule of Contractor's Submittals for substantial deviations from the previous schedule.

C. Review procedures vary with the type of submittal as described in Paragraph **[1.06]**.

1.06 SUBMITTAL REQUIREMENTS

A. Shop Drawings are required for those products that cannot adequately be described in the Contract Documents to allow fabrication, erection or installation of the product without additional detailed information from the Supplier.

1. Shop Drawings are requested so that the Engineer can:
 - a. Assist the Owner in selecting colors, textures or other aesthetic features.
 - b. Compare the proposed features of the product with the specified features so as to advise the Owner that the product does, in general, conform to the Contract Documents.
 - c. Compare the performance features of the proposed product with those specified so as to advise the Owner that it appears that the product will meet the designed performance criteria.
 - d. Review required certifications, guarantees, warranties, and service agreements for compliance with the Contract Documents.
2. Certify on the Contractor's stamp that the Contractor has reviewed the Shop Drawings and made all necessary corrections such that the products, when installed, will be in full compliance with the Contract Documents. Shop Drawings submitted without this certification will be returned without review.
3. Submit Shop Drawings for:
 - a. Products indicated in the submittal schedule following this section or as specified in the individual Specification Sections.
 - b. When a substitution or equal product is proposed in accordance with Paragraph 1.08 of this Section.
4. Include a complete description of the material or equipment to be furnished. Information is to include:
 - a. Type, dimensions, size, arrangement, model number, and operational parameters of the components.
 - b. Weights, gauges, materials of construction, external connections, anchors, and supports required.
 - c. Performance characteristics, capacities, engineering data, motor curves, and other information necessary to allow a complete evaluation of mechanical components.
 - d. All applicable standards such as ASTM or Federal specification numbers.
 - e. Fabrication and installation drawings, setting diagrams, manufacturing instructions, templates, patterns, and coordination drawings.
 - f. Wiring and piping diagrams and related controls.
 - g. Mix designs for concrete, asphalt, or other materials proportioned for the Project.

- Submittal Procedures
RRK17212 – West WWTP Force Main Relocation and Pump Replacement

5. Certification of Adequacy of Design (CAD): A certified letter from the manufacturer of the equipment stating that they have designed the equipment to be structurally stable and to withstand all imposed loads without deformation, failure, or adverse effects to the performance and operational requirements of the unit. The letter shall state that mechanical and electrical equipment is adequately sized to be fully operational for the conditions specified or normally encountered by the product's intended use.
 6. Certification of Applicator/Subcontractor (CSQ): A certified letter stating that the Applicator or Subcontractor proposed to perform a specified function is duly designated as factory authorized and trained for the application of the specified product.
- C. Submit record data to provide information to allow the Owner to adequately identify the products incorporated into the Project and allow replacement or repair at some future date.
1. Provide record data for all products per the submittal schedule or as specified in the individual Specification Sections. Record data is not required for items for which Shop Drawings and/or operations and maintenance manuals are required.
 2. Provide information only on the specified products. Submit a Contract Modification Request for approval of deviations or substitutions and obtain approval by Field Order or Change Order prior to submitting record data.
 3. Provide the same information required for Shop Drawings.
 4. Record data will be received by the Engineer, logged, and provided to Owner for the Project record.
 - a. Record data may be reviewed to see that the information provided is adequate for the purpose intended. Inadequate drawings may be returned as unacceptable.
 - b. Record data is not reviewed for compliance with the Contract Documents. Comments may be returned if deviations from the Contract Documents are noted during the cursory review performed to see that the information is adequate.
- D. Provide Samples for comparison with products delivered to the Site for use on the Project.
1. Samples shall be of sufficient size and quantity to clearly illustrate the functional characteristics of the product, with integrally related parts and attachment devices.
 2. Indicate the full range of color, texture, and patterns.
 3. Dispose of Samples when related Work has been completed and approved, and disposal is requested by the Engineer. At Owner's option Samples will become the property of the Owner.
- E. Construct mock-ups for comparison with the Work being performed.
1. Construct mock-ups of the size or area indicated in the detailed Specifications.
 2. Construct mock-ups complete with texture and finish to represent the finished product.
 3. Protect mock-ups until Work has been completed and accepted by the Owner.
 4. Dispose of mock-ups when related Work has been completed and disposal is approved by the Engineer.

- F. Submit Operation and Maintenance manuals (O&M) for all equipment, mechanical devices, or components described in the Contract Documents. Include copies of approved Shop Drawings in the manual.
- G. Submit Request for Information (RFI) in accordance with Section 01 31 13 "Project Coordination."
- H. Submit Progress Schedules (SCH) and update the schedule on a monthly basis. Provide preliminary schedule within 10 days after the Notice of Award, to be available at the pre-construction conference.
- I. Submit Certified Test Reports (CTR) from independent testing laboratories.
 - 1. Submit test reports for material fabricated for this Project with Shop Drawings for that product.
 - 2. Submit test reports produced at the point of production for standard production products with the record data for that product.
- J. Submit a list of Suppliers and Subcontractors as record data.
- K. Submit Photographic Documentation (PD) as record data. Furnish photos of the project site before the start of construction to document pre-existing conditions. Furnish photos of the project site to clearly depict the completed project.

1.07 SUBMITTALS REQUIRED FOR THIS PROJECT

- A. Furnish the following Submittals:
 - 1. As specified in the individual Specification Sections, including the City of Round Rock Standard Specifications, or referenced in the General Conditions.
 - 2. When a substitution or equal product is proposed in accordance with Paragraph 1.08 of this Section.

1.08 REQUESTS FOR DEVIATION

- A. Submit requests for deviation from the Contract Documents for any product that does not fully comply with the Contract Documents.
- B. Submit request by Contract Modification Request (CMR) by identifying the deviations and the reason the change is requested.
- C. Include the amount of cost savings to the Owner for deviations that result in a reduction in cost.
- D. A Change Order or Field Order will be issued by the Engineer for deviations approved by the Owner. Deviations from the Contract Documents may only be approved by Change Order or Field Order.

1.09 SUBMITTALS FOR EQUAL NON SPECIFIED PRODUCTS

- A. The products of the listed suppliers are to be furnished where Specifications list several manufacturers but do not specifically list "or equal" or "or approved equal" products. Use of any products other than those specifically listed is a substitution and must be approved per Paragraph 1.10.

- B. Contractor may submit other manufacturers' products that are in full compliance with the specification where Specifications list one or more manufacturers followed by the phrase "or equal" or "or approved equal."
 - 1. Submit Shop Drawings of adequate detail to document that the proposed product is equal or superior to the specified product.
 - 2. Prove that the product is equal. It is not the Engineer's responsibility to prove the product is not equal.
 - a. Indicate on a point by point basis for each specified feature that the product is equal to the Contract Document requirements.
 - b. Make a direct comparison with the specified manufacturer's published data sheets and available information. Provide this printed material with the submittal.
 - c. The decision of the Engineer regarding the acceptability of the proposed product is final.
 - 3. Provide a typewritten certification that, in furnishing the proposed product as an equal, the Contractor:
 - a. Has thoroughly examined the proposed product and has determined that it is equal or superior in all respects to the product specified.
 - b. Has determined that the product will perform in the same manner and result in the same process as the specified product.
 - c. Will provide the same warranties and/or bonds as for the product specified.
 - d. Will assume all responsibility to coordinate any modifications that may be necessary to incorporate the product into the construction and will waive all claims for additional Work which may be necessary to incorporate the product into the Project which may subsequently become apparent.
 - e. Will maintain the same time schedule as for the specified product.
 - 4. A modification request is not required for any product that is in full compliance with the Contract Documents.

1.10 SUBMITTALS FOR SUBSTITUTIONS

- A. Substitutions are defined as any product that the Contractor proposes to provide for the Project in lieu of the specified product.
- B. Submit the following for consideration of approval of a Supplier or product which is not specified:
 - 1. Contract Modification Request for deviation from the Contract Documents per Paragraph 1.08.
 - 2. Prove that the product is acceptable as a substitute. It is not the Engineer's responsibility to prove the product is not acceptable as a substitute.
 - a. Indicate on a point by point basis for each specified feature that the product is acceptable to meet the intent of the Contract Documents requirements.

- b. Make a direct comparison with the specified Suppliers published data sheets and available information. Provide this printed material with the submittal.
 - c. The decision of the Engineer regarding the acceptability of the proposed substitute product is final.
- 3. Provide a written certification that, in making the substitution request, the Contractor:
 - a. Has determined that the substituted product will perform in substantially the same manner and result in the same ability to meet the specified performance as the specified product.
 - b. Will provide the same warranties and/or bonds for the substituted product as specified or as would be provided by the Manufacturer of the specified product.
 - c. Will assume all responsibility to coordinate any modifications that may be necessary to incorporate the substituted product into the Project and will waive all claims for additional Work which may be necessary to incorporate the substituted product into the Project which may subsequently become apparent.
 - d. Will maintain the same time schedule as for the specified product.
- C. Pay engineering cost for review of substitutions.
 - 1. Cost for additional review time will be billed to the Owner by the Engineer for the actual hours required for the review and marking of Shop Drawings by Engineer.
 - 2. Cost for the additional review shall be paid to the Owner by the Contractor on a monthly basis.

1.11 WARRANTIES AND GUARANTEES

- A. Submit warranties and guarantees required by the Contract Documents with the Shop Drawings or record data.
- B. Provide additional copies for equipment and include this additional copy in the Operation and Maintenance Manuals.
- C. Provide a separate manual for warranties and guarantees.
 - 1. Provide a log of all products for which warranties or guarantees are provided, and for all equipment. Index the log by Specification section number on forms provided by the Engineer.
 - 2. Indicate the start date, warranty or guarantee period and the date upon which the warranty or guarantee expires for products or equipment for which a warranty or guarantee is required.
 - 3. Indicate the date for the start of the correction period specified in the General Conditions for each piece of equipment and the date on which the specified correction period expires.
 - 4. Provide a copy of the warranty or guarantee under a tab indexed to the log.

1.12 RESUBMISSION REQUIREMENTS

- A. Make all corrections or changes in the submittals required by the Engineer and resubmit until approved.
- B. For Shop Drawings:
 - 1. Revise initial drawings or data and resubmit as specified for the original submittal.
 - 2. Highlight in yellow those revisions which have been made in response to the first review by the Engineer.
 - 3. Highlight in blue any new revisions which have been made or additional details of information that has been added since the previous review by the Engineer.
- C. For Samples:
 - 1. Submit new Samples as required for the initial Sample.
 - 2. Remove Samples which have been rejected.
- D. For mock-ups:
 - 1. Construct a new mock-up as initially required.
 - 2. Dispose of mock-ups which have been rejected.
- E. Pay for excessive review of Shop Drawings.
 - 1. Excessive review of Shop Drawings is defined as any review required after the original review has been made and the first resubmittal has been checked to see that corrections have been made.
 - 2. Cost for additional review time will be billed to the Owner by the Engineer for the actual hours required for the review and marking of Shop Drawings by Engineer and in accordance with the rates listed in Section 00 73 00 "Supplementary Conditions."
 - 3. Pay cost for the additional review to the Owner on a monthly basis as billed by the Owner.
 - 4. Need for more than one resubmission or any other delay of obtaining Engineer's review of submittals, will not entitle the Contractor to an extension of Contract Time. All costs associated with such delays shall be at the Contractor's expense.

1.13 ENGINEER'S DUTIES

- A. Review the submittals and return with reasonable promptness.
- B. Affix stamp, indicate approval, rejection, and the need for resubmittal.
- C. Distribute documents.

2.00 PRODUCTS (NOT APPLICABLE)

3.00 EXECUTION (NOT APPLICABLE)

END OF SECTION

01350 SPECIAL PROCEDURES

1.01 SHUT DOWNS AND PLANS OF ACTION

- A. Shut downs of operations or equipment must be planned and scheduled.
1. Submit a written plan of action for approval for shutting down essential services. These include:
 - a. Electrical power.
 - b. Control power.
 - c. Process piping.
 - d. Treatment equipment.
 - e. Communications equipment.
 - f. Other designated functions.
 2. Describe the following in the plan of action:
 - a. Construction necessary.
 - b. Utilities, piping, or services affected.
 - c. Length of time the service or utility will be disturbed.
 - d. Procedures to be used to carry out the Work.
 - e. Plan of Action to handle emergencies.
 - f. Contingency plan that will be used if the original schedule cannot be met.
 3. Submit plan for shut down of West Wastewater Treatment Plant WAS Lift Station at least 2 weeks prior to beginning the Work.

1.02 CRITICAL OPERATIONS – WAS LIFT STATION

- A. The Owner has identified critical operations that must not be out of service longer than the designated maximum out of service time and/or must be performed only during the designated times. These have been identified in the table below:

Critical Operation	Maximum Time Out of Operation	Hours Operation Can be Shut Down
WAS Lift Station Operation	2 weeks	24 hours

- B. Submit a written plan of action for approval for critical operations.
1. Describe the following in the plan of action:
 - a. Construction necessary.
 - b. Utilities, piping, or services affected.
 - c. Length of time the service or utility will be disturbed.

- d. Procedures to be used to carry out the Work.
- e. Plan of action to handle emergencies.
- f. Contingency plan that will be used if the original schedule cannot be met.
- g. List of manpower, equipment, and ancillary supplies. Identify backups for key pieces of equipment such as excavators and pumps and key personnel such as welders.

2. Plan must be received by the Owner 2 weeks prior to beginning the Work.

1.03 OWNER ASSISTANCE

- A. The Owner will assist the Contractor in draining the existing pipelines as much as possible through existing blow-off valves. The Contractor will be responsible for providing dewatering pumps, etc. required to completely dewater the facilities and handle any leakage past closed valves, gates or adjacent structures.

1.04 BRUSHY CREEK CROSSING REQUIREMENTS

- A. Flow through Brushy Creek shall be maintained at all times during pipeline installation.
- B. Submit a written plan of action for approval crossing of Brushy Creek 2 weeks prior to crossing construction.
- C. Attend a site visit with Owner and Engineer after submittal of plan of action and prior to starting construction to discuss Contractor's plan of action, schedule and contingency plan. Site visit shall be at least 1 week prior to starting construction on Brushy Creek crossing.

2.00 PRODUCTS (NOT APPLICABLE)

3.00 EXECUTION (NOT APPLICABLE)

END OF SECTION

01570 TEMPORARY CONTROLS

1.00 GENERAL

1.01 WORK INCLUDED

- A. Provide labor, materials, equipment and incidentals necessary to construct temporary facilities to provide and maintain control over environmental conditions at the Site, in accordance with the prepared Storm Water Pollution Prevention Plan and the Contract Documents. Remove temporary facilities when no longer needed.
- B. Construct temporary impounding works, channels, diversions, furnishing and operation of pumps, installing piping and fittings, and other construction for control of conditions at the Site. Remove temporary controls at the end of the Project.
- C. A Storm Water Pollution Prevention Plan in accordance with TCEQ General Permit TXR150000 has been prepared by the Engineer. File required legal notices and obtain required permits prior to beginning any construction activity.
- D. Provide labor, materials, equipment, and incidentals necessary to prevent storm water pollution for the duration of the Project. Provide and maintain erosion and sediment control structures as required to prevent sediment and other pollutants from the Site from entering any storm water system, including open channels. Remove pollution control structures when no longer required to prevent storm water pollution.
- E. Cost for Temporary Controls as described in this Section and provided by Suppliers and Subcontractors as described in this Section are to be included in the Cost of Work.

1.02 QUALITY ASSURANCE

- A. Construct and maintain temporary controls with adequate workmanship using durable materials to provide effective environmental management systems meeting the requirements of the Contract Documents and requiring minimal maintenance that will disrupt construction activities while providing adequate protection of the environment.
- B. Periodically inspect systems to determine that they are meeting the requirements of the Contract Documents.

1.03 SUBMITTALS

- A. Provide copies of notices, records and reports required by the Contract Documents or regulations as Record Data in accordance with Section 01 33 00 "Submittal Procedures."
- B. Provide documents requiring approval by the Owner or Engineer as Shop Drawings in accordance with Section 01 33 00 "Submittal Procedures."

1.04 STANDARDS

- A. Comply with all requirements of the Texas Commission on Environmental Quality General Permit (TXR150000) for storm water discharges from construction activities under the Texas Pollutant Discharge Elimination System (TPDES) program.
- B. Perform Work to comply with "Best Practice" as established by the local agency of jurisdiction.

1.05 PERMITS

- A. Submit the following to the TCEQ and the Operator of any Municipal Separate Storm Sewer System (MS4) receiving storm water discharges from the Site:
 - 1. Notice of Intent (NOI) at least 48 hours prior to beginning construction activity. Construction activity may commence 24 hours after the submittal of an electronic NOI.
 - 2. Notice of Change (NOC) letter when relevant facts or incorrect information was submitted in the NOI, or if relevant information in the NOI changes during the course of construction activity.
 - 3. Notice of Termination (NOT) when the construction project has been completed and stabilized.
- B. Post a copy of the NOI at the Site in a location where it is readily available for viewing by the general public and Local, State, and Federal authorities prior to starting construction activities and maintain the posting until completion of the construction activities.
- C. Maintain copies of a schedule of major construction activities, inspection reports, and revision documentation with the storm water pollution prevention plan (SWPPP) required under the TPDES General Permit (TXR150000) for Storm Water Discharges from Construction Activities for all projects.

1.06 STORM WATER POLLUTION CONTROL

- A. Comply with the current requirements of TPDES General Permit No. TXR15000 (General Storm Water Permit) set forth by the Texas Commission on Environmental Quality for the duration of the Project:
 - 1. Submit of a Notice of Intent to the Texas Commission on Environmental Quality.
 - 2. Develop and implement appropriate Best Management Practices as established by local agencies of jurisdiction.
 - 3. Provide all monitoring and/or sampling required for reporting to the Texas Commission on Environmental Quality.
 - 4. Submit reports to the Texas Commission on Environmental Quality as required as a condition of the permit.
 - 5. Submit copies of the reports to the Engineer as Record Data in accordance with Section 01 33 00 "Submittal Procedures."
 - 6. Retain copies of these documents at the Site at all times for review and inspection by the Owner or regulatory agencies. Post a copy of the permit as required by regulations.
 - 7. Pay all costs associated with complying with the provisions of the General Storm Water Permit. Assume solely responsible for implementing, updating, and modifying the Storm Water Pollution Prevention Plan and Best Management Practices per regulatory requirements.
- B. Use forms required by the Texas Commission on Environmental Quality to file the Notice of Intent. Submit the Notice of Intent at least 2 days prior to the start of construction. Provide draft copies of the Notice of Intent, any modifications of the Storm Water Pollution Prevention Plan, and any other pertinent Texas Commission on Environmental Quality

submittal documents to Owner for review prior to submittal to the Texas Commission on Environmental Quality.

- C. Return any property disturbed by construction activities to either specified conditions or pre-construction conditions as set forth in the Contract Documents. Provide an overall erosion and sedimentation control system that will protect all undisturbed areas and soil stockpiles/spoil areas. Implement appropriate Best Management Practices and techniques to control erosion and sedimentation and maintain these practices and techniques in effective operating condition during construction. Permanently stabilize exposed soil and fill as soon as practical during the Work.
- D. Assume sole responsibility for the means, methods, techniques, sequences, and procedures for furnishing, installing, and maintaining erosion and sedimentation control structures and procedures and overall compliance with the General Storm Water Permit. Modify the system as required to effectively control erosion and sediment.
- E. Retain copies of reports required by the General Storm Water Permit for 3 years from date of final completion.

1.07 POLLUTION CONTROL

- A. Prevent the contamination of soil, water or atmosphere by the discharge of noxious substances from construction operations. Provide adequate measures to prevent the creation of noxious air-borne pollutants. Prevent dispersal of pollutants into the atmosphere. Do not dump or otherwise discharge noxious or harmful fluids into drains or sewers, nor allow noxious liquids to contaminate public waterways in any manner.
- B. Provide equipment and personnel and perform emergency measures necessary to contain any spillage.
 - 1. Contain chemicals in protective areas and do not dump on soil. Dispose of such materials at off-site locations in an acceptable manner.
 - 2. Excavate contaminated soil and dispose at an off-site location if contamination of the soil does occur. Fill resulting excavations with suitable backfill and compact to the density of the surrounding undisturbed soil.
 - 3. Provide documentation to the Owner which states the nature and strength of the contaminant, method of disposal, and the location of the disposal site.
 - 4. Comply with local, State and Federal regulations regarding the disposal of pollutants.
- C. Groundwater or run-off water which has come into contact with noxious chemicals, sludge, or sludge-contaminated soil is considered contaminated. Contaminated water must not be allowed to enter streams or water courses, leave the Site in a non-contained form or enter non-contaminated areas of the Site.
 - 1. Pump contaminated water to holding ponds constructed by the Contractor for this purpose, or discharge to areas on the interior of the Site, as designated by the Engineer.
 - 2. Construct temporary earthen dikes or take other precautions and measures as required to contain the contaminated water and pump to a designated storage area.
 - 3. Wash any equipment used for handling contaminated water or soil within contaminated areas three times with uncontaminated water prior to using such equipment in an

uncontaminated area. Dispose of wash water used to wash such equipment as contaminated water.

1.08 EARTH CONTROL

- A. Remove excess soil, spoil materials and other earth not required for backfill at the time of generation. Control stockpiled materials to eliminate interference with Contractor and Owner's operations.
- B. Dispose of excess earth off the Site. Pay cost for disposal unless otherwise noted. Provide written approval by the property owner for all disposal on private property, and approval by the Owner if such disposal affects the use of Site or other easements.

1.09 MANAGEMENT OF WATER

- A. Manage water resulting from rains or ground water at the Site. Maintain trenches and excavations free of water at all times.
- B. Lower the water table in the construction area by acceptable means if necessary to maintain a dry and workable condition at all times. Provide drains, sumps, casings, well points, and other water control devices as necessary to remove excess water.
- C. Provide continuous operation of water management actions. Maintain standby equipment to provide proper and continuous operation for water management.
- D. Ensure that water drainage does not damage adjacent property. Divert water into the same natural watercourse in which its headwaters are located, or other natural stream or waterway as approved by the Owner. Assume responsibility for the discharge of water from the Site.
- E. Remove the temporary construction and restore the Site in a manner acceptable to the Engineer and to match surrounding material at the conclusion of the Work.

2.00 PRODUCTS

2.01 MATERIALS

- A. Provide materials meeting regulatory requirements.

3.00 EXECUTION

3.01 CONSTRUCTING, MAINTAINING AND REMOVING TEMPORARY CONTROLS

- A. Construct temporary controls in accordance with regulatory requirements.
- B. Maintain controls in accordance with regulatory requirements where applicable, or in accordance with the requirements of the Contract Documents.
- C. Remove temporary control when no longer required, but before the Project is complete. Correct any damage or pollution that occurs as the result of removing controls before the point where they are no longer required.

END OF SECTION

09905 HIGH-PERFORMANCE COATINGS

1.00 GENERAL

1.01 WORK INCLUDED

- A. Furnish labor, materials, equipment and incidentals necessary to apply protective coatings to material and equipment as specified herein, including the preparation of surfaces prior to application of coatings.
- B. Protective coatings are special coatings to be used at specific locations or on specific surfaces as indicated herein.
- C. Protective coatings shall be applied to the following surfaces:
 - 1. New piping, including:
 - a. 6" Ductile Iron Force Main.
 - 2. New valves.
 - 3. As indicated on the drawings.
- D. Special applications for painting include the following:
 - 1. Buried pipe and valves shall receive a shop applied protective coating as described in the appropriate section of the Specifications.
- E. Contain, treat, and dispose of any dust, spray, drainage, or spillage resulting from coating operations. It shall be the Contractor's responsibility to determine if the materials to be disposed of are classified as Hazardous Waste. Disposed of waste, hazardous or otherwise, shall be in accordance with applicable regulations. The Contractor shall be aware of and understand the regulations concerning disposal of waste generated by coating operations.

1.02 QUALITY ASSURANCE

- A. Acceptable Manufacturers: Products which comply with the Contract Documents and are manufactured by the following companies will be acceptable:
 - 1. Tnemec Company, Inc.
 - 2. Carboline.
 - 3. Ameron International Performance Coatings and Finishes Group.
 - 4. The Sherwin-Williams Company.
 - 5. International Paint, LLC.
 - 6. ICI Devoe High Performance Coatings.
 - 7. Plasite Protective Coatings.
- B. Applicator's Qualifications: Applicators must be qualified in this line of work and have a minimum of 5 years' experience in the application of the protective coatings of the types specified herein. Submit a list of recent projects and names of references for those projects.
- C. Product Quality:

1. Use only the coatings specified in this Section. Use only those thinners and solvents recommended by the manufacturer, only in the amounts necessary to produce the manufacturer's recommended spreading rate, and in amounts not exceeding the maximum quantities stated in the manufacturer's literature.
 2. The coating material shall not show excessive settling in a freshly opened full can and shall be easily re-dispersed with a paddle to a smooth, homogeneous state. It shall show no curdling, livering, caking, or color separation and shall be free of lumps or skim surfaces.
- D. Testing: Protective coatings shall be applied under quality control procedures, which include inspection of surface preparation and for each coat. Do not proceed with the next step until the Engineer has approved the previous step. The Contractor shall be solely responsible for testing for this Section, at no further cost to the Owner. The Engineer shall also make such tests if it is considered necessary. Cooperate with the Engineer, providing equipment, scaffolds, and other equipment as requested by the Engineer.
- E. Testing Equipment: Furnish the testing apparatus necessary for testing coatings, including the following:
1. One set of U.S. Department of Commerce thickness calibration plates, certified by the National Bureau of Standards, to test dry film thickness.
 2. Five wet-film thickness gauges. Give one to Owner's representative. Each painter shall keep one to test paint as it is applied.
 3. One dry-film thickness gauge, Mikrotest III, 0 - 40 mils with calibration standard approved by the Bureau of Standards.
 4. One Bacharach Sling Psychrometer, Model 12-7011.
 5. Tinker and Rasor Model M 1 Holiday Detector and recommended wetting agent.
 6. One set of SSPC VIS 1-89 Visual Standards for Abrasive Blast Cleaned Steel.
- F. Testing Reports: Submit an inspection report for each coating applied on the Project. The testing report shall be completed on a form furnished by the Engineer and shall bear the signature of the Contractor and the Owner's representative.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with Section 01 33 00 "Submittal Procedures" and shall include:
1. Manufacturer's Product Data sheet for each paint type, including surface preparation requirements, recommended spreading rates, application procedures, recommended primers, and other instructions.
 2. Color charts of each paint type.
 3. .

1.04 STANDARDS

- A. The applicable provisions of the following standards shall apply as if written here in their entirety:

1. American National Standards Institute (ANSI), 25 West 43rd Street, New York, NY. 10036
 2. National Association of Corrosion Engineers (NACE), 1440 South Creek Drive, Houston, TX. 77084-4906
 3. Occupational Safety and Health Administration (OSHA), U.S., Department of Labor, 200 Constitution Avenue, NW, Washington DC 20210
 4. The Society for Protective Coatings, 40 24th Street (SSPC), 6th Floor, Pittsburgh, PA. 15222-4656
- B. In the event of a conflict between the published standards, codes, and this Section, the more stringent requirement shall govern.

1.05 DELIVERY AND STORAGE

- A. Deliver coating products to the Site in original unopened containers, with manufacturer's label and batch number attached. Do not apply products until the Owner's field representative has approved the product for use.
- B. Use one location at each site for the storage of coating products. Protect the floor from spills and other damage. Protect the products from extreme heat or cold. Keep containers covered. Keep the storage rooms clean of trash and debris. Dispose of oily or used rags daily. Under no circumstances shall they be allowed to accumulate. Take precautions to prevent fires. The storage of flammable liquids shall comply with the City, State, or other fire codes.

1.06 JOB CONDITIONS

- A. It is desired that the paint products be furnished by as few manufacturers as possible to meet the requirements of the Specifications. Coating products of the same type shall be supplied by the same manufacturer. Do not mix products from different sources. Apply finish coats in the field. The Owner shall select colors.
- B. Primers factory-applied to equipment shall be those specified. Where possible, notify manufacturers which shop prime coats will be required in order to be compatible with field-applied finish coats. Where equipment is purchased which has the manufacturer's standard primer or a factory finish which is other than as specified in this section, remove the factory-applied paint system or apply passivators or other special coatings as required to make the surface compatible with the finish coat specified.
- C. Do not apply any coating to machinery, piping, or other surfaces before testing has been completed and systems approved. Any damage to coatings resulting from subsequent corrective procedures shall be stripped back to bare metal and repainted with the appropriate paint system as directed by the Engineer.
- D. Surfaces which will be inaccessible after installation shall be coated prior to installation, or shall be coated and approved in stages as the work is installed.
- E. The Engineer shall approve surfaces for application of coatings at each stage. Any material that is coated prior to the Engineer's approval shall be stripped back to bare metal and repainted.

- F. At least 1 week shall be allowed for drying of finished surfaces before any machinery can be placed into service.
- G. Do not apply coating over nameplates or other identification plaques. Mask such plates and keep protected. Remove tape and polish nameplates after painting is complete.
- H. Environmental Conditions:
 - 1. Do not apply coatings under conditions that are unsuitable for the production of good results. Remove trash and debris from enclosed buildings and thoroughly clean prior to application of coatings. Do not begin application of coatings in areas where other trades are working, or where construction activities result in airborne dust or other debris. Do not apply coatings in conditions which do not conform to the recommendations of the coatings manufacturer.
 - 2. Coatings shall only be applied when conditions fall within the parameters listed in the manufacturer's printed data.
 - 3. Do not apply any coatings when weather conditions are unfavorable. In the event that climatic conditions are not conducive for best results, postpone application of coatings until conditions conform to the manufacturer's recommendations and the provisions of this Section. Do not apply coatings to a wet or damp surface in wet or damp weather conditions, or when there is dust in the air. Surfaces exposed to direct sunlight shall be shaded by awnings or other protective devices while coatings are being applied. When necessary, provide temporary heating devices of a type that produces no fumes which will discolor the paint system.
 - 4. Apply coatings to surfaces which will be under water constantly or which periodically will be under water during operation of the Project in accordance with requirements for submerged structures to a point 1 foot above the maximum water level. Mask the line of demarcation between the coating systems to a straight level line.
- I. Working Conditions:
 - 1. Provide adequate lighting at any location that coatings are being applied or testing is performed. Illumination shall be of sufficient intensity to achieve good results. Provide explosion-proof lighting when required.
 - 2. Temporary ladders and scaffolds shall conform to applicable safety requirements. Erect temporary scaffolds where needed to cover large areas. Provide ladders or scaffolding during testing procedures.

1.07 GUARANTEES

- A. Protective coating shall be guaranteed for a period of 1 year from the date of the Owner's acceptance of the Project.
- B. A warranty inspection shall be conducted in the eleventh month following completion of painting and coatings. Any defective work discovered at this date shall be corrected by the Contractor in accordance with the Contract Documents at no additional cost to the Owner. Other corrective measures may be required during the 1 year warranty period.

2.00 PRODUCTS

2.01 MATERIALS

- A. Materials shall be the manufacturer's top of line quality products, as listed herein. Products used on this project shall be as indicated below. Primers and finish coats shall be manufactured by the same manufacturer. Coatings shall be from the same batch. Products shall be as follows:

Type A	Alkyd-Phenolic Universal Primer
Tnemec	Series 1 Purple Prime
Sherwin-Williams	Kem Kromik Universal
International Paint, LLC	Interlac 573
ICI Devoe	Devguard 4165
Carboline	Rustbond 8HB
Ameron	Amercoat 185HS

Type B	Epoxy-Polyamide Primer
Tnemec	Series 66
Sherwin-Williams	Copoxy Primer
International Paint, LLC	Intergard 251; Intergard 269 for valves and gates, submerged structural steel and misc. metals, and submerged piping
ICI Devoe	Debran 201
Carboline	893
Ameron	Amerlock 400/2

Type C	Alkyd Enamel
Tnemec	Series 23 Enduratone
Sherwin-Williams	DTM Alkyd Enamel
International Paint, LLC	Interlac 665
ICI Devoe	Devguard 4308
Carboline	DTM58
Ameron	Amercoat 5450

Type D	Epoxy-Polyamide Coatings
Tnemec	Series 66
Sherwin-Williams	Macropoxy 646 Epoxy
International Paint, LLC	Intergard 475HS; Interseal 670HS for valves and gates, PVC pipe and conduit, submerged structural steel and misc. metals, and submerged piping

ICI Devoe	Devran 224 HS
Carboline	890
Ameron	Amercoat 395FD

Type E	Epoxy-Polyamide Coatings for Potable Water
Tnemec	Series N140 Pota-Pox Plus
Sherwin-Williams	Tank Clad Epoxy
International Paint, LLC	Interline 850 or Interseal 670HS (NSF colors)
ICI Devoe	Bar-Rust 233H
Carboline	891
Ameron	Amerlock 400/2

Type F	Epoxy-Polyamide Coatings for Walking Surfaces
Tnemec	Series 66 Hi-Build Epoxoline
Sherwin-Williams	Tile Clad HS
International Paint, LLC	Interseal 670HS
ICI Devoe	Devoe AST 250 Non-Skid
Carboline	890
Ameron	Amerlock 400/2 w/886 Non-Skid Additive

Type G	High Build Acrylic Polyurethane Enamel
Tnemec	Series 73 Endura-Shield
Sherwin-Williams	Hi-Solids Polyurethane
International Paint, LLC	Interthane 870HS
ICI Devoe	Devthane 359
Carboline	133HB
Ameron	Amercoat 450H

Type H	Aliphatic Polyurethane Enamel
Tnemec	Series 1074 Endura-Shield II
Sherwin-Williams	Hi-Solids Polyurethane
International Paint, LLC	Interthane 990HS
ICI Devoe	Devthane 379UVA
Carboline	134HS
Ameron	Amercoat 450H

Type I	Modified Acrylic Coatings
Tnemec	Series 29 Tuferyl
Sherwin-Williams	DTM Acrylic
ICI Devoe	Devflex 4206
Ameron	Amercoat 220
Carboline	3359
International Paint, LLC	Intercryl 520

Type J	Silicone Aluminum Coatings For High Temperature
Tnemec	Series 39 Silicon Aluminum
Sherwin-Williams	Silver Brite Aluminum B59S8
International Paint, LLC	Intertherm 50
ICI Devoe	Devoe HT-12
Ameron	Amercoat 878
Carboline	4674

Type K	Epoxy Concrete Coating
Tnemec	Series 64H-413 Hi-Build Tneme-Tar
Sherwin-Williams	Tar Guard Epoxy
International Paint, LLC	Interzone 954
ICI Devoe	Devtar 247
Ameron	Amercoat 78HB Coal Tar Epoxy

Type L	Epoxy Concrete Coating – HFS
Tnemec	Series 434/435 Perma-Shield System

2.02 COLOR SELECTION

- A. The color chart shall include the complete available range of colors, including tints and shades. The Owner shall select the colors.
- B. Use a multi-color system coating for any surface receiving more than one coat. Each coat shall be tinted differently from the preceding coat in a manner that will allow the various coats to be easily distinguished. Colors shall generally be from light to dark shades, but the Contractor may have the option to select tint shades to ensure coats will receive adequate coverage without bleeding or otherwise showing through the preceding coat.
- C. Piping and equipment shall be color coded in accordance with the requirements of the Texas Commission on Environmental Quality (TCEQ).

3.00 EXECUTION

3.01 PREPARATION

- A. Thoroughly clean surfaces before applying coating. Where field cleaning is required, apply one coat of shop primer to the surface to protect the surface until field cleaning is performed.
- B. Each surface shall have a primer, except in the instance where field cleaning is required and the manufacturer's printed literature states that the coating may be applied without a primer and approval of the Engineer is obtained. Shop-applied primer shall be thoroughly cleaned of oil, grease, and other contaminants, and nicks or other defects shall be spot-primed before subsequent coats are applied.
- C. Thoroughly clean surfaces that are blasted of abrasive material, and apply coating to surfaces before any corrosion occurs on the surface. Apply coatings no later than the same day they are blasted. In the event that surfaces are not coated immediately after cleaning, and rust reforms on the blasted surfaces, re-blast surfaces. Remove abrasives used in the blasting operations, rust, scale, and other foreign materials accumulating from the cleaning operations from the Site. Sweep abrasive blasted surfaces clean after blasting is complete.
- D. The adequacy of the preparation of surfaces shall be determined by comparing the surface with SSPC Vis 1 "Pictorial Surface Preparation Standards for Painting Steel Surfaces."
Prepare surfaces in accordance with the following requirements:
 - 1. Type SP1 Near White Blasting: Surfaces shall receive one coat of sacrificial rust inhibitive shop primer to protect the surfaces until time for cleaning and preparation of surfaces at the Site. Metal surfaces shall be cleaned to a "Near White" condition by abrasive blasting in accordance with SSPC SP10 "Near White Blast Cleaning", using 16 to 35 mesh grit. Take precautions to prevent gouging and channeling of metal. The resulting surface profile shall be in accordance with the coating manufacturer's recommendations. Protect soft metal parts, gears or other parts of the equipment that may be damaged by the cleaning process or by the introduction of grit or dust. Replace any oils or lubricants that are contaminated by the cleaning process.
 - 2. Type SP1A: Equipment that contains mechanical parts that would be damaged by field cleaning may be factory-blasted to a "Near White" condition by abrasive blasting before the equipment is assembled. Apply a single coat of primer that is compatible with the next coat to the surface and allow to thoroughly cure before assembly or shipping. This type of surface preparation may only be performed on the sensitive components. All other components will be prepared in accordance with Type SP1 Near White Blasting.
 - 3. Type SP2 Commercial Blast Cleaning: Thoroughly clean metal surfaces of mill scale, rust, and other foreign matter by abrasive blasting to gray metal in accordance with SSPC SP6 "Commercial Blast Cleaning." Perform abrasive blasting after erection, unless otherwise approved by the Engineer.
 - 4. Type SP3 Concrete Surfaces: Thoroughly cure concrete surfaces prior to application of coatings. Allow a minimum of 30 days curing time to elapse before coatings are applied. Concrete surfaces which are scheduled to receive coatings shall be dry and shall be prepared by light abrasive blasting in accordance with SSPC SP7 "Brush Blast Cleaning."

Blasting shall be sufficient to remove dirt, dust, efflorescence, oil, grease, stains, and other foreign matter and shall provide adequate surface roughening for good adhesion.

5. Type SP4 Shop Preparation of Metal Surfaces: Exterior metal surfaces, except those specified for field preparation, may be shop cleaned by blasting to a gray metal finish in accordance with SSPC SP 6 "Commercial Blast Cleaning", as described above. The blasted surface shall be primed immediately as scheduled.
6. Type SP5 Field Preparation of Shop Primed Surfaces: Slag and weld metal accumulations and splatters not removed by the fabricator shall be removed in the field by chipping or grinding. Sharp edges shall be peened, ground or otherwise blunted. Areas adjacent to welds or any area where shop primer has been damaged shall be thoroughly cleaned in accordance with SSPC SP2 "Hand Tool Cleaning" preparation and reprimed. In order to prevent injury to surrounding painted surfaces, blast cleaning may require the use of a lower air pressure, a shorter blast distance to the surface, and shielding and masking. If damage is too extensive or uneconomical to touch up, the entire item shall be recleaned and coated in accordance with the provisions of this Section. Welds and irregular surfaces shall receive a field coat of the specified primer prior to the application of the first field coat.

3.02 APPLICATION

- A. Surface preparation and application of coatings shall be in accordance with applicable standards of the Society for Protective Coatings (SSPC) and the manufacturer's recommendations. Do not apply the prime coat until the Owner's field representative is notified and approval is obtained for the surface preparation. Coating shall be applied by skilled workmen and shall be brushed out or sprayed evenly, without runs, crazing, sags, or other blemishes. Apply coating by brush or spray as noted in the Specifications.
- B. Apply the first coat to the surface, including cutting in around edges, before the second coat is applied. The second coat and any successive coats shall not to be applied before notifying the Owner's field representative and obtaining approval. Each coat shall be tested before the successive coat is applied.
- C. Each coat shall be thoroughly dry before application of the successive coat. The full drying time recommended by the manufacturer shall be allowed. Sand enamel between coats.
- D. Protect adjacent materials from damage, including over spray or spillage. Provide drop cloths or other protective tarps to cover floors, equipment or other adjacent materials.

3.03 PIPE PAINTING

- A. Paint piping exposed or occasionally exposed to the atmosphere in any location in the plant. Paint shall be of the appropriate type for the pipe material as specified.
- B. Paint color shall be as follows:

Pipe System Description	Color
Sludge	Brown
Gas	Red

Pipe System Description	Color
Potable Water	Blue
Chlorine	Yellow
Sewage	Grey
Compressed Air	Green
Heating Water	Blue w/6" Red Band spaced 30" apart
Power Conduit	Orange

3.04 FIELD QUALITY CONTROL

- A. Field Tests: Make wet film tests during painting operations to assure proper thicknesses of coating are being applied. After each coat has been applied, test the paint film thickness with a nondestructive, magnetic type thickness gauge. The total dry-film thickness for each coat shall not be less than 75 percent of the amount specified. If the thickness is less than 75 percent, apply additional coats until the total specified thickness is obtained. The total thickness after the final coat has been applied shall be 100 percent of the thickness specified, minimum. Apply additional coats until the specified thickness is reached or exceeded.
- B. Holiday Testing: Test the entire surface of coated submerged metal structures with a holiday detector. For thickness between 10 and 20 mils (250 to 500 microns) a non-sudsing type wetting agent, as recommended by the holiday detector manufacturer shall be added to the water prior to wetting the detector sponge. Mark and repair pinholes in accordance with the manufacturer's printed instructions, then retest pinholes. No pinholes or other irregularities shall be permitted in the final coats. Areas containing holidays shall receive additional coats until tests indicate no holidays.

3.05 CLEAN AND ADJUST

- A. Promptly remove trash and debris resulting from painting operation from the Site. Remove drop cloths, masking tapes and other protective coverings. Remove paint spills, splatters, overlap of paint from adjacent material and other defects. Spot paint nicks and other defects.
- B. Remove paint containers and waste products. Thoroughly clean paint storage rooms, removing spilled paint from walls and floors.

3.06 SCHEDULES

- A. Protective coatings shall be applied in accordance with the following paint schedule:

PROTECTIVE COATINGS PAINT SCHEDULE

SPEC NO.	PREP NO.	SURFACE DESCRIPTION	APPLICATION	TYPE	SHEEN	NO. OF COATS	PRODUCT TYPE	DFT (MILS)
SS-1	SP2 or SP4	Structural Steel Exterior and Interior	Brush or Spray	Alkyd Pheonolic	Gloss	1	TYPE A	2.0
						2	TYPE C	3.0
						3	TYPE C	3.0
						Total Dry Film Thickness		8.0 mils
SS-2	SP2 or SP4	Equipment, Pumps, Motors, Valves and Piping Interior and Exterior	Brush or Spray	Arcylic Polyurethane	Gloss	1	TYPE B	2.0
						2	TYPE D	4.0
						3	TYPE G	3.0
						Total Dry Film Thickness		9.0 mils
SS-3	SP2 or SP4	Structural Steel and Miscellaneous Metals Above Water Surfaces	Brush or Spray	Acrylic Polyurethane	Gloss	1	TYPE B	2.0
						2	TYPE D	5.0
						3	TYPE G	3.0
						Total Dry Film Thickness		10.0 mils
SS-4	SP1	Structural Steel and Miscellaneous Metals Submerged	Brush or Spray	Epoxy Polyamide	Gloss	1	TYPE B	2.0
						2	TYPE D	5.0
						3	TYPE D	5.0
						Total Dry Film Thickness		12.0 mils
SS-5	SP1	Piping Submerged	Brush or Spray	Epoxy Polyamide	Gloss	1	TYPE B	2.0
						2	TYPE D	5.0
						3	TYPE D	5.0
						Total Dry Film Thickness		12.0 mils
SS-6	SP1A	Valves and Gates	Brush or Spray	Epoxy Polyamide	Gloss	1	TYPE B	2.0
						2	TYPE D	5.0
						3	TYPE D	5.0
						Total Dry Film Thickness		12.0 mils
SS-7	SP1	Water Storage Tanks Submerged or Above Water	Brush or Spray	Epoxy Polyamide	Gloss	1	TYPE E	6.0
						2	TYPE E	6.0
						Total Dry Film Thickness		12.0 mils
						Total Dry Film Thickness		12.0 mils

SPEC NO.	PREP NO.	SURFACE DESCRIPTION	APPLICATION	TYPE	SHEEN	NO. OF COATS	PRODUCT TYPE	DFT (MILS)
SS-8	SP2	Water Storage Tanks Exterior	Brush or Spray	Epoxy Polyamide Polyurethane	Gloss	1 2 3	TYPE B TYPD D TYPE H	2.0 5.0 2.5
						Total Dry Film Thickness		9.5 mils
SS-9	SP3	Concrete Floor Surfaces of Chemical Storage Area Interior	Brush or Spray	Epoxy Polyamide	Gloss	1	TYPE F	5.0 mils
SS-10	SP3	Concrete Surfaces as follows: N/A	Brush or Spray	Epoxy Coating	Text.	1	TYPE K	14.0 mils
SS-11	SP1	High Temperature Surfaces	Brush	Silicone	Alum.	1 2	TYPE J TYPE J	1.5 1.5
						Total Dry Film Thickness		3.0 mils
SS-12	SP4	Electrical Equipment Exterior	Brush	Alkyd Enamel	Gloss	1 2 3	TYPE A TYPE C TYPE C	2.0 3.0 3.0
						Total Dry Film Thickness		*
SS-13	*	PVC Pipe and Conduit Exterior and Interior	*	*	*	*	*	*
						Total Dry Film Thickness		*

END OF SECTION

15065 HDPE PIPING

1.00 GENERAL

1.01 WORK INCLUDED

- A. Furnish labor, materials, equipment and incidentals necessary to install polyethylene pipe, and complete installation in accordance with the Contract Documents. The finished pipe shall be continuous over the entire length of the sewer between manholes and be free from defects.

1.02 QUALITY ASSURANCE

- A. Polyethylene pipe jointing shall be performed by personnel trained in the use of the thermal butt-fusion equipment and recommended methods for new pipe connections. Personnel directly involved with installing the new pipe shall have received training in the proper methods for handling and installing the polyethylene pipe. Training shall be performed by a qualified representative of the pipe manufacturer. The Contractor shall maintain records of trained personnel, and shall certify that training was received not more than 12 months before commencing construction.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with Section 01 33 00 "Submittal Procedures" and shall include:
1. Shop Drawings, catalog data, and manufacturer's technical data showing complete information on material composition, color, physical properties, and dimensions of new pipe and fittings. Include manufacturer's recommendation for handling, storage, and repair of pipe and fittings.

1.04 STANDARDS

- A. Comply with local governing regulations if more stringent than specified herein. Piping shall meet the following standards and shall be a part of this Section as if written here in their entirety.
1. American Society for Testing and Materials (ASTM) Standards:

ASTM F1473	Test Method for Notch Tensile Test to Measure the Resistance to Slow Crack Growth of Polyethylene Pipes and Resins
ASTM D2122	Determining Dimensions of Thermoplastic Pipe and Fittings
ASTM F2620	Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
ASTM D2837	Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
ASTM D3035	Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter (up to 3-Inch IPS)
ASTM D3350	Specification for Polyethylene Plastics Pipe and Fittings Material
ASTM F714	Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter (4-Inch IPS and larger)

2. American Water Works Association (AWWA) Standards:

AWWA C906	Polyethylene (PE) Pressure Pipe and Fittings, 4 through 64 Inches, for Water Distribution
AWWA M55	Polyethylene (PE) Pipe Design and Installation

- B. Domestic water piping shall be approved by the Underwriters Laboratory and shall be accepted by the State Fire Insurance Commission for use in water distribution systems. HDPE water pipe shall bear the seal of approval (or “NSF” mark) of the National Sanitation Foundation Testing Laboratory for potable water pipe.

1.05 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

- A. Transport, handle, and store pipe and fittings as recommended by manufacturer.
- B. If new pipe and fittings become damaged before or during installation, it shall be repaired as recommended by the manufacturer or replaced as required by the Owner’s Project Representative at the Contractor’s expense, before proceeding further.
- C. Deliver, store, and handle other materials as required to prevent damage.

2.00 PRODUCTS

2.01 MATERIALS

- A. Pipe: Polyethylene Plastic Pipe shall be high density polyethylene pipe (HDPE).
1. Appropriate for use as a gravity sanitary sewer and meet the applicable requirements of ASTM F714 “Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter”, ASTM D3350, Ductile Iron Pipe Sizing.
 2. Solid wall high density polyethylene for pressure water pipe shall meet the requirements of AWWA C906 “Polyethylene (PE) Pressure Pipe and Fittings, 4 through 64 Inches, for Water Distribution” (Ductile Iron Pipe Sizing).
- B. All pipe shall be made of virgin material. No rework except that obtained from the manufacturer’s own production of the same formulation shall be used.
1. The pipe shall be homogenous throughout and shall be free of visible cracks, holes, foreign material, blisters, or other deleterious faults.
 2. Dimension Ratios: The minimum wall thickness of the polyethylene pipe shall meet the following:
 - a. Pressure Applications: AWWA C906 DR-13.5 Pressure Class 128 psi, DR-11 Pressure Class 160, DR-9 Pressure Class 200 – DR-7.3 Pressure Class 254.
 3. All HDPE shall be carbon black or solid gray stabilized throughout the structural wall for ultra-violet protection. The pipe shall have a near white inside diameter to facilitate future TV inspection.
- C. Polyethylene Fittings: The polyethylene fittings shall be manufactured from a polyethylene compound which conforms to ASTM D3350 cell class PE445574C or E material. Fittings shall be manufactured by the same manufacturer as the pipe.

1. Pipe fittings shall have a long-term hydrostatic strength rating of 1600 psi or more at 23 degrees Celsius, in accordance with ASTM D2837.
 2. Environmental stress crack resistance (ESCR) of the material shall meet the requirements as specified in ASTM D3350 Cell Classification of 7 for a 500-hour PENT material using ASTM F1473 (PENT).
- D. Select Material: Selected or processed excavated trench material shall be Class 10 Aggregate Fill in accordance with Section 31 23 33 "Trenching and Backfill [Utilities]."

2.02 MATERIALS TEST

- A. Tests for compliance with this Section shall be made as specified herein and in accordance with the applicable ASTM Specification. A certificate of compliance with ISO 9000 shall be furnished, by the manufacturer for all material furnished under this Section. Polyethylene plastic pipe and fittings may be rejected for failure to meet any of the requirements of this Section.

3.00 EXECUTION

3.01 HANDLING

- A. The joints shall be handled near the middle with wide web slings and spreader bars. Rope slings also work well with straight lengths. The use of chains, end hooks or cable slings that may scar the pipe are not permitted. The following procedures shall be observed when handling HDPE pipe.
1. Always stack the heaviest series of pipe at the bottom.
 2. Protect the pipe from sharp edges when overhanging the bed of a truck or trailer by placing a smooth, rounded protecting strip on the edge of the bed.
 3. The load should be anchored securely to prevent slippage.
- B. Lengths of small-diameter, lightweight pipe can be unloaded manually.
- C. Pipe applications shall normally be handled by:
1. Unloading the pipe from the truck in a row along the side of the installation area and moving the fusion unit along the row of joints.
 2. Stacking the pipe beside the fusion unit and trailing the pipe out after fusion, then dragging the long length of pipe into place for installation. It is suggested that as the pipe is fused and moved through the fusion machine, additional joints of pipe should be placed in the moveable jaw side of the machine for each subsequent fusion. This prevents the hydraulic system of the machine from having to pull the previously fused long length.
- D. Dragging the pipe into place is permitted provided the pipe isn't damaged from sharp rocks or excessive abrasion created by pulling the pipe great distances.

3.02 STORAGE

- A. If the pipe must be stacked for storage, avoid excessive stacking heights. Out-of-roundness can be created in the lower rows of pipe, due to excessive stacking heights. The limitation

on storage height is 8 rows for pipe 6 inches or less, 3 rows for pipe 8 inches or less, 2 rows for pipe 32 inches or less and 1 row for pipe 63 inches or less.

- B. Care shall be taken to ensure that the pipe is stacked in straight rows. The expansion and contraction caused by uneven heating by the sunlight shall be prevented by restraining the racks.
- C. Pipe laid directly on the ground shall be placed on an area free of loose stones or sharp objects. Scarring or gouging of the pipe shall be avoided.

3.03 PIPE JOINING

- A. The polyethylene pipe shall be assembled and joined at the Site using the thermal butt-fusion method to provide a leak proof joint. Threaded or solvent-cement joints and connections are not permitted. All equipment and procedures used shall be in strict compliance with the manufacturer's recommendations. Fusing shall be accomplished by personnel certified as fusion technicians by a manufacturer of polyethylene pipe and/or fusing equipment.
- B. The butt-fused joint shall be in true alignment and shall have uniform roll-back beads resulting from the use of proper temperature and pressure. The joint shall be allowed adequate cooling time before removal of pressure. When cool, all weld beads shall then be removed from both the inside and outside surface such that the joint surfaces shall be smooth. The fused joint shall be watertight and shall have a tensile strength equal to that of the pipe. All joints shall be subject to acceptance by the Owner's Project Representative. All defective joints shall be cut out and replaced at no cost to the Owner. Any section of the pipe with a gash, blister, abrasion, nick, scar or other deleterious fault greater in depth than 10 percent of the wall thickness, shall not be used and must be removed from the Site. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above. In addition, any section of pipe having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness or any other defect of manufacturing or handling as determined by the Owner's Project Representative shall be discarded and not used.

3.04 BENDING PIPE

- A. HDPE may be cold-bent to a minimum radius of 40 times the pipe diameter as it is installed, eliminating the need in many cases for elbows for slight bends. The minimum bending radius that can be applied to the pipe without kinking varies with the diameter and wall thickness of the pipe. Contractor shall conform to manufacturer's recommendations. If adequate space is not available for the required radius, a fitting of the desired angle shall be fused into the piping system to obtain the necessary change in direction.

3.05 INSTALLATION BELOW GROUND

- A. Pipe Laying:
 - 1. When pulling pipe, either a pulling head or a suitable wraparound sleeve with rubber protective cover shall be used to prevent the pulling cables from damaging the pipe. The pipe shall not be pulled by the flanged end.

2. Open cut installations shall be in accordance with Section 31 23 33 "Trenching and Backfill [Utilities]."
- B. Grouting (Continuous or at Manholes): Pipe running through a manhole wall shall be anchored by attaching a collar or side fused branch saddles to the pipe and encasing them in the wall of the manhole.

3.06 FIELD QUALITY CONTROL

- A. Testing shall be as specified in Section 01 40 00 "Quality Requirements."
- B. Hydrostatic Testing for pressure piping systems shall be performed in accordance with ASTM F2164. Testing pressure shall not exceed 1.5 times the system design pressure and total testing time including the time required to pressurize, stabilize, hold test pressure, and depressurize should not exceed 8 hours. If 5 psi is lost during testing pipeline must be re-pressurized.
- C. Air testing of gravity piping systems shall be performed in accordance with ASTM F1417. The specified rated test pressure shall be maintained for 10 minutes to 1 hour (dependent on pipe diameter and according to ASTM F1417), but not more than 1 hour. Test pressure ratings shall not be exceeded. Consult pipe manufacturer for maximum allowable test pressure.
- D. HDPE pipe deflection shall not exceed deflection percentages identified in ASTM F1962 or manufacturer's maximum allowable deflection, whichever is lower. Allowable pipe deflection varies based on DR rating. The following maximum deflection percentages can be used for the following DR ratings: DR21 – 7.5 percent, DR17 – 6.0 percent, DR15.5 – 6.0 percent, DR13.5 – 6.0 percent, DR11 – 5.0 percent, DR9 – 4.0 percent, DR7.3 – 3.0 percent. Deflection measurements can be taken by mandrel or by measurement of inside diameter before and after backfill operations.
- E. Do not enclose or cover any Work until inspected.

3.07 CLEAN AND ADJUST

- A. Remove surplus pipeline materials, tools, rubbish and temporary structures and leave the construction site clean, to the satisfaction of the Owner's Project Representative.

END OF SECTION

15096 ECCENTRIC PLUG VALVES

1.00 GENERAL

1.01 WORK INCLUDED

- A. Furnish labor, materials, equipment and incidentals necessary to install eccentric plug valves.

1.02 QUALITY ASSURANCE

- A. Acceptable Manufacturers:
 - 1. DeZurik.
 - 2. Pratt.
 - 3. Val-Matic.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 "Submittal Procedures" and shall include:
 - 1. Shop drawings
 - 2. Operation and Maintenance Manuals.

1.04 STANDARDS

- A. The applicable provisions of the following standards shall apply as if written here in their entirety:
 - 1. American Water Works Association (AWWA) Standards:

ANSI B16.1	Standard for Cast Iron Pipe Flanges and Flanged Fittings
AWWA C110	Standard for Ductile-Iron and Grey-Iron Fittings
AWWA C111	Standard for Rubber Gasket Joints for Ductile Iron Pipe and Fittings
AWWA C517	Standard for Resilient Seated Cast-Iron Eccentric Plug Valves
ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

2.00 PRODUCTS

2.01 MATERIALS

- A. Valve Bodies: Constructed of cast iron, ASTM A126, Class B, in accordance with AWWA C517.
- B. Flanges: Class 125 conforming to ANSI B16.1 standard for cast-iron flanges.
- C. Mechanical Joint Ends: For buried service shall be to AWWA Standard C111.
- D. Nuts, Bolts, Springs, Washers, etc.: Type 316 Stainless Steel.

- E. Resilient Plug Facings: Neoprene, nitrile rubber, BUNA-N, or approved equal.
- F. Mating Surface: Overlaid with thick, welded and machined nickel alloy.
- G. Valve Boxes: Three piece cast iron extension type, Mueller No. 10380 or Clow F2450, with No. 6 round base. The three pieces shall consist of the top section, center section, and base plus the cover.

2.02 ECCENTRIC PLUG VALVES

- A. Eccentric valves shall be non-lubricated quarter-turn type with resilient faced plugs. Unless otherwise indicated, buried valves shall be furnished with mechanical joint ends and exposed valves shall be furnished with flanged ends. Valves shall have a minimum nominal port area of 80 percent of the pipe for valve sizes up to 20 inches.
- B. Valves 6 inches and smaller shall be wrench operated unless otherwise shown or scheduled. Supply a wrench operator for each wrench operated valve. Valves shall be supplied with a handwheel. Valves shall have seals on shafts and gaskets on the valve operator covers to prevent the entry of water.

2.03 VALVE COATING AND LINING

- A. COATING: All Valves shall be cleaned to a bright metal and given a shop coat of rust inhibitive primer. Primer shall be coordinated with field painting to ensure compatibility. The exterior coating on the valve shall be in accordance with Specification Section 09905, "High-Performance Coatings".
- B. The interior of the valve shall be lined by the manufacturer with factory installed Protecto 401 Ceramic Epoxy Lining by Enduron or American Polybond Plus (fusion bonded epoxy and fusion bonded polyethylene) or an approved equal. Lining primers, applications, and thicknesses shall be in accordance with manufacturer's recommendations for sanitary sewer applications, but shall not be less than 40 mils.

3.00 EXECUTION

3.01 INSTALLATION

- A. Carefully handle and lower valves into position in such a manner as to prevent damage to any part of the valves. Place the valve in the proper position with stem truly vertical or horizontal as the case may be. Furnish bolts and gaskets for flange connections. Adjust the valve boxes to the proper length to conform with the ground surface.

END OF SECTION

15101 GATE VALVES

1.00 GENERAL

1.01 WORK INCLUDED

- A. Furnish labor, materials, equipment and incidentals necessary to install gate valves and appurtenances, including valve boxes, operators, bolts, nuts and gaskets.

1.02 QUALITY ASSURANCE

- A. Acceptable Manufacturers:
1. American-Flow Control.
 2. East Jordan Iron Works.
 3. Mueller.
 4. Clow.
 5. Kennedy Valve.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 "Submittal Procedures" and shall include:
1. Shop Drawings.
 2. Operation and Maintenance Manuals.

1.04 STANDARDS

- A. The applicable provisions of the following standards shall apply as if written here in their entirety:

1. American National Standards Institute (ANSI) Standards:

ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings

2. American Society for Testing and Materials (ASTM) Standards:

ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A536	Standard Specification for Ductile Iron Castings

3. American Water Works Association (AWWA) Standards:

AWWA C111	Rubber-Gasket Joints
AWWA C500	Gate Valves for Water and Sewage Systems
AWWA C515	Reduced-Wall, Resilient Seated Gate Valves for Water and Sewage Systems

2.00 PRODUCTS

2.01 GATE VALVES

A. General:

1. Gate valves shall be parallel seat internal wedging type with non-rising stem. Unless otherwise specified, gate valves 3 through 24 inches in size shall be in accordance with AWWA C515, Resilient Wedge.
- B. Gate: Gate for double disc valves shall be cast iron with bronze mounted wedges and seats. Gate for resilient seated valves shall be cast iron with rubber-seat compound bonded to the valve gate.
- C. Operators: Operators shall turn counterclockwise to open the valve. Exposed valves shall have handwheel operators unless otherwise designated. A directional arrow and the word "open" shall be cast on the handwheel. Valves for buried service shall have a 2-inch square nut operator and shall be installed with extension stems where required to extend operating nut to within 12 inches of the finished grade. Provide a cast iron valve box to enclose the operating stem. Valve box shall be three-piece extension type equal to Mueller No. 10380 or Clow F2450.
- D. Stem and Seal: The non-rising stem shall be bronze with inside screw. Shaft seal shall employ O-rings or V-type packing.
- E. Bell Ends: Where designated, valves shall be mechanical joint or rubber gasketed push on joints in accordance with the applicable requirements of AWWA C111.
- F. Lining: The interior of the valve shall be lined by the manufacturer with factory installed Protecto 401 Ceramic Epoxy Lining by Enduron or American Polybond Plus (fusion bonded epoxy and fusion bonded polyethylene) or an approved equal. Lining primers, applications, and thicknesses shall be in accordance with manufacturer's recommendations for sanitary sewer applications, but shall not be less than 40 mils.

3.00 EXECUTION

3.01 INSTALLATION

- A. Carefully handle and lower buried valves into position to prevent damage to any part of the valves. Place the valve in the proper position with stem truly vertical and securely hold until connections have been made. Furnish bolts, nuts, and gaskets. The Contractor shall be responsible for adjusting the valve boxes to the proper length to conform with the ground surface.

3.02 FIELD QUALITY CONTROL

- A. Upon completion of installation of the equipment, an acceptance test to verify the satisfactory operation of each unit shall be conducted. The test shall be conducted in a manner approved by and in the presence of the Engineer. The unit shall be checked for general operation and leakage. The unit must perform in a manner acceptable to the Engineer before final acceptance will be made by the Owner.

END OF SECTION

15111 SWING CHECK VALVES

1.00 GENERAL

1.01 WORK INCLUDED

- A. Furnish labor, materials, equipment and incidentals necessary to install swing check valves (external weight and lever) at the locations and size as indicated. Valves shall be designed, manufactured and tested in accordance with American Water Works Association Standards ANSI/AWWA C508.

1.02 QUALITY ASSURANCE

- A. Acceptable Manufacturers:
 - 1. APCO Valve & Primer Corporation.
 - 2. Golden Anderson Equal Model.
 - 3. Val-Matic.
- B. Experience Requirements: The Manufacturer shall have had successful experience in manufacturing valves for this type service in the sizes indicated. The Manufacturer shall have at least 10 years' experience in the manufacture of the valves.
- C. Manufacturer's Representative for Startup and Training: The Manufacturer shall provide the services of a competent manufacturer's representative for an indefinite period of time as required to insure proper adjustment, installation and operation of the valve.
- D. All valves shall be hydrostatically tested and seat tested to demonstrate zero leakage. When requested, the Manufacturer shall provide test certification and required documentation.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 "Submittal Procedures" and shall include:
 - 1. Shop Drawings.
 - 2. Operation and Maintenance Manuals.

1.04 STANDARDS

- A. The following standards shall apply as if they are included in these documents:
 - 1. American Society for Testing and Materials (ASTM) Standards:

ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A276	Standard Specifications for Stainless Steel Bars
ASTM A582 T303	Standard Specification for Free-Machining Stainless Steel Bars

2. American Water Works Association (AWWA) Standards:

AWWA C508	Swing-Check Valves for Waterworks Service, 2- through 24-inch NPS

2.00

2.00 PRODUCTS

2.01 SWING CHECK VALVES

- A. The check valves used shall be swing check valves unless otherwise specified and shall be constructed with a ductile iron body and stainless steel body seat ring, single continuous stainless steel shaft for attachment of weight and lever, and complete aluminum alloy air cylinder. The air cushion cylinder shall be totally enclosed, and externally attached to the side of the valve body with the cylinder piston rod connected to the external lever arm in a manner to lift the piston upwards when flow starts and downwards when flow stops to compress the trapped air in the cylinder for cushion closing. The air cushion cylinder shall be fitted with an adjustable valve to increase or decrease air compression in the cylinder.
- B. The valve disc shall absolutely prevent the return of water or sewage back through the valve when the inlet pressure decreases below the delivery pressure, on pump shutoff or power failure. The valve shall be tight-seating. The seat ring shall be renewable and shall be securely held in place by stainless steel screws. The valve disc shall be of ductile iron and shall be suspended from a stainless steel (non-corrosive) shaft which passes through bushings and shall be connected to the weight and lever on the outside of the valve. The shaft shall be keyed into the disc and lever arm. Set screws shall not be acceptable.
- C. Swing check valves shall be furnished with ANSI 125/150 pound flat faced flanges. Valve exterior and interior to be painted with Fusion Epoxy Paint per AWWA C550. Swing check valves shall be APCO Series 250, or pre-approved equal.
- D. The closing and opening rate of the valve shall be field adjustable.

2.02 VALVE COATING AND LINING

- A. COATING: All Valves shall be cleaned to a bright metal and given a shop coat of rust inhibitive primer. Primer shall be coordinated with field painting to ensure compatibility. The exterior coating on the valve shall be in accordance with Specification Section 09 96 00.01, "High-Performance Coatings".
- B. The interior of the valve shall be lined by the manufacturer with factory installed Protecto 401 Ceramic Epoxy Lining by Enduron or American Polybond Plus (fusion bonded epoxy and fusion bonded polyethylene) or an approved equal. Lining primers, applications, and thicknesses shall be in accordance with manufacturer's recommendations for sanitary sewer applications, but shall not be less than 40 mils.

3.00 EXECUTION

3.01 INSTALLATION

- A. Carefully handle and lower the valves into position so to prevent damage to any part of the valves.

3.02 CLEAN AND ADJUST

- A. Adjust weight position and air cushion operation in accordance with manufacturer recommendations.

END OF SECTION

15117 AIR RELEASE AND AIR AND VACUUM VALVES

1.00 GENERAL

1.01 WORK INCLUDED

- A. Furnish labor, materials, equipment and incidentals necessary to install air release and air and vacuum valves of the sizes and types indicated. Furnish the necessary isolating valves and piping.

1.02 SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 "Submittal Procedures" and shall include:
 - 1. Shop Drawings.

2.00 PRODUCTS

2.01 MANUFACTURED PRODUCTS

- A. General:
 - 1. Each air valve shall have a cast iron body, bronze, or stainless steel trim and stainless steel float. Float shall be baffled to prevent air from blowing valve closed until air is exhausted.
 - 2. Valve body, float, etc., shall be designed for a working pressure and shall seat at a minimum pressure of 5 psi.
 - 3. Air valves shall be manufactured by A.R.I. or approved equal.
 - 4. Top of valve assembly shall be fitted to attach discharge pipe as indicated. Valve inlet shall be N.P.T. for 2-inch and smaller valves. Valve inlet shall be ANSI flange for 3-inch and larger valves. Flange rating shall equal or exceed the maximum working pressure.
 - 5. Valves shall be rated for use with pressurized raw sewerage.
- B. Air Release Valves (AR): Air release valves shall be designed to automatically release accumulated air pockets within the pipeline while in operation and under pressure. Air release valves shall be A.R.I. Model S-020 or approved equal.

3.00 EXECUTION

3.01 INSTALLATION

- A. Carefully handle and install valves vertically in such a manner as to prevent damage to any part of the valves. Installation shall be in accordance with the Manufacturer's instructions. Provide nuts, bolts, and gaskets where applicable.

END OF SECTION

15145 SUBMERSIBLE PUMPS

1.00 GENERAL

1.01 WORK INCLUDED

- A. Furnish labor, materials, equipment and incidentals necessary to install two (2) new submersible sewage pumps. Accessories shall be furnished as required for a complete functioning pumping unit in accordance with the specified performance and installation conditions. Coordinate wetwell access doors with the slide rails. Test equipment in accordance with Paragraph 1.02 of this Section.
- B. The pump supplier shall furnish discharge elbows, pump impellers, guiderails, brackets, anchor bolts and anchor bolt layouts and bases, lifting chains and grip eye systems, and power cables as indicated on the plans.
- C. Pump and motor shall each have a standard Manufacturer's nameplate securely affixed with adhesive in a conspicuous place, showing the ratings, speed, rotation, serial number, model number, manufacturer, and other pertinent data.
- D. For this specification section, the Equipment Manufacturer shall be defined as the Pump Manufacturer or his designated representative. The Equipment Manufacturer shall be responsible for supplying and coordinating the design, testing, and installation of the pumps and motors. In order to ensure compliance with this paragraph the motors must be manufactured by the Equipment Manufacturer. The Equipment Manufacturer shall be responsible for the adequacy and compatibility of the pump and motor.

1.02 QUALITY ASSURANCE

- A. Acceptable Manufacturers:
 - 1. Hydromatic.
 - 2. Flygt.
 - 3. KSB
- B. Manufacturer's Representative for Startup and Testing: The services of the Manufacturer's technical representative shall be provided for pre-startup installation checks, startup assistance, training of Owner's operating personnel, troubleshooting and other services.
 - 1. Testing:
 - a. Each pump and motor shall be performance tested at the factory. All pumps shall be tested with motor cables to be supplied with the pumps. Three copies of certified test reports, including actual test records, shall be submitted and approved by the Engineer prior to shipment of the equipment.
 - 2. Each pump shall be tested for performance at the factory to determine the head vs. capacity, and motor input power for the full speed at which the pumps are specified and shown on a certified performance test curve as continuous functions throughout the pump's performance range. Tests of models, prototypes or similar units will not be acceptable. All tests shall be run in accordance with the test code for centrifugal pumps of the Standards of Hydraulic Institute, latest edition. The motor and cable on each pump shall be tested for moisture content or

insulation defects. After the test, the pump cable end shall be fitted with a shrink-fit rubber boot to protect it from moisture or water.

C. SERVICE OF MANUFACTURER'S REPRESENTATIVE

1. Pump Manufacturer Representative

- a. The pump manufacturer shall furnish the services of a competent factory technician, who shall have had a minimum of ten (10) years experience in the installation, adjustment, and operation of the equipment which is being furnished under this contract. This service is for the purpose of insuring proper installation and adjustment of the equipment (proposed pump and motor setup); instructing operating personnel in proper operation, maintenance, and care of the equipment; for making operation tests of equipment and making recommendations for obtaining the most efficient use thereof.
- b. The service representative shall be at the site at any time the Construction CONTRACTOR is assembling, setting, aligning, connecting or adjusting and testing the pump and motor assembly, and shall direct such work and certify in writing to the OWNER that it has been properly installed and operates satisfactorily during acceptance tests.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01300 "Submittal Procedures" and shall include:

1. Shop Drawings:

- a. Shop drawings shall include a complete description of the equipment offered including control and mounting system. Shop drawings shall include catalog cuts and pertinent engineering data required to fully evaluate the equipment. Characteristic curves shall be submitted with the shop drawings showing the capacity, head, efficiency, and brake horsepower throughout the full operating range of the pump. Complete specifications on the control equipment including a list of optional features shall be submitted with the shop drawings. Submittal data shall be in such form and so presented that the Engineer may readily review the data.
- b. The Equipment Manufacturer shall submit with the shop drawings a list of 20 similar installations in Texas which have been in satisfactory operation for at least two years. Shop drawings not including this required information will not be accepted. Also, manufacturer must furnish evidence of having an authorized fully staffed and stocked service facility within 250-mile radius of the jobsite as well as having 24-hour parts availability.
- c. Data sheets supplying the following information for the pumping units shall be submitted with the shop drawings.
 - 1). Pump Manufacturer
 - 2). Characteristic Curves (capacity, head, efficiency, recommended operating range indicated on curves, motor curves, required NPSH and brake horsepower throughout the operating range of the pump from shut off to maximum

specified operating capacity. Characteristic curves shall have the capacity plotted as abscissa and the operating head, brake horsepower, efficiency and required NPSH plotted as ordinates.)

- 3). Data Sheet: Fill out and submit with the Shop Drawing submittal the information requested on the Pump Submittal Data Sheet (Attachment A)
- d. Motor Manufacturer shall supply documentation for the motors as follows:
 - a). Letter of Compatibility: The soft starter supplier in conjunction with the pump/motor supplier shall issue a letter of compatibility stating that the soft starter and motor are compatible.
 - b). Data Sheet: Fill out and submit with the Shop Drawing submittal the information requested on the Motor Submittal Data Sheet (Attachment B)
 - c). Rated full load horsepower
 - d). Rated volts
 - e). Number of phases
 - f). Frequency in hertz
 - g). Full load amperes (FLA)
 - h). Motor no load data (i.e. amps, power factor, etc.)
 - i). Locked rotor amperes (LRA) at rated voltage and Locked rotor KVA/HP.
 - j). Synchronous speed (srpm)
 - k). Guaranteed maximum slip at full load in percent
 - l). NEMA insulation system classification and description of manufacturer's method of application.
 - m). Temperature rise at rated full load by resistance temperature detector
 - n). Maximum ambient temperature for which motor is designed
 - o). Service factor
 - p). The limiting temperature rise by resistive temperature detector motor as design and corresponding horsepower
 - q). Bearing size and calculation
 - r). Safe stall time
 - s). Maximum acceleration time with NEMA standard Wk2 value, at rated voltage and at 90 percent of rated voltage
 - t). Number of safe starts in succession when starting from a 40 degree Celsius ambient, intermediate waiting periods, and other conditions for driving equipment with a NEMA standard Wk2 value
 - u). Efficiency at 1/4, 1/2, 3/4, full load; and service factor
 - v). Power factor at 1/4, 1/2, 3/4, full load; and service factor

- w). Maximum kVAR allowed for power correction. Maximum allowed kVAR shall be included on the motor nameplate as well.
- x). Surge protection information, including mounting details
- y). Thermistors literature with wiring diagram.

2). Pump:

Make and type of pump	
Maximum Speed	___ rpm
Maximum Horsepower at rated head	___ HP

3). Pump:

Maximum total weight (pump and motor)	___ lb.
Rated capacity	
Rated head	

4). Motor:

Make and type of motor	HAZ
Brake horsepower of motor	7.5 HP
Locked Rotor Current at full nameplate voltage	63 amps
Motor Voltage/ Phase	460/3
Motor service factor	1.15
Insulation class and temperature rise at service factor load	Class H

- 5). Shop drawings shall be supplied to ensure successful installation and operation of the control system and shall consist of all of the following:
 - a). Sufficient detail to evaluate compliance with these specifications.
 - b). A detailed component list including manufacturer and catalog number.
 - c). A custom wiring diagram for this specific application to facilitate and ensure accurate field connections to the control panel by electrical installation personnel.
 - d). A description of operation for the control system.

2. Equipment Installation Report

3. Operation and Maintenance Manuals:

- a. Manuals shall be prepared by the equipment Manufacturer per Section 01300 "Submittal Procedures" and shall incorporate storage and installation instructions and operation and maintenance procedures, appropriate final certified shop drawings, performance curves, and test data. Manuals may be Manufacturer's standard instructions, but shall be supplemented as necessary to cover any special feature not included in standard material. Submit preliminary manuals for review prior to delivery of the equipment.

1.04 STANDARDS

- A. The applicable provisions of the following standards shall apply as if written here in their entirety:
 - 1. American Water Works Association (AWWA)
 - 2. American National Standards Institute (ANSI)
 - 3. ASTM International (ASTM)
 - 4. National Electrical Manufacturers Association (NEMA)
 - 5. National Electric Code (NEC)
 - 6. Test Code of the Hydraulic Institute Standards (HIS)
 - 7. Institute of Electrical and Electronic Engineers (IEEE)
 - 8. The applicable provisions of the following electrical standards shall apply as if written here in their entirety:
 - a. ANSI/NEMA MG-I - Motors and Generators
 - b. UL 1004 - Standard for Safety for Electric Motors
 - c. ANSI/NEMA MG-II - Installation and Operation of Electric Motors
 - d. IEEE STD 112 - Standard Test Procedure for Polyphase Induction Motors and Generators
 - e. IEEE STD 85 - Standard Test Procedure for Airborne Sound Measurements on Rotating Electric Machinery
 - f. ANSI 51.2 - Physical Measurement of Sound
 - g. Other Standards - Motors shall be built to all other applicable NEMA, ANSI, and IEEE standards not included above.

1.05 DESIGN CONDITIONS

- A. The pumps shall be designed to handle untreated or not thickened waste activated sludge on a continuous duty basis and shall be capable of passing a 3-inch non-compressible sphere. Pumps shall be guaranteed free from excessive cavitation and/or vibration throughout the system performance range. The pumps shall meet the operating conditions as specified and shall be designed to operate on a continuous duty basis. Design conditions for the pumps at each lift station shall be as specified.
- B. The presence of abrasives, rags, large solids and stringy materials shall not be considered as abnormal, unanticipated or abusive with regard to the equipment operation or warranty.
- C. Pump manufacturer shall review pump station configuration and make comments prior to bid on any design modifications required to the wet well to accommodate the supplied pumps dimensionally and hydraulically.

1.06 DELIVERY AND STORAGE

- A. The Vendor shall be responsible for delivery of the pump, motor, and accessories, f.o.b. to the job site or to such storage site as may be designated by the OWNER or Construction CONTRACTOR, in good condition and undamaged.

- B. Unloading and storage of the equipment shall be the responsibility of the Construction CONTRACTOR who shall inspect the equipment for apparent damage. Equipment which is found to be damaged shall not be accepted until properly repaired or replaced by the Vendor.
- C. The pumps, motors, and accessories shall be stored indoors. When this equipment is stored indoors, it shall never be in direct sunlight and the indoor temperature shall be maintained at a level satisfactory to the OWNER. The CONTRACTOR is responsible for providing the indoor storage facility or enclosure.
- D. Furnish anchor bolts and necessary appurtenances as necessary to meet the Installation CONTRACTOR's schedule.

1.07 WARRANTY

- A. Vendor shall warrant the equipment and motors furnished under this specification for a period of 1 year against defects in materials and workmanship and operational failure.
 - 1. In the event of failure of any part or parts of the equipment and motors during the first 1 year of service, provided that the equipment and motor has been operated and maintained in accordance with good practice, the Vendor shall furnish, deliver and install the defective part or parts at the Vendor's own expense. Vendor is also responsible for pump and/or motor removal, reinstallation and freight.
 - 2. The first 1 year of service shall be interpreted as the 12 month period following the installation, adjusting and acceptance testing, and the start of actual operation of the equipment, or 24 months after delivery, whichever occurs first.
 - 3. For the 1 year warranty, the OWNER and Vendor shall together perform an equipment evaluation on each unit during the eleventh month of the warranty. This shall be a complete electrical, mechanical, and hydraulic evaluation of the motor and pump. The Vendor's cost for the equipment evaluations shall be included in the price under this contract, and the coordination and scheduling of the annual equipment evaluation shall be the responsibility of the Vendor. A detailed report will be produced by the Vendor after the evaluation describing the tests, data collected, and issues identified.

1.08 SPARE PARTS

Manufacturer/Supplier shall submit a complete listing of spare parts for all equipment and motors furnished under this specification. Also furnish the list and price of manufacturer's recommended normal wear and tear spare parts for the equipment furnished in this Purchase Order.

2.00 PRODUCTS

2.01 SUBMERSIBLE SEWAGE PUMP

- A. Each pump, motor, and cable assembly shall be furnished in one integral unit, factory assembled by the Pump Manufacturer. Pump shall be listed as explosion proof by Underwriter Laboratories (U.L.) or by C.S.A.
- B. The pump design shall be such that the pumping unit will be automatically and firmly connected to the discharge piping when lowered into place on its mating discharge connection. The discharge connection shall be permanently installed in the wet well. The pump shall be easily removable for inspection or service, requiring no bolts, nuts or other fastenings to be disconnected. The guide

mechanism shall be a non-sparking design and U.L. or C.S.A. listed. Connection and disconnection of the pumping unit from the discharge piping shall not require personnel to enter the wetwell. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump. A sliding guide bracket shall be an integral part of the pump unit.

- C. The pump assembly shall also be capable of running dry or partially submerged for extended periods without any damage to the pump, motor, seals, or accessories.
- D. Major parts, such as the stator casing, oil casing, sliding bracket, volute, impeller, and base coupling shall be constructed of cast iron or bronze. Surfaces coming into contact with the pumped liquid shall be protected by a factory-applied epoxy coating or shall be stainless steel. External bolts, nuts, and fastening hardware shall be a minimum 300 series stainless steel.

2.02 PUMP CONSTRUCTION

- A. Pump Volute: The pump volute shall be constructed of ASTM A-536 (65-45-12) ductile iron or A 48 Class 35B cast iron. A wear ring shall be provided in the volute which is constructed of 304 stainless steel with a minimum Brinell hardness of 300. The discharge flange shall be 125 PSI A.N.S.I. drilling. Wear ring provided shall be compatible with mating material to prevent galling. For pumps smaller than 40 HP, stainless steel wear plate shall be acceptable in place of wear rings.
- B. Impeller: The impeller shall be constructed of cast iron, ductile iron or bronze and shall be of the enclosed, non-clogging, dynamically balanced, one-, two- or three-vane design capable of passing 3-inch diameter spherical solids. The impeller shall have a slip fit onto the motor shaft and drive key and shall be fastened using the manufacturer's standard technique. The impeller wear ring shall be 304 stainless steel, with a minimum Brinell hardness of 200. For pumps smaller than 40 HP, a two-vane semi-open impeller is acceptable.
- C. Shaft: The pump shaft shall be series 420 stainless steel. Carbon steel shafts or shafts with sleeves of any type are not acceptable. The shaft shall be one piece construction without joints or stubs attached. All shafts shall be dynamically balanced and shall be amply sized to minimize shaft deflection. Shaft overhang shall not exceed 2.5 times the shaft diameter.
- D. Mechanical Seals: Each pump shall be equipped with a double mechanical seal of the cartridge type or a balanced tandem-type design, running in an oil reservoir. The upper and lower faces of the rotating portion of the seal shall be made of tungsten carbide or a high quality silicon carbide. The two faces shall be held in contact by multiple springs or bellows to insure uniform face following of the rotating faces against the stationary faces. The entire seal shall be mounted within the oil chamber. The lower stationary seal face shall be made of tungsten carbide or a high quality silicon carbide. The seals shall require neither routine maintenance, nor adjustment, and shall not be damaged when the pump is run dry. When required, seal oil inspection shall be achieved without disassembly of the pump. The seal shall not require the pumped liquid as a lubricant. All metal parts shall be 316 stainless steel.
- E. O-Rings and Fasteners: All mating surfaces of the pump and motor shall be machined and fitted with Viton or Buna-N O-rings where watertight sealing is required. Sealing shall be accomplished by the proper fitting of the parts and not be compression or special torque requirements. All external screws and fasteners shall be made of 316 stainless steel.
- F. Bearings: The impeller and motor shaft for each pump shall be suspended on two permanently lubricated ball bearings that are designed by the manufacturer for minimum 50,000-hour AFBMA B10 bearing life under the design conditions.

2.03 MOTOR AND CABLE

- A. The motor shall be housed in either an air or oil filled chamber, watertight enclosure. The motor shall conform to NEMA design Class B, and incorporate minimum Class F insulation material to withstand a continuous operating temperature of 155 C (311 F). The pump and motor shall be capable of handling liquids with a maximum temperature of 40 C (104 F). The motor shall be capable of sustaining up to 10 evenly spaced starts per hour. The motor shall be capable of operating in dry or partially submerged conditions for extended periods without damage. If the motor is expected to be exposed for longer than 15 minutes, furnish air filled motors with a water jacket if required. The nameplate motor service factor shall be at least 1.15. The motor shaft shall be 400 series stainless steel. The motors shall be 460-volt, 3-phase, 60-cycle. Lead wires shall be suitable for operation in oil. The motor shall be provided with Klaxon motor thermal switches embedded in the windings to protect the motor from burnout due to excessive heating. Inrush on starting shall be no more than allowed by NEC Code Letter G for motors less than 50 HP. Each motor shall be suitable for use in a NEC Class 1, Division 1, Group D location and be U.L. or C.S.A. listed.
- B. The electrical cable entrance to the motor shall be provided with positive strain relief to prevent leakage or pullout of the cable in the event that a force is accidentally placed on the cable during the raising or lowering of the pump. The design of cable entry shall preclude specific torque requirements to insure a watertight and submersible seal. Cable entry shall consist of a single cylindrical elastomer or Buna-N grommet, flanked by stainless steel washers all having a close tolerance fit against the cable's outside diameter and the entry inside diameter and compressed by the body containing the strain relief function separate from the function of sealing the cable. One spare set of cable seal accessories shall be provided. The entry cable system shall be warranted as described in Paragraph 1.07, Warranty.
- C. Incoming lead wires shall be spliced in the motor terminal housing. After splicing, the terminal housing shall be filled with epoxy to seal the outer cable jacket and the individual strands to prevent possibility of water entering the motor housing or the terminal housing. A secondary elastomer compression grommet shall also be supplied. The combination of the epoxy seal and compression grommet shall provide complete sealing and strain relief. Sufficient cable shall be supplied to extend from the motors to the pump control without splicing. Each pump shall be equipped with adequate cable to be routed from the termination junction box to the pump without any splices at a minimum. The power cable shall be sized according to NEC and ICEA standards and also meet P122-MSHA approval and this classification shall be embossed on the cable.
- D. Each unit shall have motor seal failure sensor(s). This sensor shall be compatible with the Flygt miniCAS module located in the existing pump control panel.
- E. Each motor shall be thermally protected with a motor thermal switch installed in each phase winding. Thermal switch provided shall be compatible with the Flygt miniCAS module located in the existing pump control panel. When power is applied the overtemp contacts change state. The pump current loop 7mA<I<30mA pump sensors are good. Less than 7mA overtemp contact re-closes, greater than 30mA moisture contact closes.
- F. The motor, cable, and electrical controls shall be sized, furnished, and installed so that the motor shall never exceed the nameplate rating at any point on the pumping curve.
- G. Provide stainless steel cable strain relief on each cable at wet well roof slabs.

2.04 DISCHARGE ELBOW AND GUIDERAIL BASE

- A. A discharge elbow and guiderail base shall be provided for each pump and shall be permanently installed in the wetwell. Stainless steel anchor bolts embedded in concrete in accordance with pump manufacturer's layout and recommendations shall secure these connections.

2.05 GUIDERAIL AND LIFTING CHAIN

- A. The guiderails and lifting chain positive recovery system shall be sized by the pump supplier. Guiderails and lifting chains shall be constructed of stainless steel. Intermediate and upper guiderail brackets shall be provided by the pump supplier to achieve the arrangement shown on the Plans.
- B. The slide rails shall be continuous stainless steel designed to resist corrosion in sewage or sludge applications. Any joints in the rails shall be reinforced from within if pipe is used; continuously full-depth welded, ground smooth, and treated to resist corrosion. If pipe is used, it shall be minimum Schedule 40. The rail system shall be of adequate length to extend from the lower guide holders on the pump discharge connection to 6 inches below the top of the wet well. The system shall be mounted with stainless steel hardware.
- C. The rail support system shall be furnished by the Pump Manufacturer, to adequately support the guide (slide) rails. Rail system shall also support the riser piping from the pump discharge. A minimum of one (1) intermediate guide rail supports shall be used or as recommended by the pump manufacturer. The system shall be mounted with stainless steel hardware.
- D. Each pump shall be fitted with a stainless steel chain or cable of adequate strength and length to permit raising and lowering the pump for inspection or removal. The chain or cable shall be long enough to extend from the pump in its operating position to 4 inches above the top of the wet well. Furnish and install a stainless steel hook at the top of the wet well to hold the chain when the pump is in service.
- E. Each pump shall be fitted with 3 feet of stainless steel chain of adequate strength to permit raising and lowering of the pump, and an adequate length of 1/4-inch diameter nylon rope or 18-inch stainless steel rope. The pump supplier shall provide a grip eye, which when lowered into position over the nylon rope, will automatically attach to the chain for lifting and automatically release the chain after lowering the pump back into position. The grip eye, pump chain, and associated hardware shall have a minimum capacity of 1-1/2 times the pump weight.
- F. An ASTM 316 stainless steel cable system as designed and manufactured by the pump manufacturer may be utilized in place of the slide rail removal system if the cable system is the standard used by the pump manufacturer and there are adequate number of installations using this type system as required in Paragraph 1.03A.

2.06 SLIDING COUPLING SYSTEM

- A. A sliding guide bracket shall be an integral part of the pumping unit or securely attached thereto. The guide bracket shall be designed such that no strain is placed on the pump or guide rails. The volute casing shall have a machined discharge flange to automatically and firmly connect with the discharge connection, which when bolted to the floor of the sump and discharge line, will receive the pump discharge connecting flange without the need of adjustment, fasteners, clamps or similar devices. Discharge base elbow and base plate shall be supplied by the Pump Manufacturer.
- B. The pump sliding coupling system shall be designed so that the downward force of the machined mating flanges shall shear away rags, hair, or other debris that would prevent a uniform watertight

seal. No portion of the pump unit shall bear directly on the floor of the wet well. The pump body and slide coupling mating faces shall be bronze against cast iron.

3.00 EXECUTION

3.01 INSTALLATION

- A. Installation shall be in accordance with the Manufacturer's instructions. Any modification to the structure as a result of requiring different size access door hatchways is the responsibility of the Contractor.
- B. Re-use conduit penetrations to the wet well for new cabling. Completely seal cabling (watertight) into wet well to meet all local, state, and federal codes. Provide strain relief.
- C. Attach pump cabling to existing cable strut support system. Use tie-wraps approved for this purpose. Maintain minimum cable bending radius and do not overtighten tie-wraps.
- D. Provide and install waterproof splice kit(s) for splicing pump cables inside the termination cabinet.
- E. Project area is prone to occasional flooding. Provide and install drain/breather on bottom of termination cabinet.

3.02 FIELD QUALITY CONTROL

- A. Upon completion of installation of the equipment, an acceptance test to verify the satisfactory operation of each unit shall be conducted. The Contractor shall provide the services of authorized representative to conduct all field tests. The test shall be conducted in a manner approved by and in the presence of the Engineer. The unit shall be checked for excessive noise, vibration, alignment, general operation, ease of removal, etc. All automatic and manual controls shall be tested to verify that they function in accordance with the requirements. Verify that drive equipment operates without being overloaded. The unit must perform in a manner acceptable to the Engineer before final acceptance will be made by the Owner.

3.03 INSPECTION AND START UP

- A. Inspect equipment prior to placing any equipment or system into operation. Make adjustments as necessary for proper operation.
 - 1. Check for adequate and proper lubrication.
 - 2. Determine that parts or components are free from undue stress from structural members, piping or anchorage.
 - 3. Adjust equipment for proper balance and operations.
 - 4. Determine that vibrations are within acceptable limits.
 - 5. Determine that equipment operates properly under full load conditions.
 - 6. Determine that the equipment is in true alignment.
- B. Have the Supplier's representative present when the equipment is placed in operation.
 - 1. The Representative is to be on-site as often as necessary for proper and trouble free operation.

2. Ensure that the proper procedure is employed in start up of systems.
- C. Provide Equipment Installation Reports for Equipment on the form indicated by Engineer.
 1. Certify that the equipment and related appurtenances have been thoroughly examined and approved for start-up and operation.
 2. Include the date when Owner's personnel were instructed in the proper operation and maintenance of the equipment in the report.

3.04 INITIAL OPERATION

- A. Start, test, and place equipment and systems into operation for 30 days to allow the Owner and Engineer to observe the operation and overall performance of the equipment and to determine that controls function as intended.
- B. Equipment which operates on a limited or part-time basis shall be operated in the presence of the Engineer to demonstrate that controls function as specified.
- C. Equipment and systems are not substantially complete until the end of this initial operation period. If an exception to this requirement is specifically noted in an individual equipment specification, the exception shall only apply to that particular piece of equipment and not to the remaining components provided under the Project.

3.05 INITIAL MAINTENANCE

- A. Maintain equipment until the Project is accepted by the Owner.
 1. Insure that mechanical equipment is properly greased, oiled, or otherwise cared for as recommended by the Supplier.
- B. Service equipment per the Supplier's instructions immediately before releasing the equipment to the Owner.

3.06 PAINTING

- A. Pumps, motors, baseplates, discharge elbows, and guiderails shall be painted in accordance with Section 09905 "High-Performance Coatings" of these Specifications.

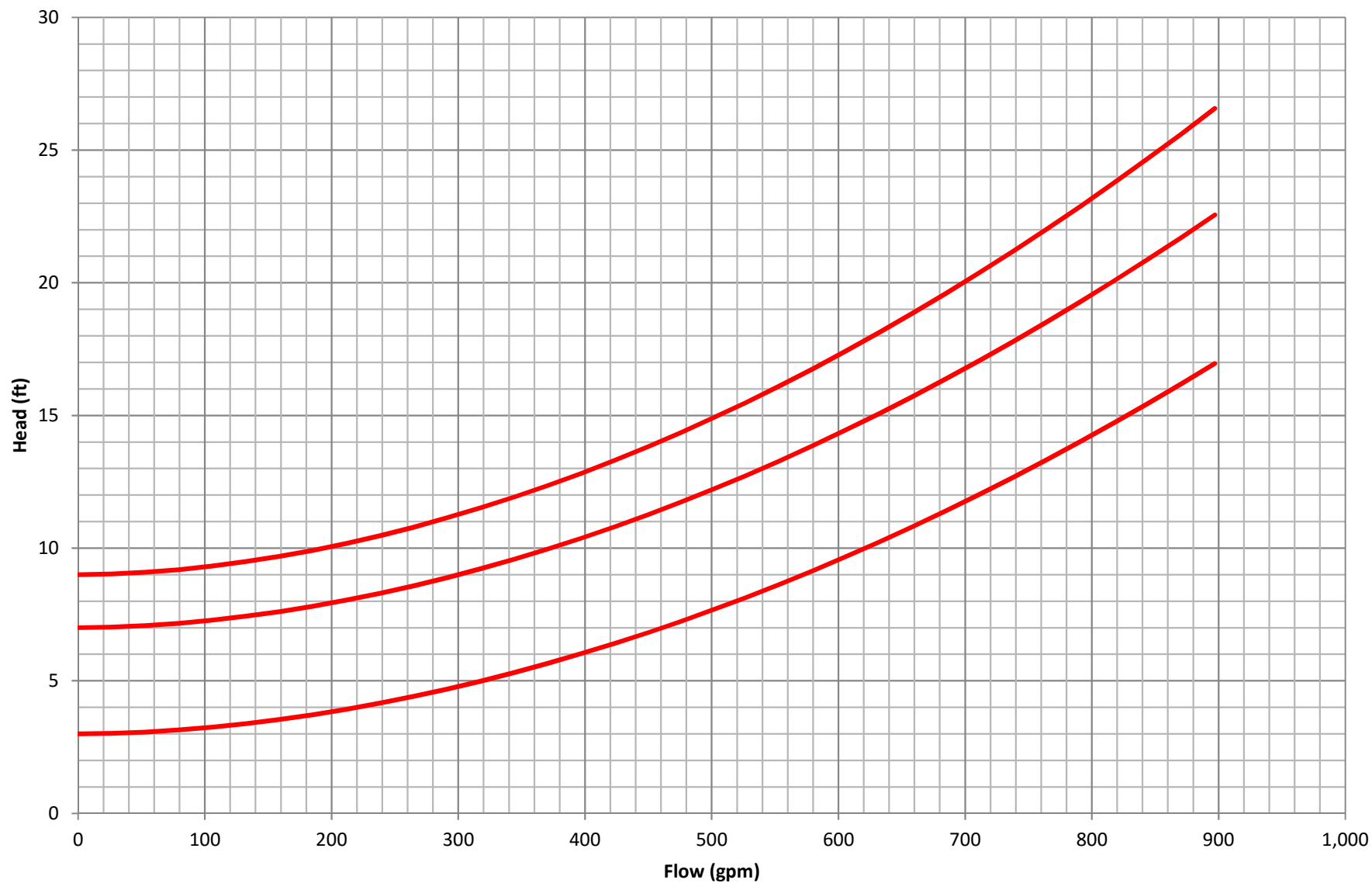
3.07 SCHEDULES

Location	West WWTP WAS Lift Station
Number of Units	2
Rated Capacity (gpm)	500
Rated Head, TDH (ft.)	15
Minimum Shutoff Head (ft.)	22
Maximum Speed (rpm)	1800
Minimum Motor HP	5
Minimum Pump Efficiency	65%

Minimum Overall Efficiency (pump and motor)	54%
Normal Operating Head Range (ft.)	10-15
Minimum diameter of test sphere (in.)	3
Maximum NPSHR at duty (ft.)	10
Maximum Motor pole number	3
Minimum pump discharge size (in.)	4

END OF SECTION

Round Rock West WWTP WAS Pump Station System-Head Curve - 8in Force Main



ATTACHMENT A
SUBMITTAL DATA SHEET

Submit the following data with Shop Drawings for each size of Pumping Unit:

Item No.	Description
1	Make and Type Design
2	Rated Speed
3	Casing Material
4	Impeller Diameter and Material
5	Max. Impeller Diameter for Casing
6	Diameter of Suction Flange
7	Diameter of Discharge Flange
8	Shutoff Head
9	Diameter of Shaft at Impeller
10	Maximum Brake Horsepower
11	NPSH Required at Rated Head
12	NPSH Required at Minimum Head
13	Suction Specific Speed
14	Specific Speed
Item No.	Description
1	Rated Brake Horsepower
2	Rated Full Load Speed
3	Full Load Efficiency
4	3/4 Load Efficiency
5	Full Load Power Factor
6	3/4 Load Power Factor
7	Maximum Thrust Rating
8	Locked Rotor KVA
9	Frame Size
10	Enclosure Type
11	Locked Rotor Amperes (LRA) at rated voltage
12	NEMA Starting Code Letter
Item No.	Description
1	Complete Pumping Unit

END OF ATTACHMENT

16010 COMMON WORK RESULTS FOR ELECTRICAL

1.00 GENERAL

1.01 WORK INCLUDED

- A. Furnish labor, materials, equipment and incidentals necessary for complete and operational electrical systems, as specified herein.
- B. This Section, as well as Division 1, concerns all other Sections in Division 16, and shall be considered a part of each of those Sections as if written in their entirety.

1.02 QUALITY ASSURANCE

A. ELECTRICAL CONTRACTORS' QUALIFICATIONS

- 1. Use adequate numbers of skilled workmen, trained and experienced in their crafts, and who are familiar with the specifications and methods of performing the work in this Division. A licensed Journeyman shall be on site at all times when electrical work is being performed. Electrical work shall be performed under the direct supervision of a Master Electrician who holds a valid license in the State of Texas.

- B. Submit copy of Master Electrician's license and each Journeyman's license that will be working on the project. Workers must be licensed to work in the City where the project is located.

C. WORKMANSHIP

- 1. Work shall be performed in accordance with quality, commercial practices. The appearance of finished work shall be of equal importance with its operation. Materials and equipment shall be installed based upon the actual dimensions and conditions at the project site. Locations for materials or equipment requiring an exact fit shall be field measured. Conduit, transformers, and motors shall be isolated to avoid unacceptable noise levels from objectionable vibrations from all systems.

1.03 SUBMITTALS

Submittals shall be in accordance with Section 01300, SUBMITTALS and shall include:

- A. Component catalog number and manufacturing data sheet, indicating pertinent data and clearly marked identifying each component by the item number and nomenclature as specified.
- B. Component drawings showing dimensions, mounting, and external connection details.
- C. Complete interconnection and point to point wiring diagrams in AutoCAD format for all field control and instrumentation wiring between instruments, electrical equipment, cabinets, etc. A hard copy shall be submitted to the ENGINEER for approval prior to the final AutoCAD files being submitted. Interconnection/wiring diagrams shall include cable numbers, wire tags, actual equipment terminal strip numbers at both ends of the cable, etc.
- D. Operation and maintenance manuals shall contain the approved shop drawings, submittals, spare part lists, schematics, final wiring diagrams with any changes made during start-up and maintenance procedures.

- E. Unless other additional information is required by the detailed equipment specifications, the following information shall be included for motors:
 - 1. Motor identification number and nomenclature as specified
 - 2. Make and motor type
 - 3. Brake horsepower of the motor
 - 4. Locked rotor current at full load
 - 5. Motor efficiency at full load (3-phase motors only)
 - 6. Starting torque
 - 7. Method of insulating and impregnating motor coils (3-phase only)
 - 8. Speed of the motor at full torque
 - 9. Full load current
 - 10. Service factor
 - 11. Motor temperature rise measured by resistance over 40 degrees C ambient
- F. The CONTRACTOR shall submit a copy of the Master Electrician's license and Journeyman's license who will be working on the project. This information shall be submitted as a formal submittal prior to beginning any work.
- G. The CONTRACTOR shall:
 - 1. Prepare, and keep up-to-date, the Record Drawings and detailed construction drawings which shall be available at each monthly pay application.
 - 2. Record the exact locations of each of these differences, sizes and details of the Construction Work as executed, with cross-references to and other requirements on the Record Drawings.
 - 3. Keep the Record Drawings on the Work Site;
 - 4. Upon completion of the Work, or at such other time as may be determined by the ENGINEER, submit the Record Drawings and copies to the OWNER's Representative in accordance with the OWNER's Requirements.
 - 5. Provide revised final shop drawings in AutoCAD format noting any changes made to equipment during start-up.
 - 6. Provide a laminated copy to the OWNER of the final certified wiring schematics for the Pump Control Panel. A laminated copy shall also be placed in the corresponding panel.

1.04 STANDARDS

- A. Electrical work shall be executed in accordance with local, State and national codes, ordinances and regulations which have jurisdiction or authority over the work. If the standards and codes conflict with each other, the most stringent shall apply. The applicable provisions of the following standard shall apply as if written here in their entirety:
 - 1. National Electrical Manufacturer Association (NEMA)
 - 2. American Society for Testing and Materials (ASTM)

3. National Fire Protection Association (NFPA)
 4. National Electrical Safety Code (NESC)
 5. Institute of Electrical and Electronic Engineers (IEEE)
 6. National Electrical Code (NEC)
 7. Underwriters' Laboratories (UL)
 8. American National Standards Institute (ANSI)
 9. Uniform Building Code (UBC)
 10. Occupational Safety and Health Administration (OSHA)
 11. Local utility companies
 12. Local (City of Round Rock) Electrical Ordinance
 13. Rural Electrification Association (REA)
 14. Insulated Power Cable Engineers Association (IPCEA)
 15. International Electrical Testing Association (NETA)
 16. National Electrical Contractors Association (NECA)
 17. Association Edison Illuminating Companies (AEIC)
- B. Electrical work shall be performed under the direct supervision of a Master Electrician who holds a valid license in the State of Texas.

1.05 DELIVERY AND STORAGE

- A. Follow the Manufacturer's directions for the delivery, storage and handling of equipment and materials. Tightly cover equipment and materials and protect it from dirt, water, chemical or mechanical injury and theft. Major electrical equipment shall be stored indoors in a climate controlled atmosphere and space heaters energized where applicable. Equipment that will be stored indoors for an extended period of time and that do not have space heaters shall have a 100 watt incandescent light placed in it and energized to eliminate the build-up of condensation in the equipment. Coordinate with equipment manufacturer for additional storage requirements. Damaged equipment shall not be acceptable. Upon installation, protect the materials until the work is completed and accepted by the OWNER.

1.06 JOB CONDITIONS

- A. Permits, licenses and inspections shall be secured and paid for as required by law by the CONTRACTOR for the completion of the work. Certificates of approval shall be secured, paid for, and delivered to the OWNER before receiving the final acceptance of the work.
- B. The location of materials, equipment, devices and appliances indicated are approximate and subject to revisions at the time the work is installed. Final location shall be as proposed by the CONTRACTOR and approved by the ENGINEER.

- C. Should project conditions require any rearrangement of work, or if equipment or accessories can be installed to a better advantage than the general arrangement of work on the plans, the CONTRACTOR shall before proceeding with the work prepare and submit plans of the proposed rearrangement for the ENGINEER's review and approval.
- D. Motor Horsepower ratings identified are anticipated ratings. If the actual equipment is a different size, the CONTRACTOR shall provide the appropriate wiring, conduit, over current protection, starters and accessories for a complete and working system at no cost to the OWNER.
- E. All enclosures for equipment unless specified otherwise shall be NEMA 4X, 316 stainless steel for exterior applications. All enclosures shall have a quick release luggage type clasp.

2.00 EXECUTION

2.01 INSTALLATION

- A. Maintain the waterproof integrity of conduit penetrations through concrete slab(s) and enclosures.

2.02 PAINTING

- A. Maintain the original factory finish on material and equipment installed, unless specifically indicated on the plans or specifications. If the finish is marred in transit or during installation, re-finish to a neat, workmanlike appearance equal to the original factory finish. Leave equipment and raceway systems clean and free of grease, dirt, rust, and in a suitable condition for painting.

2.03 CLEAN AND ADJUST

- A. Remove shipping labels, dirt, paint, grease, and stains from equipment. Remove debris as it accumulates. Upon completion of work, clean electrical equipment and the entire electrical installation so that it is suitable for the OWNER's use.

END OF SECTION

16011 IDENTIFICATION FOR ELECTRICAL SYSTEMS

1.00 GENERAL

1.01 WORK INCLUDED

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Equipment identification labels.
 - 5. Miscellaneous identification products.

1.02 SUBMITTALS

- A. Submittals shall be in accordance with Section 01300, SUBMITTALS and shall include Record Data:
 - 1. Product Data to include cut sheets for each electrical identification product to be used on the project. Provide example of labeling for Owner/Engineer approval prior to beginning any work.

1.03 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, are not acceptable.

2.00 PRODUCTS

2.01 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Circuits shall be tagged at terminations (both ends), in pull boxes, cabinets, and enclosures as follows:
 - 1. Tags relying on adhesives or tapes-on markers are not acceptable.
 - 2. Provide conductor tags for conductors No. 10 AWG and below with legible permanent sleeve of yellow or white PVC with machine printed black marking, Raychem TMS sleeves or approved equal.

3. Provide tags for cables and for conductors No. 8 AWG and larger consisting of permanent nylon marker plates with legible designations hot stamped on the plate. Attach these marker plates to conductors and cables with plastic wire wraps. Tags shall be Raychem TMS-CM cable markers or approved equal.
4. Tags shall be imprinted with panelboard and panelboard position number (e.g. HA-23/25/27) for conductors fed from panelboards. Other conductors shall have tags imprinted with the source which feeds the conductors.
5. Where more than one neutral is present with a group of conductors, a tag shall be applied to each neutral indicating which phase conductors are served by each neutral (e.g. HA-2, 4, 6).

2.02 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Color and Printing:
 1. Comply with ANSI Z535.1 through ANSI Z535.5.

2.03 2.03 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 2. 1/4-inch grommets in corners for mounting.
 3. Nominal size, 7 by 10 inches.
- D. Warning label and sign shall include, but are not limited to, the following legends:
 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.04 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch. Attach plates to equipment with stainless steel screws. Adhesive attachment is only acceptable on NEMA 4X enclosures.

2.05 CONDUIT IDENTIFICATION PLATE

- A. A conduit identification plate shall be installed on all power, control and instrumentation conduits at the end of each run and at the conduit ends inside intermediate junction and pull boxes, etc. Conduit plates shall be installed before conductors are pulled into the conduits. Exact identification plate location shall be coordinated with the Owner/Engineer at the time of installation. The conduit identification tags shall identify the cable numbers and the "to" and "from" information. Coordinate with Owner for exact requirements for plate material and type. Provide an example to Owner/ Engineer as a formal submittal for approval prior to the installation.

3.00 EXECUTION

3.01 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with stainless steel mechanical fasteners appropriate to the location and substrate.

3.02 IDENTIFICATION SCHEDULE

- A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in pull and junction boxes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - a. Color shall be field applied for sizes larger than No. 8 AWG
 - b. Colors for 208/120-V or 240V/120V, 3-phase Circuits:
 - 1). Phase A: Black.
 - 2). Phase B: Red.
 - 3). Phase C: Blue.
 - 4). Neutral: White
 - 5). Equipment Grounding Conductor: Green
 - c. Colors for 480/277-V Circuits:
 - 1). Phase A: Purple.
 - 2). Phase B: Brown.
 - 3). Phase C: Yellow.

- 4). Equipment Grounding Conductor: Green
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- B. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
 - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Controls with external control power connections.
- C. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- D. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Outdoor Equipment: Engraved, laminated acrylic or melamine label
 - b. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners and gaskets that do not change the NEMA or NRTL rating of the enclosure and void the U.L. listing of the enclosure.
 - 2. Equipment to Be Labeled:
 - a. Enclosures and electrical cabinets.
 - b. Monitoring and control equipment.
 - c. Conduits

END OF SECTION

16120 LOW VOLTAGE ELECTRICAL POWER CONDUCTORS & CABLES

1.00 GENERAL

1.01 WORK INCLUDED

- A. Furnish labor, materials, equipment and incidentals necessary to install 600 volt wires and cables. Electrical work shall be in accordance with Section 16010, COMMON WORK RESULTS FOR ELECTRICAL.
- B. Work shall include building wire, cable, wiring connections and terminations, and modular wiring systems.

1.02 QUALITY ASSURANCE: TESTING

Megger test circuits for continuity and ground. Verify phasing at connection points. Torque test conductor connections and terminations to the Manufacturer's recommended values. Megger tests shall be performed by a testing company with a minimum of 10 years experience. All low voltage cables shall be verified by use of telephone communications.

1.03 SUBMITTALS

Submittals shall be in accordance with Section 01300, SUBMITTALS and shall include:

- A. Low voltage wire
- B. Ground wire

1.04 STANDARDS

The applicable provisions of the following standards shall apply as if written here in their entirety:

ICEA S-19-81/NEMA WC-3	Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

ICEA S-61-402/NEMA WC-5	Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

1.05 DELIVERY AND STORAGE

Deliver cable and wire to the project site in the original packages. Conductors with damaged insulation or exposed nylon jacketing shall not be permitted.

2.00 PRODUCTS

2.01 CONDUCTORS AND CABLES

- A. **CONDUCTORS:** Soft-drawn, annealed copper with a conductivity of not less than that of 98% pure copper bearing the U.L. label. The minimal size shall be #12 unless specified otherwise on plans. Conductors #8 or larger and conductors #14 shall be stranded. Utilize single conductors.
- B. **SINGLE CONDUCTORS:** Conductor with thermoplastic insulation rated at 600 volts and insulated with XHHW-2 insulation. Wire shall be water tank tested and approved as machine tool wire, in accordance with National Machine Tool Builders Association. Wire in light fixture channels and other special locations shall be as specifically noted for temperature in NEC Article 300. Conductors #8 or larger and conductors #14 shall be stranded. Wire shall be manufactured by Southwire, Okonite, General Cable, and Houston Wire & Cable
- C. **GROUND WIRE:** Ground wire shall be Class B stranded tin-plated conductor without insulation in all cases where a single ground wire is indicated to be installed in a conduit with no other conductors in the conduit, or where the ground wire is directly buried in earth or concrete. In all other cases, insulate ground wire with green insulators as specified for low voltage wire.

3.00 EXECUTION

3.01 PREPARATION

- A. Completely swab raceway system before installing conductors. Do not use cleaning agents and lubricants which have a deleterious effect on the conductors or their insulation.

3.02 INSTALLATION

A. GENERAL

- 1. Conductors shall be continuous from terminal block to terminal block without splice. Condulet type fittings shall not contain splices. No splicing of conductors shall be performed in any below ground structure.
- 2. Splice only in junction or outlet boxes for branch circuits. Splices for all other circuits shall be disallowed. Neatly train wiring inside boxes, equipment and enclosures. Pull conductors into a raceway at the same time and use U.L. listed, water based, wire pulling lubricant for pulling No. 4 AWG and larger wire. Install raceway first as a complete system without conductors. Do not install pull wires and conductors until the raceway system is in place.

3. Grouping conductors together into one conduit shall not be allowed where the plans indicate the conductors to be placed in separate conduits. Each home run shown on the plans shall be in its own conduit.
 4. Properly support cables in accordance with the NEC and manufacturer's recommendations in all raceways. Provide strain relief as required.
 5. The cable shall not be bent to a radius no smaller than the manufacturer cable's minimum bending radius.
 6. Sharing of neutrals is not allowed.
 7. Verify all cables and conductors by field telephone communications. Any conductor not tested as specified will be de-terminated, tested and re-terminated at the Contractor's expense. Payment will not be made for the work until the test has been done.
 8. All terminated conductors shall be labeled as specified prior to final terminations being done. Any conductor that is de-terminated for any reason shall be re-tested. All associated controls, if tested before, shall be re-tested.
- B. SINGLE CONDUCTORS: Conductors shall be continuous from outlet to outlet and no splices shall be made except at outlets. Sufficient wire shall be left at outlets to make connections to equipment without straining.
- C. GROUND CONDUCTORS
1. Conduits and other raceway shall contain an insulated equipment grounding conductor whether the raceway is metallic or not. Conduits, motors, cabinets, outlets, and other equipment shall be properly grounded in accordance with National Electrical Code requirements. Make connections to equipment with solderless connections. All connections to ground rods shall be of the fused type utilizing an exothermic welding process.
 2. Ground metallic material, including but not limited to metallic raceway, metallic boxes and metallic enclosures. Where metallic material is not connected by raceway to a solid ground, connect the metallic material to the largest equipment grounding conductor which it houses. Clean the metal surface under the grounding lug to bright metal. Grounding connections to motors shall be to the grounding stud which shall be threaded into the stationary frame; Use Burndy KC Servit, or approved equal. The ground wire shall not be lugged to a mounting bolt.
 3. Insulate ground wire with green insulation as specified for low voltage wire. Provide and size bonding conductors in accordance with the National Electrical Code.

END OF SECTION

16122 WIRE CONNECTIONS AND DEVICES

1.00 GENERAL

1.01 WORK INCLUDED

Furnish labor, materials, equipment and incidentals necessary to install wire connections and devices. Electrical work shall be in accordance with Section 16010, COMMON WORK RESULTS FOR ELECTRICAL.

1.02 QUALITY ASSURANCE

A. ACCEPTABLE MANUFACTURERS

600 volt connectors shall comply with the specifications and the following Manufacturers will be acceptable:

1. Burndy
2. Thomas & Betts
3. Ideal Industries
4. Minnesota Mining and Manufacturing

1.03 SUBMITTALS

Submittals shall be in accordance with Section 01300, SUBMITTALS and shall include Record Data for:

- A. Wire connections and devices.

2.00 PRODUCTS

2.01 MANUFACTURED PRODUCTS

A. CONNECTORS, COMPRESSION, COPPER, 600 VOLT AND MEDIUM VOLTAGE: Of the appropriate hole sizes and spacing which are in accordance with NEMA standards; two (2) holes in the tongue for use on conductor sizes 250 kcmil or larger; not required for connections to the circuit breakers in the lighting and/or receptacle panels. All compression connectors shall be long-barrel type, no exceptions.

B. 600 VOLT PLASTIC TAPE: Minnesota Mining & Manufacturing Company, No. 35.

- C. WIRENUTS: Silicone-based pre-filled spring wire connecting devices with plastic covering; UL listed for damp and wet locations. Wirenut shall meet requirements of UL 486D for Sealed Wire Connector Systems and shall be manufactured by Ideal Industries, Inc model 63, or as manufactured by ITT or Panduit. Wirenut shall be spring insulated, properly sized and resistant to vibration may be used for No.12 through No.10 solid gauge conductor for lighting and branch circuits only.
- D. SPLIT BOLTS: Kearney, Burndy, or IlSCO; shall be usable for connecting conductors which are both copper, both aluminum or one copper and one aluminum. Split bolts shall have a spacer between the two conductors which it connects.
- E. MECHANICAL SET SCREW CONNECTOR: Blackburn HPS, ADR-ALCUL, GP or GT, Burndy or IlSCO; consisting of an aluminum body which has openings on opposite ends for insertion of the conductors. Conductors inserted into these holes shall each be clamped by two set screws. Connectors shall be suitable for use with copper conductors.
- F. RUBBER TAPE: Scotch 2210.
- G. VINYL TAPE: Scotch 88.
- H. INSULATING RESIN: Scotch 3576, 3577, or 3578.
- I. POWER DISTRIBUTION BLOCKS: Ferraz Shawmut, IlSCO or Allen-Bradley; rated for 600 VAC and termination of copper conductors. Individual poles shall be constructed of tin plated aluminum and mounted on an insulating base.

3.00 EXECUTION

3.01 INSTALLATION

- A. For No. 10 and smaller, connect conductors with a twist-on spring wirenut. If a splice or tap is below 3' above the final grade, fill the spring connectors with an electrical insulating resin so that conductor and spring materials are encapsulated by the resin. Conductor splices and taps inside the control panel shall be on the terminal strips or power distribution blocks.
- B. Splice 600 Volt conductors in junction boxes or at outlets only. All splices are subject to the Engineer's approval. Obtain approval from Engineer before installing any splices. For existing installations, splices of 120V circuits shall use twist-on wire nuts. For splices of existing 480V circuits, the Contractor shall terminate the existing and new conductors using power distribution blocks mounted in a junction box or as indicated on the plans.
- C. For No. 8 and larger, connect conductors with a split bolt type of connector or a mechanical, set screw type connector. Wrap splices and taps with a single half-lapped layer or rubber tape followed by successive layers of vinyl tape until a vinyl tape layer thickness of twice the original conductor insulation thickness is achieved. If splice or tap is below 3' above the finished grade, the tape or splice shall have a final outer coating or insulating resin.

- D. Furnish and install power distribution blocks as required for tapping conductors at their load connection point with conductors of smaller size. Install power distribution blocks with the number of poles and sizes needed for connecting the phase, neutral, and ground conductors.
- E. Pair shielded cable shield shall be broken at terminal strips only.
- F. Application of tape shall be in accordance with the Manufacturer's recommendations.

END OF SECTION

16155 MOTOR STARTERS

1.00 GENERAL

1.01 WORK INCLUDED

Furnish labor, materials, equipment and incidentals necessary to install motor starters. Electrical work shall be in accordance with Section 16010, GENERAL ELECTRICAL REQUIREMENTS.

1.02 QUALITY ASSURANCE - ACCEPTABLE MANUFACTURERS

Manual motor starters, magnetic motor starters and controller overcurrent protection and disconnecting means that comply with the specifications by the following Manufacturers will be acceptable:

- A. Square D.
- B. General Electric.
- C. Allen Bradley.

1.03 SUBMITTALS

Submittals shall be in accordance with Section 01300, SUBMITTALS and shall include:

- A. Provide manufacturer's catalog data for each unique equipment item provided.
- B. Provide wiring diagrams for starter control circuiting.

1.04 STANDARDS

The applicable provisions of the following standards shall apply as if written here in their entirety:

ANSI/NEMA ICS 6	"Enclosures for Industrial Controls and Systems"
FSW-C-375	"Circuit Breakers, Molded Case; Branch Circuit and Service"
NEMA AB 1	"Molded Case Circuit Breakers"
NEMA ICS 2	"Industrial Control Devices, Controllers and Assemblies"

1.05 JOB CONDITIONS

The motor horsepower indicated on the plans are approximate. The Contractor shall furnish properly sized equipment when actual horsepower are determined. If horsepower differ from the plans, obtain the Engineer's assistance to determine if the hardware and/or the wiring changes are necessary. The Contractor shall be responsible for all items necessary to accommodate the modifications.

2.00 PRODUCTS

2.01 MANUFACTURED PRODUCTS

- A. MAGNETIC MOTOR STARTERS: NEMA ICS 2; AC general purpose, Class A for induction motors rated in horsepower. Magnetic motor starters shall have the following characteristics:
 - 1. FULL VOLTAGE STARTING: Reversing type.
 - 2. COIL OPERATING VOLTAGE: 120 volts, 60 Hertz.
 - 3. SIZE: NEMA ICS 2; of the size indicated on the plans.
 - 4. OVERLOAD RELAY: NEMA ICS 2; electronic type.
 - 5. AUXILIARY CONTACT: NEMA ICS 3; two (2) normally open, field convertible contacts in addition to a seal-in contact.
- B. CONTROLLER OVERCURRENT PROTECTION AND DISCONNECTING MEANS
 - 1. MOTOR CIRCUIT PROTECTOR: Re-use existing Square "D" 3P/30A circuit breakers with an integral, instantaneous trip in each pole.

3.00 EXECUTION

3.01 INSTALLATION

- A. Install motor control equipment in accordance with the Manufacturer's recommendations. Mount inside pump control panel as indicated on plans.
- B. Re-connect control wiring to starter per the control panel control schematic diagram, located on the door of the pump control panel. Identify the conductors in accordance with Section 16120, 600 VOLT WIRES AND CABLES.
- C. Adjust the overload relay in motor starters to match the installed motor characteristics.

END OF SECTION

16540 GROUNDING & BONDING FOR ELECTRICAL SYSTEMS

1.00 GENERAL

1.01 WORK INCLUDED

- A. Furnish labor, materials, equipment and incidentals necessary to install a complete grounding system in strict accordance with Article 250 of the National Electrical Code (NEC) as shown on the drawings or as specified herein. Electrical work shall be in accordance with Section 16010, COMMON WORK RESULTS FOR ELECTRICAL.

1.02 SUBMITTALS

- A. Submittal shall be in accordance with Section 01300, SUBMITTALS and shall include:
 - 1. Grounding materials, equipment and processes.
 - 2. Product Data: For each type of product supplied.
 - 3. Field quality-control test reports.

1.03 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

1.04 JOB CONDITIONS

- A. Measure the ground grid resistance with the earth test megger and install additional ground rods and conductors as required until the resistance to the ground conforms to National Electrical Code requirements. Ground resistance measurement shall not exceed 5 ohms. Add ground rods as required to bring resistance to 5 ohms and connect to grounding system.

2.00 PRODUCTS

2.01 MATERIALS

- A. GROUND RODS: 304 stainless steel, having a diameter of 3/4" and a minimum length of 10'.
- B. GROUND CABLES: Stranded, bare tinned copper of 98% conductivity and as specified in Section 16120, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.
- C. CONDUIT GROUND FITTINGS: Fittings for bonding ground cable to the conduit shall be FCI Burndy Corp., type NE or Thomas & Betts No. 3951 series.
- D. EXOTHERMIC WELDING PROCESS: CADWELD MATERIALS – as manufactured by ERICO products or approved equal.

2.02 PROCESSES

- A. All grounding system connections to steel and ground rods shall be exothermically welded including all cable connections, and cable steel terminations. The use of mechanical type connections is not acceptable.
- B. Any concealed connection (buried, encased in concrete or otherwise sealed) shall be done only with exothermic welds.
- C. All materials involved must be from the same sources to insure compatibility. Connections made from this process shall meet the requirements of IEEE Standards 80 and 837 and as listed in MIL 419 and other standards, National Electrical Code, etc.

2.03 GROUNDING SYSTEM

- A. Provide a complete grounding system that includes all connections and the testing of ground rods, ground cables, ground buses, conduits, fittings, anchor supports, thermite process materials and equipment and other materials required for a complete installation. Grounding system shall be installed and sized in accordance with the National Electrical Code.

3.00 EXECUTION

3.01 INSTALLATION

- A. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted/clamp type connectors.
 - 2. Underground Connections: Exothermically welded connectors,

3. Connections to Ground Rods at Test Wells: Exothermically welded connectors.
 4. Connections to Structural Steel: Exothermically welded connectors.
- B. Ground electrical work in accordance with NEC Article 250 and local codes.
- C. Install ground cables in conduits above grade or directly buried in earth to a depth of not less than 12" below grade. Installation to provide sufficient mechanical protection so as not to break ground cables or connections. If ground cables are exposed, run in conduits for added protection.
- D. Install ground cables continuously between connections. Splices shall not be permitted, except where indicated on the plans.
- E. Install a green-colored, equipment grounding conductor in raceways. Size conductors in accordance with NEC Article 250.
- F. Metal conduits stubbed up into enclosures, termination cabinets, or other electrical equipment shall be terminated with insulated grounding bushings and connected to the equipment ground bus. Size the grounding wire in accordance with applicable sections of the National Electrical Code. Provide grounding and bonding jumpers as required per the NEC and sized in accordance with the NEC.
- G. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
1. Provide grounding and bonding jumpers as required per the NEC.
 2. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 3. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 4. Use exothermic-welded connectors for outdoor locations, but if a disconnect type connection is required; use a bolt on crimp type lug.
- H. Liquid tight flexible metal conduit in sizes 1-1/2" or larger shall have bonding jumpers. Bonding jumpers shall be external, run in parallel (not spiraled) and fastened with plastic tie wraps. Bonding jumpers shall be insulated copper conductors. CONTRACTOR shall provide bonding jumpers sized in accordance with the National Electrical Code.
- I. All equipment enclosures, motor and transformer frames, conduit systems, cable armor, exposed structural steel and all other equipment and materials required by the NEC to be grounded, shall be grounded and bonded in accordance with the NEC. Provide grounding and bonding jumpers as required per the NEC and sized in accordance with the NEC.
- J. Where exothermic bonding is used, molds shall be of the appropriate size for the wire and rod used. All bonds shall remain exposed for inspection of the OWNER's Representative.

- K. Ground rod shall be installed such that the top of the ground rod is 6" below grade and enclosed by a ground rod box.

3.02 INSPECTION

- A. Inspect the grounding and bonding system conductors and connections for tightness and proper installation.
- B. Use Biddle Direct Reading Earth Resistance Tester or equivalent to measure resistance to ground of the system. Perform testing in accordance with the test instrument manufacturer's recommendation using the fall of potential method.
- C. All test equipment provided under this section shall be approved by the ENGINEER.
- D. Resistance to ground testing shall be performed during dry season. Submit test results in the form of a graph showing the number of points measured (12 minimum) and the numerical resistance to ground.
- E. Testing shall be performed before energizing the distribution system.
- F. A separate test shall be conducted for each building or system.
- G. Notify the ENGINEER immediately if the resistance to ground for any building or system is greater than five ohms. Provide additional ground rods and conductors as required to bring the resistance to five ohms.

END OF SECTION

ATTACHMENT C

Standard Specifications Manual

SERIES 500 - UNDERGROUND PIPED UTILITIES

Item No.

- 501 Jacking or Boring Pipe
- 502 Tunneling
- 503 Frames, Grates, Rings and Covers
- 504 Adjusting Structures
- 505 Concrete Encasement and Encasement Pipe
- 506 Manholes
- 507 Bulkheads
- 508 Miscellaneous Structures and Appurtenances
- 509 Trench Safety Systems
- 510 Pipe
- 511 Water Valves
- 551 Pipe Underdrains
- 558 Structural Plate Structures
- 559 Portland Cement Concrete Box Culverts
- 591 Riprap for Slope Protection
- 593 P.C. Concrete Retards
- 594 Gabions and Revet Mattresses

ITEM NO. 501

JACKING OR BORING PIPE

501.1 Description

This item shall govern furnishing and installing of encasement pipe by methods of jacking or boring as indicated on the Drawings and in conformity with this specification. This item shall also include, but not be limited to other constructions activities such as traffic control measures, excavation, removal of all materials encountered in jacking or boring pipe operations, disposal of all material not required in the work, grouting, bulkhead installation, backfilling and re-vegetation.

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.

501.2 Submittals

The submittal requirements for this specification item shall include:

- A. Shop drawings identifying proposed jacking or boring method complete in assembled position
- B. Trench Safety Plan including pits, trenches and sheeting or bracing if necessary,
- C. Design for jacking or boring head,
- D. Installation of jacking or boring supports or back stop,
- E. Arrangement and position of jacks and pipe guides, and
- F. Grouting plan,

501.3 Materials

- A. Pipe

Carrier pipe and encasement pipe shall conform to Standard Specification Item Nos. 505, "Concrete Encasement and Encasement Pipe" and 510, "Pipe" and shall be size, type, materials, thickness and class indicated on the Drawings, unless otherwise specified.

- B. Grout

Grout for void areas shall consist of 1 part Portland cement and 4 parts fine, clean sand mixed with water.

501.4 Construction Methods

A. General

The Contractor is responsible for:

1. Adequacy of jacking and boring operations,
2. Installation of support systems as indicated on the Drawings,
3. Provision of encasement and carrier pipe, and
4. Execution of work involving the jacking operation, the wet or dry method of boring and the installation of encasement pipe simultaneously.

The Contractor shall have sole responsibility for the safety of the jacking and boring operations and for persons engaged in the work. The Contractor's attention is directed to the Construction Industry Occupational Safety and Health Administration (OSHA) Standards (29 FR 1926/1920) as published in U.S. Department of Labor publication OSHA 2207, latest revision, with particular attention to Subpart S. The Contractor shall conform to the requirements in accordance with Standard Specification Item No. 509, "Trench Safety System" and shall provide an appropriate Trench Safety Plan.

When the grade of the pipe at the jacking or boring end is below the ground surface, suitable pits or trenches shall be excavated to provide sufficient room to conduct the jacking or boring operations, joining pipe, and for placement of the pipe and appurtenances. In order to provide a safe and stable work area, the excavated area shall be securely sheeted and braced to prevent earth caving in accordance with the Trench Safety Plan.

The location of the work pit and associated traffic control measures required for the jacking or boring operations shall conform to the requirements of the City of Round Rock and Texas Manual on Uniform Traffic Control Devices.

Where installation of pipe is required under railroad embankments, highways, streets, or other facilities by jacking or boring methods, construction shall be undertaken in such a manner that it will not interfere with operation of any railroad, street, highway, utility or other facility and shall not weaken or damage any embankment or structure. All appropriate permits shall be acquired prior to the initiation of the work.

During construction operations, and until the work pits are backfilled and fill material compacted, traffic barricades, signs, and warning lights to safeguard traffic and pedestrians shall be furnished and maintained by the Contractor. The Contractor shall submit the proposed pit location and traffic control plan for review by the Engineer or designated representative. The Review by the Engineer or designated representative, however, will not relieve the Contractor from his responsibility to obtain specified results in a safe, workmanlike manner.

The pipe shall be jacked or bored from the low or downstream end, if possible. Minor lateral or vertical variation in the final position of pipe from line and grade established by Engineer or designated representative will be permitted at the

discretion of Engineer or designated representative provided that such variation is regular and occurs only in one direction and that the final grade of the flow line conforms to the specified direction.

When conforming to details indicated on the drawings, but the bottom of the work pit is unstable or excessively wet or the installation of water and wastewater pipe will result in less than 30 inches (750 mm) of cover, the Contractor shall notify the Engineer or designated representative. The Engineer or designated representative may require the Contractor to install a concrete seal, cradle, cap or encasement or other appropriate action.

Immediately after jacking or boring is complete and the encasement pipe is accurately positioned and approved for line and grade, the clear space between the pipe and the surrounding excavated material shall be completely filled by pressure grouting for entire length of installation.

After placement of the carrier pipe is complete, the ends of the encasement pipe shall be bulkheaded with a manufactured boot, brick, concrete blocks or stones of sufficient mass to prevent the intrusion of backfill, etc. into the encasement pipe. The bulkhead shall also be provided with sufficient number and placement of weep holes to facilitate the escape of the contents of carrier pipe should failure occur.

As soon as possible after the carrier pipe(s) and bulkheads are completed, the work pits or trenches, which are excavated to facilitate these operations, shall be backfilled. The backfill in the street ROW shall be compacted to not less than 95 percent of the maximum density conforming to TxDOT Test Method Tex-114-E, "Laboratory Compaction Characteristics & Moisture-Density Relationship of Subgrade & Embankment Soil". Field density measurements will be made in accordance with TxDOT Test Method Tex-115-E, "Field Method for Determination of In-Place Density of Soils and Base Materials".

Where the characteristics of soil, size or size of proposed pipe dictate that tunneling is more satisfactory than jacking or boring, a tunneling method may be submitted for acceptance by Engineer or designated representative. Tunneling shall conform to Standard Specification Item No. 502, "Tunneling".

B. Jacking

Heavy duty jacks suitable for forcing the encasement pipe through the embankment shall be provided. In operating the jacks, an even pressure shall be applied to all jacks used so that the pressure will be applied to the pipe uniformly around the ring of the pipe. A suitable jacking frame or back stop shall be provided. The pipe to be jacked shall be set on guides properly braced together, to support the section of the pipe and to direct it in the proper line and grade. The complete jacking assembly shall be placed in order to line up with the direction and grade of the pipe. In general, the embankment material shall be excavated just ahead of the pipe, the material removed through the pipe and the pipe forced through embankment by jacking, into the space 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 no more than 2 inches (50 mm) may be provided for the upper half of the pipe. This clearance shall be tapered to zero at the point where excavation conforms to contour of pipe.

The distance that excavation shall extend beyond the end of the pipe depends on the character of material encountered, but it shall not exceed 2 feet (0.6 meter) in any case. This distance shall be decreased, when directed by the Engineer or designated representative, if the character of the material being excavated makes it desirable to keep the advance closer to the end of the pipe.

The Contractor may use a cutting edge of steel plate around the head end of the pipe extending a short distance beyond the end of pipe with inside angles or lugs to keep the cutting edge from slipping back onto the pipe.

When jacking of the pipe is begun, all operations shall be carried on without interruption, insofar as practical, to prevent the pipe from becoming firmly set in the embankment.

Any pipe damaged in jacking operations shall be removed and replaced by the Contractor at his entire expense.

C. Boring

The boring shall proceed from a work pit provided for the boring equipment and workmen. Excavation for the work pits and the installation of shoring shall be as outlined in the Trench Safety Plan. The location of the pit shall be approved by the Engineer or designated representative. The boring shall be done mechanically using either a pilot hole or the auger method.

In the pilot hole method, an approximate 2 inch (50 mm) pilot hole shall be bored the entire length of the crossing and shall be checked for line and grade on the opposite end of the bore from the work pit. This pilot hole shall serve as the centerline of the larger diameter hole to be bored.

When the auger method is used, a steel encasement pipe of the appropriate diameter equipped with a cutter head to mechanically perform the excavation shall be used. Augers shall be of sufficient diameter to convey the excavated material to the work pit.

Excavated material will be removed from the working pit and disposed of properly. The use of water or other fluids in connection with the boring operation will be permitted only to the extent to lubricate cuttings. Water jetting will not be permitted.

In unstable soil formations, a gel-forming colloidal drilling fluid, that consists of at least 10 percent of high grade carefully processed bentonite, may be used to consolidate the drill cuttings, seal the walls of the hole and furnish lubrication to facilitate removal of the cuttings from the bore.

D. Tunneling

Where the characteristics of the soil, the size of the proposed pipe, or the use of monolithic sewer would make the use of tunneling more satisfactory than jacking or boring; or when indicated on the drawings, a tunneling method may be used, with the approval of the Engineer or designated representative. The tunneling shall be in accordance with Standard Specification Item No. 502, "Tunneling".

E. Joints

If reinforced concrete pipe is used, the joints shall be in accordance with TxDOT Specification Item 464, "Reinforced Concrete Pipe".

501.5 Measurement

Jacking or boring pipe will be measured by the linear foot (meter: 1 meter equals 3.281 feet) of pipe complete in place. Such measurement will be made between the ends of the pipe along the central axis as installed.

501.6 Payment

The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit bid price per linear foot for "Jacking or Boring Pipe" as the case may be, of type, size and class of encasement pipe indicated on the Drawings. The price shall include full compensation for furnishing, preparing, hauling and installing required materials, encasement pipe, bulkhead, for grouting and for labor, tools, equipment and incidentals necessary to complete work, including excavation, backfilling and disposal of surplus material.

The Carrier pipe shall be paid at the unit price bid for Standard Specification Item 510, "Pipe".

Payment when included as a contract pay item, will be made under one of the following:

Jacking or Boring ____ In. Pipe, Class ____ Per Linear Foot.

End

<u>SPECIFIC</u> Cross Reference Materials

Specification Item 501, "Jacking or Boring Pipe"

City of Round Rock Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 502	Tunneling
Item No. 505	Concrete Encasement and Encasement Pipe
Item No. 509	Trench Safety Systems
Item No. 510	Pipe

TxDOT Standard Specifications For Construction And Maintenance Of Highways, Streets, And Bridges

<u>Designation</u>	<u>Description</u>
Item 464	Reinforced Concrete Pipe

TxDOT Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-114-E	Laboratory Compaction Characteristics & Moisture Density Relationship of Subgrade & Embankment Soil
Tex-115-E	Field Method for Determination of In-Place Density of Soils and Base Materials

TxDOT Manual on Uniform Traffic Control Devices (MUTCD)

<u>Designation</u>	<u>Description</u>
MUTCD Part VI	Traffic Controls for Street and Highway Construction, Maintenance, Utility and Incident Management Operations
MUTCD Section 6C	Channelizing Devices
MUTCD Section 6C-8	Barricade Design
MUTCD Section 6C-9	Barricade Application
MUTCD Section 6E	Lighting Devices
MUTCD Section 6F	Control of Traffic Through Work Areas
Section 8	Traffic Control
Section 8.5.5.E	Typical Applications/Bore Pits

<u>RELATED</u> Cross Reference Materials

Specification Item 501, "Jacking or Boring Pipe"

TxDOT Standard Specifications

<u>Designation</u>	<u>Description</u>
Item 476	Jacking, Boring or Tunneling Pipe
Item 502	Barricades, Signs and Traffic Handling

ITEM NO. 502 TUNNELING

502.1 Description

This item shall govern excavating, furnishing and installing a pipe or a smooth walled structure by tunneling methods as indicated on the Drawings and in conformity with this specification. This item shall also include all equipment, mobilization, materials, handling and disposal of all materials encountered, all drainage, pumping and dewatering, all tunnel support, lining, installing pipe, grouting, ventilation, lighting and wiring, telephone system shafts and all other appurtenant work.

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.

502.2 Submittals

The submittal requirements of this specification item include:

- A. The Contractor's Engineer work experiences
- B. The Contractor's Engineer tunnel-related experience
- C. Method of ground water and surface water flood control
- D. Tunnel Design
- E. Equipment Plan
- F. Tunneling Procedures
- G. Material Selection for Linings
- H. Sequence of Placement
- I. Construction

502.3 Materials

Where the use of the following materials is required, such material shall conform to the following:

Material	Reference Specification
Concrete	CORR Standard Specification Item Nos. 403, 410
Structural Steel	CORR Standard Specification Item No. 720
Steel Ribs	ASTM A 36
Steel Plates	ASTM A 36, A 283
Rock Bolts	ASTM F 432
Steel Liner Plates	Armco "Standard", Commercial Shearing, Stamping Company "Commercial"
Lumber and Timber	Hardwood, sound or better, as defined by Commercial Standard CS60
Fine Aggregate	CORR Standard Specification Item No. 403.2 (4)

A. Shotcrete

Shotcrete shall conform to Standard Specification Item No. 404, "Pneumatically Placed Concrete" of the class indicated on the Drawings, except for measurement and payment.

B. Grout

Grout shall consist of not less than 6 sacks per cubic yard (335 Kilograms per cubic meter) Portland cement and clean washed sand mixed with water. An air entraining admixture may be added to facilitate placement when acceptable to Engineer or designated representative.

502.4 Equipment

A. Surveying

A laser system shall be used to maintain line and grade at all times.

B. Excavating, Handling and Disposal.

The Contractor shall select the "Excavation, Handling and Disposal" equipment compatible with the support system selected. In soft ground conditions a shield system shall be used. A tunnel boring machine may be employed on the project.

C. Special Methods

The Contractor shall select "special equipment" required to complete the work in a timely schedule.

502.5 Construction Methods

A. General

The Contractor shall have sole responsibility for the safety of the tunnel and of persons engaged on the work. The Contractor's attention is directed to the Construction Industry Occupational Safety and Health Administration (OSHA) Standards (29FR 1926/1920) as published in the U.S. Department of Labor publication OSHA 2207, latest revision October 1, 1979, with particular attention to Subpart S.

The Contractor is solely responsible for the adequacy of the tunnel and support system, lining placement and the faithful execution of the work covered by the Contract.

The Contractor shall engage a Registered Professional Engineer, licensed in the State of Texas, who is experienced in the design of tunnels, support systems and linings, to prepare and seal all designs, calculations, recommendations and drawings required for the site conditions anticipated and encountered.

The Contractor will have the option of selecting the method of excavation, supporting system, primary lining, final lining or a combination of the above, from the typical sections indicated on the Drawings.

The Engineer or designated representative shall review the submittal materials (see Section 502.2, "Submittals"); however the review by the Engineer or designated representative shall not be construed in any way as relieving the Contractor of its sole and final responsibility for the faithful execution of the work covered by the Contract.

In the event that the timely completion of the work cannot be met by the methods proposed in the bid, the Contractor shall submit a new plan to the Engineer or designated representative to insure the completion of the project in a timely manner.

B. Excavation.

The hours of work and permitted noise levels for this project shall be indicated on the Drawings, the Special Provisions to this item or as directed by the Engineer or designated representative.

There will be no classification for excavated materials and the term "excavation" shall include all materials excavated or removed from the tunnel, regardless of the type, character, composition or condition of the material so excavated.

Portals and shafts shall be located as shown on the Drawings or as approved by the Engineer or designated representative. The portals and shafts shall be designed and constructed to withstand all imposed loads, including saturated soil conditions, dynamic loads from equipment and surcharge loads from materials. The portal and shaft sites shall be graded to prevent surface water from entering the excavation. All excavation for portals and shafts shall be to the lines and grades indicated on the Drawings.

Open cut excavation may be performed at the portals if conditions are favorable to obtain a stable and suitable portal opening. Shafts may be constructed using Raised Boring Machines or other equipment listed with the Bid and approved by the Engineer or designated representative.

The tunnel shall be excavated to the lines, grades and dimensions indicated on the Drawings using a Tunnel Boring Machine (TBM) or other equipment listed with the bid and approved by the Engineer or designated representative. The tunnel excavation may begin at either end or at a shaft, but the Contractor shall control the drift of any heading to maintain the lines and grades.

Determination of a proper tunnel size and section to meet the requirements of these Specifications is the entire responsibility of the Contractor and it shall be expressly understood and agreed that the dimensions and shape indicated on the Drawings represent the minimal dimensions acceptable to the Engineer and do not necessarily represent a tunnel size or section large enough for the construction methods or the operational procedure which may be proposed or conducted by the Contractor. The Manning "n" value for water conveyance tunnels shall be 0.012 and 0.015 for other uses.

Grouting of the final lining shall not exceed 1 inch (25 mm) and shall be limited to the joints unless otherwise indicated on the Drawings.

Construction equipment to be used in tunnel excavation shall be operated by electricity, compressed air or another approved power source. Use of gasoline engine powered equipment within the tunnel is prohibited. Diesel engine powered equipment may be used provided each piece of equipment is in first-class condition and is equipped with a special ventilation system designed in accordance with U.S. Bureau of Mines recommendations.

The propulsion system of Mechanical Excavating Machines shall be equipped to prevent backward movement of the shield or machine if the propulsion system fails. The machine shall be equipped with a detection and alarm system for immediate warning of toxic or flammable gases. All electrical components shall be treated for hazardous areas, Class I, Division I Group in accordance with the National Electrical Code.

The machine shall contain sufficient brake jacks, breast tables or both and such additional bracing as necessary to fully support the face. The system shall be equipped with manually operated backup controls for emergency closing of the tunnel face if the mechanical system is inoperable.

C. Blasting

The Contractor shall comply with all laws, ordinances, applicable safety code requirements, Uniform Fire Code Articles 77, "Explosive Materials" and 80, "Hazardous Materials" and any regulations relative to handling, storage and use of explosives. Protection of life and property shall conform to "General Conditions" and Section 01550, "Public Safety and Convenience" of the Standard Contract Documents.

The Contractor shall be responsible for all damage caused by his blasting operations.

The Contractor shall erect signboards of adequate size stating that blasting operations are in progress over the area. The signs shall be located that they are clearly visible at all points of access to the area. The Contractor shall utilize a reliable audible warning system to ensure that any personnel in the area are forewarned of the impending detonation of explosives.

Appropriate precautions shall be taken during thunderstorms to prevent unintentional firing of charges due to static electricity.

The Contractor shall space his production blasting drill holes and schedule the delays of caps so that all shots break toward a free-face. Lifters shall not be used.

Controlled blasting shall be performed in such a manner to yield a minimum of overbreakage. Excavation of the tunnel and faces of cut slopes through rock shall be performed by presplitting, cushion blasting, line drilling or other approved methods.

Presplitting shall be defined as the establishment of a free surface or shear plane in the rock by the controlled usage of explosives and blasting accessories in appropriately aligned and spaced holes.

Cushion blasting shall be defined as the establishment of a free surface or shear plane in the rock by controlled usage of explosives and blasting accessories in appropriately aligned and spaced holes, except that the holes along the neat lines shall be detonated last.

Line drilling shall be defined as a technique of controlled blasting where a single row of closely spaced unloaded holes are used along the neat excavation line.

The holes shall provide a plane of weakness to which the primary blast can break and which also will cause some of the shock waves created by the primary blast to be reflected.

Explosives shall be limited in quantity and shall be placed in such locations as will not tend to open bedding planes or to crack or damage rock outside the limits of excavation.

Tunnel faces, slopes or faces shattered and/or loosened outside the proposed excavation lines by blasting or any other cause shall be excavated beyond the lines.

Overbreak within the tunnel shall be replaced with grout as specified on the Drawings.

All rock surfaces shall be clean and free from oil, grease, mud, objectionable coatings, loose, unsound or semi-detached rock fragments and other deleterious materials.

Immediately following each blast, the newly excavated surfaces shall be inspected and the tunnel roof and sidewalls shall be scaled of all loose materials.

The cleaning of the excavated rock surfaces shall be accomplished by high velocity air jets, brooming, barring, chipping and other such machine work as required. Special care shall be given to the cleaning of all cracks, crevices, joints and openings within the tunnel.

It is the intent of this section to control vibrations (shock waves) sufficiently to prevent structural damage to surface structures or interruption of surface activities. To ensure that this criteria is met, blasts within 50 feet (15 meters) or any portal or manhole shaft or any surface structure shall be monitored. Blasting will not be permitted in places where vibrations (shock waves) may affect existing gas pipelines. A recording seismograph should be used and a permanent record should be maintained throughout the project.

It is anticipated that the maximum explosive charge weight per time delay can be calculated using a scaled distance of $50 w^{1/2}$ feet ($22.6 w^{1/2}$ meters), where w = weight (mass) of individual explosive charge in pounds (kilograms: 1 kilogram equals 2.205 pounds). If the measured maximum particle velocity exceeds 2.0 inches per second (50 mm per second) within 50 feet (15 meters) of a portal or manhole shaft, the explosive charge weight (mass) shall be reduced. "Maximum particle velocity" is defined as the vector sum of 3 component amplitudes measured at a common time on a seismograph record. A permanent record of "Maximum Particle Velocity" on strip paper shall be maintained by the Contractor for review by the Engineer or designated representative.

The Contractor shall monitor vibration levels for each blast with a seismograph. The location of the seismographs shall be acceptable to the Engineer or designated representative.

Excess excavated material shall be removed from the site and disposed of at a permitted disposal site, unless otherwise indicated on the Drawings. The

disposal of excess excavated materials, including hauling, handling, leveling, clearing and compacting shall be subsidiary to tunneling.

D. Access

The work areas provided by the Owner/Developer are indicated on the Drawings. The Contractor shall arrange for employee access and parking, as well as material storage, hoisting, surplus material transfer and the construction office as indicated on the Drawings or within this space. The Contractor shall comply with other contract conditions for additional space.

The tunnel portals and intermediate shafts for permanent manholes can be used as access for personnel and material handling for work within the tunnel. Any additional temporary intermediate shafts required shall be located by Contractor. No construction shafts or other construction activity will be allowed without the written permission of the Engineer or designated representative.

E. Removal of Water

The Contractor shall keep the tunnel floor free from standing water. The Contractor may provide an open drainage channel in the tunnel floor to transport water to the portal or may excavate sumps at intervals to collect water and pump the water through pipe drains to the portal or shafts.

All water removed from the tunnel shall be free of suspended solids, oil or any other deleterious substances prior to discharge to area streams. All work and materials in connection with water removal shall be considered a subsidiary to tunneling.

F. Lighting and Wiring

Adequate and satisfactory electric lighting shall be provided by the Contractor in the tunnel. Electric lights shall be placed every 20 feet (6 meters) or as required to ensure proper work and inspection. Attention shall be particularly paid to the amount of illumination at the tunnel face and at places where supports or forms are being erected or where pipe laying or concreting is being performed.

All wiring for lighting and power shall be installed and maintained in first-class condition. All wiring shall conform to the National Electrical Code and shall be thoroughly insulated. Lighting and power circuits shall be separated and in addition shall be kept as far as possible from telephone wires and from wires used for firing blasts, if used. Special precautions shall be taken to avoid short circuits in any part of the wiring system.

All work and materials in connection with tunnel lighting and wiring shall be considered a subsidiary to tunneling.

G. Ventilation

The Contractor shall maintain tunnel air in a condition suitable for the health of workmen and clear enough for surveying operations. Whenever personnel are in the tunnel area, proper ventilation and gas detectors shall be maintained to keep atmosphere free of toxic or flammable gases. The ventilation system shall have

sufficient capacity and shall meet all applicable ventilation requirements of the U.S. Bureau of Mines, the U.S. Occupational Safety and Health Administration and the State of Texas.

Ventilating piping shall be of approved size, well supported and maintained airtight.

During grouting or concreting operations, the Contractor shall cool and ventilate the tunnel continuously to remove excess heat of hydration released by curing concrete.

All work and materials in connection with tunnel ventilation shall be considered a subsidiary to tunneling.

H. Telephone System

The Contractor shall install and maintain a telephone, in good working order at the working face in the tunnel, that is connected with a portal or access shaft to afford prompt communication with personnel outside the tunnel. The telephone system shall be available for use at all times during tunnel excavation, support erection and pipe laying or concreting operations.

All work and materials in connection with the telephone system shall be considered a subsidiary to tunneling.

I. Lining

1. General

The Contractor shall select a lining system from the typical sections indicated on the Drawings. The lining system to be used at any location will depend on the type of material encountered. It shall be the responsibility of the Contractor to determine whether or not a primary lining will be required at a given location and he shall notify the Engineer or designated representative in writing of his decision to begin or end any supports.

All primary supports used shall be protected against damage from blasting or other construction operations. Any damage that occurs shall be promptly repaired. Supports, which in the opinion of the Engineer or designated representative, cannot be satisfactorily repaired, shall be removed and replaced at the expense of the Contractor.

The Contractor shall be responsible for protecting all existing surface structures and utilities from disturbances caused by tunnel construction.

2. Rock Bolts

Except where otherwise specified herein, rock bolts shall conform to ASTM F 432 and shall be of the resin anchored type. Rock bolts shall be provided complete with all accessories including bearing plates, retaining washers, lock nuts, couplings and resin cartridges. Rock bolts shall be 3/4 inch (19 mm) minimum diameter. Holes for rock bolts shall be drilled to the diameter recommended by the rock bolt manufacturer. Spacing and

length of the rock bolts will be determined by the rock conditions encountered. Rock bolts shall not be bent. Where bolt length exceeds the tunnel diameter, couplings, as recommended by the manufacturer, shall be used.

After the holes have been drilled and adequately cleaned of debris, the resin cartridges and rock bolts shall be installed in accordance with the manufacturer's instructions. Two copies of the manufacturer's instructions shall be submitted to the Engineer or designated representative. Where a torque limiting impact wrench is used to tension rock bolts, such wrench shall be calibrated at the initiation of rock bolt installation and recalibrated as often as specified on the Drawings or required by the Engineer or designated representative.

Rock bolt installations shall follow, as closely as possible, the advancement of the tunnel heading. At the end of each day's work, the length of unsupported tunnel shall not be greater than the interval between tunnel supports.

3. Wire Reinforcement Steel

Wire woven chain link fence, zinc coated, 9 gage (3.76 mm) conforming to AASHTO M 181.

4. Shotcrete

Shotcrete shall conform to ACI 506.2, except no calcium chloride shall be used. For tunnel primary support systems not providing continuous support, the Contractor shall apply a protective coating of shotcrete on all exposed surfaces except massive limestone in the tunnel and access shaft excavations. The excavated surfaces shall be protected within 2 hours after exposure. Surfaces to be coated shall be cleaned of all loose material, dirt, dust, mud and other foreign matter. Temporary protective coverings accepted by the Engineer or designated representative shall be permitted, if necessary, until the permanent shotcrete coating is applied. Protective coating damaged by frost, heat, traffic or other causes shall be removed and replaced or repaired by the Contractor.

Where shotcrete is the only primary liner to be installed, adequate wire mesh reinforcing shall be provided to support all loads.

The non-reinforced shotcrete coating shall be not less than 2 inches (50 mm) in thickness and 3 inches (75 mm) when reinforced. The nozzelman shall select a water cement ratio [by weight (mass)] between 0.32 and .40, which will produce the minimum rebound. The placement of the placing machine and its operation shall be subject to the approval of the Engineer or designated representative.

The shotcrete shall be cured by membrane curing or by water curing, at the option of the Contractor, subject to approval by the Engineer or designated representative. Curing shall be such as to prevent the

development of an objectionable degree of cracking due to rapid loss of moisture following placement.

5. Tunnel Liner Plate

The design and shape of liner plates shall be such that erection and assembly can be accomplished entirely from inside the tunnel. Plates shall be installed to form a cylindrical tube having an outside diameter not less than that indicated on the Drawings. Liner plates shall be capable of withstanding the ring thrust load and transmitting this from plate to plate and shall conform to ASTM A 569.

Thickness of the plates shall be sufficient to support the loads above and around the tunnel with deflection of the liner plate tunnel not exceeding 3 percent of the nominal tunnel outside diameter at any point, measured diametrically.

The thickness of liner plate to be used shall be determined by the Professional Engineer engaged by the Contractor to design the primary support system of the tunnel, in accordance with Table 1 as a minimum.

Sufficient liner plate sections shall be provided with 2 inch (50 mm) grouting holes, located near the centers, so that when the plates are installed there will be one line of holes on each side of the tunnel below the springline and one at the crown; the lower line of holes on each side shall not be more than 18 inches (450 mm) above the invert. The holes in each line shall not be more than 9 feet (2.75 meters) apart and, unless otherwise approved, shall be staggered. Grout holes shall be equipped with screw type galvanized plugs for final watertight closure of the grout holes.

After the plates are formed to shape and after all holes are punched, the plates shall be galvanized on all surfaces by the hot-dip process. A coating of prime western spelter, zinc or equal, shall be applied at the rate of not less than 3 ounces per square foot (920 grams per square meter) of finished plate or 1-1/2 ounces (460 grams) each side. Spelter coating shall be of first class commercial quality, free from injurious defects such as blisters, flux and uncoated spots. All nuts and bolts shall be galvanized.

The plates shall be given a bituminous coating meeting in all respects the A.R.E.A. Specifications for bituminous-protected corrugated metal pipe. As an alternative the plates may be spray coated in the field prior to installation.

The tunnel liner plates may be either 2 flanged or 4 flanged type, 16 inches (400 mm) or 18 inches (450 mm) in width.

Bolts used with lapped-seam type (2 flange) liner plates shall be not less than 5/8 inch (16 mm) diameter. Bolts shall conform to ASTM A 449 for plate thickness equal to or greater than 0.209 inch (5.3 mm) and to ASTM

A 307 for plate thickness less than 0.209 inch (5.3 mm). The nuts shall conform to ASTM A 307.

Bolts and nuts used with the 4 flanged type shall be not less than 1/2 inch (12 ½ mm) diameter for plate thickness up to and including 0.179 inch (4.5 mm) and not less than 5/8 inch (16 mm) diameter for plates of greater thickness. The bolts and nuts shall be quick acting coarse thread and shall conform to ASTM A 307, Grade A.

The plates shall be new and unused prior to fabrication. All plates shall be punched for bolting on both longitudinal and circumferential seams or joints and shall be so fabricated in order to permit complete erection from the inside of the tunnel. All plates shall be of uniform fabrication and those intended for one size tunnels shall be interchangeable.

Structures on which the spelter coating has been bruised or broken, either in the shop or in shipping or which shows defective workmanship, shall be rejected. The following defects are specified as constituting poor workmanship and the presence of any or all of them in any individual culvert plate or in general in any shipment shall constitute sufficient cause for rejection:

- a) Uneven laps
- b) Elliptical shaping
- c) Variation from a straight center line
- d) Ragged edges
- e) Loose, unevenly lined or spaced bolts
- f) Illegible brands
- g) Bruised, scaled or broken spelter coating
- h) Dents or bends in the metal itself.

The minimum thickness gauge, joint strength and wall buckling strength shall meet or exceed the values tabulated in Table 1, which are calculated by the design methods of the AASHTO "Design Specifications for Tunnel Liner Plates".

TABLE 1: 2 FLANGE LINER PLATE, H-20 LIVE LOAD					
Nominal Diameter		Thickness		Height of Fill	
Feet, inches	meters, m	Gage	mm	Feet	meters, m
7' & less	2.1m & less	12	2.7	all fill heights	
7'2" to 9'	2.15m to 2.7m	10	3.4	all fill heights	
9'2" to 11'	2.75m to 3.3m	8	4.2	all fill heights	
11'2" to 13'	3.35m to 3.9m	8	4.2	to 15'	To 4.5m
11'2" to 13'	3.35m to 3.9m	7	4.6	15' to 70'	4.5m to 21m
13'2" to 15'	3.95m to 4.5m	7	4.6	to 15'	to 4.5m
13'2" to 15'	3.95m to 4.5m	5	5.3	15' to 60'	4.5m to 18m

Note: For diameters larger than 15 feet (4.5 meters) or for any diameter with unstable soil conditions, consult the manufacturer.

TABLE 2: 2 FLANGE LINER PLATE, RAILROAD E-80 LIVE LOAD					
Nominal Diameter		Thickness		Height of Fill	
Feet, inches	meters, m	Gage	mm	Feet	meters, m
6' and less	1.8m and less	12	2.7	all fill heights	
6'2" to 9'	1.85m to 2.7m	10	3.4	all fill heights	
9'2" to 10'	2.75m to 3.0m	8	4.2	all fill heights	
10'2" to 12'	3.05m to 3.60m	7	4.6	maximum 70'	maximum 21m
12'2" to 14'	3.65m to 4.20m	5	5.3	maximum 60'	maximum 18m
14'2" to 15'	4.25m to 4.50m	3	6.1	maximum 60'	maximum 18m

Note: For diameters larger than 15 feet (4.5 Meters) or any diameter with unstable soil conditions, consult the manufacturer.

TABLE 3: 4 FLANGE LINER PLATE, H-20 LIVE LOAD					
Nominal Diameter		Thickness		Height of Fill	
feet, inches	meters, m	Gage/inches	mm	feet	meters, m
7' or less	2.10m and less	10 gage	3.4	all fill heights	
7'2" to 9'	2.15m to 2.70m	8 gage	4.2	all fill heights	
9'2" to 11'	2.75m to 3.30m	7 gage	4.6	to 28'	to 8.4m
9'2" to 11'	2.75m to 3.30m	5 gage	5.3	Over 28'	over 8.4m
11'2" to 13'	3.35m to 3.90m	5 gage	5.3	to 15'	To 4.5m
11'2" to 13'	3.35m to 3.90m	5/16"	7.9	15' to 40'	4.5m to 12m
13'2" to 15'	3.95m to 4.50m	3 gage	6.1	To 15'	To 4.5m
13'2" to 15'	3.95m to 4.50m	3/8"	9.5	15 to 40'	4.5m to 12m

Note: For diameters larger than 15 feet (4.5 meters) or any diameter with unstable soil conditions, consult the manufacturer.

TABLE 4: 4 FLANGE LINER PLATE, RAILROAD E-80 LIVE LOAD					
Nominal Diameter		Thickness		Height of Fill	
feet, inches	meters, m	Gage/inches	mm	feet	meters, m
6' and less	1.80m and less	10 gage	3.4	all fill heights	
6'2" to 8'	1.85m to 2.40m	8 gage	4.2	all fill heights	
8'2" to 9'	2.45m to 2.70m	7 gage	4.6	all fill heights	
9'2" to 10'	2.75m to 3.00m	5 gage	5.3	all fill heights	
10'2" to 11'	3.05m to 3.30m	3 gage	6.1	maximum 70'	maximum 21m
11'2" to 12'	3.35m to 3.60m	5/16"	7.9	maximum 60'	maximum 18m
12'2" to 15'	3.65m to 4.50m	3/8"	9.5	maximum 60'	maximum 18m

Note: For diameters larger than 15 feet (4.5 meters) or any diameter with unstable soil conditions, consult the manufacturer.

When the liner plates are being installed, care shall be taken to maintain alignment, grade and the circular shape of the tunnel. Units in consecutive rings shall be installed so that the longitudinal joints in adjacent rings are staggered and not aligned more often than every second ring. The clear inside diameter of tunnel liner shall be within 4 inches (100 mm) of the nominal diameter indicated on the Contractor's submittal drawings.

All space between the lining and the earth or rock shall be filled with grout forced in under low pressure. The grout shall be mixed in the volumetric proportions of 1 part Portland cement, 1 part Bentonite and not to exceed 5 parts of sand. Enough water shall be used to produce, when well mixed, a grout having the consistency of thick cream. As the pumping through any hole is stopped, it shall be plugged to prevent backflow or flow of grout. Grouting shall closely follow the liner plate installation, since it is extremely important that firm contact exist between the liner plates and the surrounding ground. Not more than 1 day's or 1 shift's (if more than 2 shifts per day) time shall elapse between the installation of liner plates and the placement of grout behind the plates. If necessary, grout stops shall be placed at the end of the lining to permit grouting to or near the forward end of the erected liner plate tunnel.

A secondary liner shall be required with this support system.

6. Steel Sets and Lagging

Steel sets shall be fabricated in accordance with all applicable provisions of the AISC "Steel Construction Manual". Blocking shall be installed between each rib set and the rock at not less than 4 points, if tunnel is excavated by blasting. Blocking shall consist of wood or steel adequately wedged in place. Blocking shall be maintained and kept tight until the final secondary liner is in place.

The Contractor shall furnish and install wood or steel lagging between steel ribs, as necessary, to maintain the tunnel excavation. Lagging may be used (a) to support rock, (b) to retain backpacking in excessive overbreak areas and (c) to divert water. All wood lagging shall be placed outside the minimum secondary tunnel liner thickness as indicated on the Drawings. The quantities and type of lagging shall be determined by the Contractor.

A secondary liner shall be required with this support system.

7. Precast Concrete Segmental Tunnel Liner

The Contractor may use precast concrete segmental tunnel liner providing primary support and secondary liner are installed in a single operation. Precast concrete segmental rings shall be fastened together.

The precast concrete segments shall be furnished by a manufacturer having a minimum of 5 years experience in the fabrication of precast concrete segmental tunnel liners. A list of job references of the manufacturer shall be submitted to the Engineer for review. The Contractor shall also employ a person whose prime occupation for a minimum of the past 5 years has been installation of precast concrete segmental tunnel liner. Employee references shall be submitted to the Engineer or designated representative for review.

The alkalinity of the concrete shall be a minimum calcium carbonate equivalency of 65 percent.

Cement:	ASTM C 150, Type I, II or III, containing not more than 5 percent tri-calcium aluminate.
Fine Aggregate:	Clean natural sand, ASTM C 33. Artificial or manufactured sand will not be acceptable
Coarse Aggregate:	Clean natural aggregate, ASTM C 33. Coarse Aggregate shall be limestone.
Reinforcement:	Wire conforming to ASTM A 82 or A496, wire fabric conforming to ASTM A 185 or A 497 or bars of grade 40/60 (SI yield levels of 300/420 mPa) steel conforming to ASTM A 615.
Joint Packing Material:	Precut bituminous material, 3/8 inch (9.5 mm) minimum thickness for circumferential joints and 1/8 inch (3.2 mm) minimum thickness for longitudinal joints.
Bolts, Nuts & Washers	IFI-104, Grade 303 or 305 stainless steel
Dowels:	Lock-up dowel assemblies for circumferential joints shall conform to the manufacturer's recommendations. Detailed specifications to satisfy ring retention, joint compression, erection and articulation shall be furnished for Engineer or designated representative approval.

All materials shall be stored and handled in such a manner as preserve their quality and condition to the standards specified. Care shall be taken to avoid damage or contamination. Location and facilities for storage of materials shall be subject to review by the Engineer or designated representative.

The precast concrete segmental tunnel liner plates shall be manufactured in the vicinity of Round Rock, Texas and access to the facility shall be provided to the Engineer or designated representative. The mold bases for forming the segments shall be machined metal or concrete and shall be rigid and deflection free during placing and setting of concrete. Segments shall be cast with sufficient accuracy and uniformity of dimensions that all similar segments shall be interchangeable. Concrete shall not be placed when the ambient temperature is below 40°F (5°C). Concrete shall be maintained below 90° F (32°C) at the time of placement.

All segment joint faces shall have a minimum 3/4 inch (19 mm) deep by 1/8 inch (3 mm) wide caulking recess. Each segment shall be provided with at least one grout hole.

All reinforcement shall be bent cold. No heating or rebending will be permitted. Spacers to position reinforcement shall be corrosion resistant stainless steel. Minimum concrete cover on reinforcement shall be 1 1/2 inches (38 mm).

All segments shall have the date of manufacture permanently and clearly marked at the time of manufacture. Also, all tapered rings for curves shall

have each segment marked with the radius and the location of the segment within the ring clearly marked. Segments shall be symmetrically tapered. All marking materials shall be inert and indelible to the extent of identification for manufacturing and installation.

The cement, fine aggregate, coarse aggregate and water shall be proportioned to obtain a dense, workable and durable concrete of specified strength. A minimum of 564 pounds of cement shall be used for each cubic yard (306 kilograms of cement for each cubic meter) of concrete. The concrete shall have an average strength of 6,000 psi (41.4 mPa) at 28 days and a maximum absorption of 5.5 percent.

Quality control tests shall be made in accordance with ASTM C 39 on standard concrete cylinders vibrated, cured and stored in the same manner as the segments. At least 6 test cylinders, for compressive strength tests, shall be cast from each day's concreting. One-half of the cylinders shall be tested at 7 days to determine when the concrete has attained sufficient strength for delivery. The remainder shall be tested at 28 days. The average of strength tests shall be equal to or greater than the specified compressive strength and no individual cylinder shall be less than 5,500 psi (37.9 mPa). If the average of the 7 and 28 days compressive strength test results are less than 5,500 psi (37.9 mPa), all segments cast during that day's production shall be marked as rejected and retained at the manufacturer's site. Rejected units at the construction site shall be returned by Contractor to manufacturer and retained with other rejects.

In addition to cylinders, representative cores shall be cut from a test segment selected at random from each lot of 500 segments. The compressive strength of each core tested shall be equal to or greater than the specified compressive strength. The segments used for core samples may be repaired and used after being inspected by the Engineer or designated representative.

Absorption test shall be conducted in accordance with ASTM C 497 on samples representing each day's production. The concrete segments shall be cured by water or steam curing. The segments shall be cured for a sufficient time so the concrete will attain specified strength in 28 days or less. The segments shall be confined under a curing cover for a minimum of 8 hours and the concrete shall have a minimum compressive strength of 1,500 psi (10.3 mPa) before being removed from the molds.

Segments shall be handled carefully and stored in an adequate onsite location subject to acceptance by the Engineer or designated representative. Wire ropes, chains or hooks shall be kept from contact with concrete surfaces at all times.

The quality of materials, the process of manufacture and the finished segment shall be subject to inspection, testing and review by the Engineer or designated representative. Segments shall be rejected on account of any of the following:

- a) Defects that indicate any imperfect mixing and casting.
- b) Surface defects indicating honeycombed or open texture.
- c) Damaged ends preventing a satisfactory joint.
- d) Improper reinforcement.
- e) Improper fit of joints which produces turbulence or excess head loss.

The alkalinity of the concrete for wastewater linings shall be verified by an independent testing laboratory selected by Owner/Developer at the expense of the Contractor. Samples of the interior concrete shall be obtained for alkalinity determination by use of a 1 inch (25 mm) diameter carbide concrete drill. The depth of the drill hole will be equal to the depth of cover over the reinforcing steel. The ground (pulverized) concrete from this drilling shall be the sample material used for the alkalinity determination.

Drill hole samples shall be obtained and tested from a single section selected by the Engineer or designated representative for each day's production. The alkalinity test shall be conducted in accordance with the method described in the Encyclopedia of Industrial Chemical Analysis, Vol. 15, page 230, Interscience Publishers Division, John Wiley and Sons.

In the event that the average value of alkalinity for the test section is less than the specified value of alkalinity, two additional sections shall be selected from the same production period and alkalinity determinations made for these two sections. If either of the two retest sections fail to meet the specified alkalinity value, all sections in the failed production lot shall be tested prior to acceptance. If both retest sections meet the specified alkalinity value, the production lot will be accepted.

Certified copies of the alkalinity test results will be forwarded weekly to the Engineer or designated representative for review.

The drill holes in test sections may be repaired. The repaired section may be used on the project after being inspected and approved by the Engineer or designated representative at the site.

Segments shall be manufactured to the following tolerances:

Minimum thickness:	Not less than Class III, C-76 Wall C Reinforced Concrete Pipe, after deduction for concrete cover over reinforcement.
Minimum concrete cover over reinforcement on inside face of linerplate:	2 1/2 inches (62.5 mm)
Circumferential length:	$\pm 1/16$ inch (± 1.6 mm)
Radius of curvature:	$\pm 1/8$ inch (± 3.2 mm)
Thickness (on back surface only):	0 to +1/4 inch (+ 6.3 mm)
Width	$\pm 1/16$ inch (± 1.6 mm)
Internal diameter of ring:	$\pm 1/8$ inch (± 3.2 mm)
Bolt hole positions:	$\pm 1/16$ inch (± 1.6 mm)

During production, a trial ring shall be assembled on a horizontal surface to check the dimensional accuracy. This ring will be used as a pattern to check the accuracy of subsequent rings. One completed ring segment in every 200 rings or more frequently, as determined by the Engineer or designated representative, shall be selected at random and placed on the guide ring at the manufacturer's site to form a second ring for comparison.

The Contractor shall erect the precast concrete liner segments in accordance with the specifications and the recommendations of the manufacturer. A tunnel boring machine shall be used for the tunnel excavation if precast concrete segmental tunnel liner is used.

When ground conditions dictate, the segments shall be erected within a shield having a full tail skin and a mechanical erector. The shield shall be designed to withstand all imposed loads and shall be fitted with suitable tail seals to enable grouting of the rings as soon as possible after erection and prevent ingress of material into the tail skin. The invert of the tail skin shall be readily accessible, kept free from debris and cleaned as required prior to ring erection.

The lining shall be capable of being built with longitudinal joint rotation. The rings shall be erected in their final position as work proceeds. The faces of all joints shall be cleaned before fastening. Erection of the linings shall commence with the invert segment and any temporary struts or braces required to maintain the diameter and shape of the rings until the annulus has been grouted. Preformed jointing sealants shall be applied, per the manufacturer's recommendations, to all joint faces during erection and compressed within the meeting faces of all rings by a positive means using bolts and/or stressed loops and pins. Care shall be taken to ensure continuity of the joint sealants. Dowel and/or bolt connections shall be used to produce a self-aligning, circular, internal surface, which gives a circumferential face, which remains plane.

The circumferential joints between rings shall be able to withstand the jacking pressures of the tunnel boring machine. Even distribution of

jacking forces to the lining is essential. Any damaged segments due to jacking forces shall be subject to replacement as determined by the Engineer or designated representative.

After the secondary liner has been installed, grouting shall be performed to fill all cavities between the liner and rough tunnel bore surfaces and any void spaces within the supports, if used. If precast concrete segmental tunnel liner is used, grouting shall be done daily and no more than 100 feet (30 meters) of tunnel liner shall be left ungrouted after the segments are in place. A minimum of 3 inches (75 mm) of grout shall be provided between the outside wall of the precast concrete segmental tunnel liner and the inside of the rough bore tunnel.

Grout pipes and fittings shall be provided in the secondary liner to permit the attachment of grout pumps. All grout and vent pipes shall have a minimum 1 1/2 inch (38 mm) diameter and consist of stainless steel pipe as specified in ASTM A 312.

Care should be taken to avoid premature clogging of grout pipes and any grout pipe that becomes clogged or obstructed before completion of operations shall be cleaned out or repaired if required.

All grout pipes and fittings shall be cleaned thoroughly of all dirt, grease, grout and mortar immediately prior to installation.

8. Cast in Place Concrete Lining

Lining may be a single, two stage or a secondary liner. The single or two stage lining shall be placed immediately behind the excavation and completely fill the space between the rock and the lining. Suitable weep devices shall be incorporated into the pour to prevent a hydrostatic buildup behind the concrete while curing.

When cast in place concrete is used as a secondary liner, it shall be constructed in the excavated tunnel using the unsupported tunnel wall or primary lining for the outside form as indicated on the Drawings.

9. Pipe in Tunnels

All pipe shall be laid to the required line and grade through the tunnel previously prepared. Pipe shall be handled and placed in tunnels by the use of proper skids, wedges, guide rails or other approved means and care shall be taken that once the pipe is in place to line and grade, it shall not be disturbed or become displaced.

All water and wastewater pipe in tunnels shall be supported on a cradle bedding of Class B concrete conforming to Standard Specification Item No. 403, "Concrete for Structures", except the cement content may be reduced to not less than 4 sacks per cubic yard (225 Kg per cubic meter), provided that in no case shall the 28 day minimum compressive strength be less than 2,250 psi (15.5 mPa). The concrete bedding shall be so placed and compacted that it is in contact with the bottom portion of the

pipe for at least 90 degrees in the cradle area or to details indicated on the Drawings.

a) Reinforced Concrete Pipe

Unless otherwise specified on the Drawings, reinforced concrete pipe shall conform to the City of Round Rock Standard Specification Item No. 510, "Pipe".

b) Corrugated Galvanized Steel Pipe Unless otherwise specified on the Drawings, corrugated galvanized metal pipe shall conform to Item No. 510, "Pipe".

c) Concrete Lined Corrugated Metal Pipe Unless otherwise specified on the Drawings, concrete lined corrugated metal pipe shall conform to Item No. 510, "Pipe".

10. Tunnel Shield

A tunnel shield shall be used for all tunnel excavation requiring tunnel liner plate for support. The upper half of the tunnel heading shall be supported, whenever ground conditions indicate potential raveling of the crown. Over excavation of the tunnel cross section shall be limited to that required to maintain the proper grade and alignment of the tunnel shield. The tunnel heading shall be completely closed off whenever tunneling work is not being performed.

11. Patching and Cleanup

Upon completion of tunnel grouting, the Contractor shall remove or cut off all grout pipes and fittings from the cast in place concrete or precast concrete pipe to a minimum depth of 1 inch (25 mm), measured from the inside finished face. All holes or depressions thus formed shall be patched in accordance with the manufacturer's procedures with a non-shrinking chemical grout suitable for use in sewers and hydrogen sulfide corrosive atmospheres. All surface areas to be patched shall be clean and free of contamination. The patching shall be done in a neat and workmanlike manner so as to provide a surface smoothness at least equal to undisturbed areas of the concrete lining.

During the work, the Contractor shall provide for adequate disposal of all wash wastewater and shall remove all waste grout caused by his operations. Prior to final acceptance of the work, the interior surface of the tunnel lining shall be thoroughly cleaned.

Verification of the adequacy of the grouting operation will be required. Verification will be accomplished by coring the tunnel lining at locations determined by the Engineer or designated representative. Any voids discovered will be filled with grout as directed by the Engineer or designated representative.

12. Construction Tolerances

The finished tunnel liner shall be constructed to the following tolerances:

Alignment:	± 3 inches (± 75 mm)
Grade	± 3 inches (± 75 mm)
Diameter of Lining:	± 1/2 inch (± 12.5 mm)
Maximum offset between adjacent edges of adjacent rings in the invert of precast liner segments:	3/16 inch (4.8 mm)

13. Permanent Station Markers

Permanent markers shall be installed in the interior crown of the permanent lining of the tunnel at 100 feet (30 meters) intervals along the pipeline stationing as indicated on the Drawings.

14. Drawings and Data

Drawings, specifications, samples and other data showing details of fabrication, construction and installation of the tunnel, together with complete data covering all materials, shall be submitted prior to commencing any tunnel excavation work. The above information shall be submitted to the Engineer or designated representative for reference and record purposes.

502.6 Measurement

Tunneling will be measured by the lineal foot (meter: 1 meter equals 3.281 feet) along the centerline of completed tunnel of the various sizes of lining in accordance with these specifications and the Drawings, complete in place and accepted by the Engineer or designated representative including all excavation, blasting, ventilation, supports, primary and final lining, grouting, survey monuments, portal and backfilling, unless otherwise specified.

Transitions will be measured by the lineal foot (meter) along the centerline of the completed tunnel for the largest size of lining.

502.7 Payment

The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" shall be paid for at the unit bid price per lineal foot. This price shall include full compensation for:

- (a) furnishing all materials, pipe, liner materials required for tunnel operations,
- (b) all preparation, hauling and installing of same and
- (c) all labor, tools, equipment and incidentals necessary to complete the work, including excavation, backfilling and disposal of surplus material.

Payment when included as a contract pay item will be made under one or more of the following:

Tunneling, _____ Per Lineal Foot.

End

<u>SPECIFIC</u> Cross Reference Materials

Standard Specification Item Number 502, "Tunneling"

TxDOT Specifications

<u>Designation</u>	<u>Description</u>
Item 7.9	Use of Explosives
Item 421	Portland Cement Concrete
Item 431	Pneumatically Placed Concrete

City of Round Rock Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 510	Pipe

Uniform Fire Code

<u>Designation</u>	<u>Description</u>
Article 77	Explosive Materials
Article 80	Hazardous Materials

American Society for Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
ASTM A 36/A 36M	Specification for Structural Steel
ASTM A 82/A 36M	Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A 185	Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement
ASTM A 283 /283M	Specification for Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars
ASTM A 307	Specification for Carbon Steel Externally Threaded Standard Fasteners
ASTM A 312	Specification for Seamless and Welded Austenitic Stainless Steel Pipe
ASTM A 449	Specification for Quenched and Tempered Steel Bolts and Studs
ASTM A 496	Specification for Steel Wire, Deformed, for Concrete Reinforcement
ASTM A 497	Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement
ASTM A 569	Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality
ASTM A 615	Specification for Deformed and Plain-Billet Steel Bars for Concrete Reinforcement
ASTM C 33	Specification for Concrete Aggregates
ASTM C 39	Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 150	Specification for Portland Cement
ASTM C 497/497M	Method of Testing Concrete Pipe, Sections or Tile
ASTM F432	Specification for Roof and Rock Bolts and Accessories

American Association of State Highway and Transportation Officials (AASHTO)

<u>Designation</u>	<u>Description</u>
M181	Chain Link Fence

American Concrete Institute (ACI)

<u>Designation</u>	<u>Description</u>
ACI 506.2	Specification for Shotcrete

ITEM NO. 503

FRAMES, GRATES, RINGS AND COVERS

503.1 Description

This item shall govern furnishing and installation of frames, grates, rings and covers for inlets, manholes and other structures indicated on the Drawings.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

503.2 Submittals

The submittal requirements of this specification item include manufacturer, model number, description, painting requirements and characteristics of frames, grates, rings, covers, height adjustment insert and nuts and bolts required for completion of the work.

503.3 Materials

The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation in the Work is the kind and quality that satisfies the specified functions and quality. Items shall conform to the items shown on the Drawings, called for in the specifications, or specified in the Bidding Requirements, Contract Forms and Conditions of Contract, unless approved by the Engineer or designated representative.

A. Welded

Steel Welded steel grates and frames shall conform to the number; size, dimensions and details indicated on the Drawings and shall be welded into an assembly in accordance with those details. Steel shall conform to the requirements of ASTM A 36/A 36M, "Specification for Structural Steel".

B. Castings

Castings, whether Carbon-Steel, Gray Cast Iron or Ductile Iron shall conform to the shape and dimensions indicated on the Drawings and shall be clean substantial castings, free from sand or blowholes or other defects. Surfaces of the castings shall be free from burnt on sand and shall be reasonably smooth. Runners, risers, fins and other cast on pieces shall be removed from the castings and such areas ground smooth. Bearing surfaces between manhole rings and covers or grates and frames shall be cast or machined with such precision that uniform bearing shall be provided throughout the perimeter area of contact. Pairs of machined castings shall be matchmarked to facilitate subsequent identification at installation with the exception of water and wastewater manhole and valve castings. These manhole and valve castings shall be fabricated with such draft, tolerances, bolt hole spacing, etc., that all rings and covers of a particular type or class are interchangeable and match-marking will not be required.

Steel castings shall conform to ASTM A 27/27M, "Specifications for Steel Castings, Carbon, for General Application". Grade 70-36 (480-250) shall be

furnished unless otherwise specified on the Drawings.

Cast iron castings shall conform to ASTM A 48, "Specification for Gray Iron Castings", Class 30.

Ductile Iron castings shall conform to ASTM A 536, "Specification for Ductile Iron Castings". Grade 60-40-18 (415-275-125) shall be used unless otherwise indicated on the Drawings.

C. Manhole Cover Riser Rings

Height-adjustment inserts for wastewater manhole rings, which are used for raising standard manhole covers, shall be as shown on the Drawings unless otherwise approved by the Engineer or designated representative.

D. Nuts and Bolts

Nuts and bolts shall be hex head 5/8" x 2.5" (16 mm x 63.5 mm) #11 National Coarse Thread, Type 316 stainless steel. For bolted manhole covers, a thin film of an approved "Anti-freeze" compound, approved by the Engineer or designated representative, shall be applied to all bolts.

E. Mortar

Unless otherwise specified or approved by the Engineer or designated representative, the mortar for bedding castings shall consist of one (1) part Portland cement and three (3) parts sand and sufficient water to provide the desired consistency. The gradation of the fine aggregate shall meet the requirements for Grade No. 1, Item No. 403, "Concrete for Structures".

503.4 Construction Methods

Frames, grates, rings and covers shall be constructed of the specified materials in accordance with the details indicated on the Drawings. The Frames, grates, rings and covers shall be placed carefully to the lines or grades indicated on the Drawings or as directed by the Engineer or designated representative.

All welding shall conform to the requirements of the ANSI/AWS Structural Welding Code D1.1. Welded frames, grates, rings and covers shall be given 1 coat of a commercial grade red lead oil paint and 2 coats of commercial grade aluminum paint. All coats shall be a minimum of 1.5 mils (0.4 mm), dry.

Painting of gray iron castings will not be required, except when used in conjunction with structural steel shapes.

503.5 Measurement and Payment

Frames, grates, rings and covers will not be measured and payment for furnishing all materials, tools, equipment, labor and incidentals to complete the Work will be included in the Bid Items which constitute the complete structures.

End

<u>SPECIFIED</u> Cross Reference Materials

Standard Specification Item Number 503, "Frames, Grates, Rings and Covers"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 403	Concrete for Structures

American Society for Testing Materials (ASTM)

<u>Designation</u>	<u>Description</u>
A36/A36M	Specification for Structural Steel
A27/A27M	Specification for Steel Castings, Carbon, for General Application
A48	Specification for Gray Iron Castings
A536	Specification for Ductile Iron Castings

ANSI/AWS

<u>Designation</u>	<u>Description</u>
Code D 1.1	Structural Welding Code

<u>RELATED</u> Cross Reference Materials

Standard Specification Item Number 503, "Frames, Grates, Rings and Covers"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 504	Adjusting Structures
Item No. 510	Pipe

TxDOT Specifications

<u>Designation</u>	<u>Description</u>
Item 421	Portland Cement Concrete

ITEM NO. 504

ADJUSTING STRUCTURES

504.1 Description

This item shall govern the removal and replacement of surfacing, furnishing of materials, adjusting and/or repositioning existing structures, valve boxes, pull boxes, survey monument boxes and water meters in accordance with these specifications to the locations or elevations indicated on the Drawings or as directed by the Engineer or designated representative. This item shall also govern any pumping, bailing and drainage required to complete the Work and Standard Specification Item No. 509, "Trench Safety Systems" for trench walls when indicated on the Drawings.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text the inch-pound units are given preference followed by SI units shown within parentheses

504.2 Submittals

The submittal requirements of this specification item include:

- A. Aggregate type, gradations and physical characteristics for the Portland cement concrete mix.
- B. Proposed proportioning of materials for the mortar mix.
- C. Type of structures and proposed adjustment technique (lowering, raising, lateral displacement).
- D. Type of structure, repair technique and materials to be furnished (new replacement or reuse of existing). Type of mixing plant and associated equipage including chart indicating the calibration of each cold bin.

504.3 Materials

Precast reinforced concrete rings and castings in good condition, which are removed from the structures to be adjusted, may be reused with the written approval of the Engineer or designated representative. Additional materials required shall conform to the details indicated on the Drawings.

- A. Portland Cement Concrete The Portland cement concrete shall be Class A conforming to Standard Specification Item No. 403, "Concrete for Structures".
- B. Mortar Unless otherwise specified or approved by the Engineer or designated representative, the mortar for bedding castings shall consist of one (1) part Portland cement and three (3) parts sand, by volume based on dry materials. Sufficient water will be added to provide the desired consistency. The gradation of the fine aggregate shall meet the requirements for "Fine Aggregate" as given in Standard Specification Item No. 403, "Concrete for Structures".

504.4 Construction Methods

All adjustments shall be completed prior to the placement of the final surface.

Pull box and valve box components scheduled for reuse shall be carefully removed and the contact areas shall be cleaned of all mortar, concrete, grease and sealing compounds. Any items broken in the process of removal and cleaning shall be replaced in kind by the Contractor at his own expense.

If the adjustment involves slight lowering or raising a valve box or survey monument box, the outside shell of a slip or screw casing shall be excavated to its full length and adjusted to the proposed grade. Pipe castings shall be excavated to the depth required to cut from or weld a section to the casing as may be needed to adjust the ring to the proposed elevation. The ring shall be welded to the casing prior to pouring concrete around the casing.

If the adjustment involves a vertical (lowering or raising) or a horizontal reassignment of a water meter and the property owner's cut off valve, this work shall be completed in accordance with the Drawings.

After the adjustments have been completed and cured, structures within the paved area shall be paved as indicated on the Drawings.

504.5 Measurement

The work performed and materials furnished as prescribed by this item as indicated shall be measured per each.

504.6 Payment

The work performed, materials furnished and measures as provided above, will be paid by the unit bid price per each. The price shall include full compensation for furnishing all materials, handling, placing, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under one of the following:

Adjusting Water Meters -	Per Each
Repositioning & Adjusting Water Meters -	Per Each
Adjusting Gas Valve Boxes to Grade -	Per Each
Adjusting Survey Monument Boxes to Grade -	Per Each
Adjusting Water Valve Boxes to Grade -	Per Each
Adjusting Pull Boxes to Grade -	Per Each

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification 504, "Adjusting Structures"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 403	Concrete for Structures
Item No. 509	Trench Safety Systems

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 504, "Adjusting Structures"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 501	Jacking or Boring
Item No. 502	Tunneling
Item No. 503	Frames, Grates, Rings and Covers
Item No. 505	Concrete Encasement and Encasement Pipe
Item No. 507	Bulkheads
Item No. 508	Miscellaneous Structures and Appurtenances
Item No. 511	Water Valves

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No.421	Portland Cement Concrete

ITEM NO. 505

CONCRETE ENCASEMENT AND ENCASEMENT PIPE

505.1 Description

This item shall govern the furnishing of materials and the methods of constructing a Portland cement concrete encasement or encasement pipe.

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.

505.2 Submittals

The submittal requirements of this specification item include:

- A. Type of pipe, construction methods and sequence,
- B. Aggregate types, gradations and physical characteristics for the Portland cement concrete mix,
- C. Proposed proportioning of materials for the mortar mix.

505.3 Materials

- A. Portland Cement Concrete

The Portland cement concrete shall conform to Class B Concrete, Item No. 403, "Concrete for Structures".

- B. Pipe

Portland Cement concrete pipe shall conform to ASTM C-76, Class III or better.

Corrugated Metal Pipe (CMP) shall conform to Section 510. 2 (8)(o) of the City of Round Rock Standard Specification Item No. 510, "Pipe".

Steel Pipe shall conform to ASTM A134 with a minimum thickness of 3/8 inch (9.5 mm) for pipe with a diameter of 16 inches (400 mm) and greater.

- C. Grout

Grout shall consist of not less than 6 sacks Portland cement per cubic yard (335 kilograms Portland cement per cubic meter) and clean washed sand mixed with water. The grout shall have a consistency such that the grout will flow into and completely fill all voids. If allowed by the Engineer or designated representative, an air entraining admixture may be added to facilitate placement.

505.4 Construction Methods

When indicated on the Drawings or acceptable to Engineer or designated representative, concrete encasement or encasement pipe shall be placed to protect the pipe. Unless approved by the Engineer or designated representative

- (a) the top of the pipe would have less than 30 inches (60 mm) of cover,
- (b) ground water invades the trench, or
- (c) the trench bottom is of unstable material.

If any of these conditions is encountered, the Engineer or designated representative shall be notified and may direct the Contractor to:

- (a) encase the pipe with concrete,
- (b) change pipe material,
- (c) use a higher strength class of pipe, or
- (d) provide an encasement pipe.

Concrete encasement shall extend from 6 inches (150 mm) below to 6 inches (150 mm) above the outer projections of the pipe over the entire width of the trench.

The ends of encasement pipe shall be bulkheaded (Standard Specification Item No. 507) with manufactured boots or, concrete blocks, bricks or stones, dry-stacked without mortar, sufficient to prevent the intrusion of trench backfill material into the encasement, but fitted loosely enough to facilitate the escape of water from the encasement should carrier pipe leakage or failure occur.

505.5 Measurement and Payment

Concrete encasement will be measured by the lineal foot (meter: 1 meter equals 3.281 feet), for size of pipe being encased, complete in place. The measurement will be made between ends of the encasement, along the central axis as installed.

Encasement pipe will be measured by size of encasement installed, complete in place. The measurement will be made between the ends of the pipe, along the central axis as installed.

505.6 Payment

Work performed and materials furnished as prescribed by this item will be subsidiary to Item No. 510, "Pipe" unless included as a separate pay item in the contract. When included for payment, it shall be measured as provided under "Measurement" and will be paid at the unit bid price per lineal foot for "Concrete Encasement" or "Encasement Pipe" of the size indicated on the Drawings. The unit bid price shall include full compensation for furnishing all materials, pipe for all preparation, hauling, installation and for all labor, tools, equipment and incidentals necessary to complete the work, including bench excavation and disposal of surplus material.

Payment, when included as a contract Pay Item, will be made under one of the following:

Concrete Encasement for ____ Dia. Pipe -	Per Lineal Foot
Encasement Pipe ____ Dia., Type ____, -	Per Lineal Foot.

End

<i>SPECIFIC</i> Cross Reference Materials

Standard Specification Item No. 505, "Encasement and Encasement Pipe"

City of Round Rock Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item 403	Concrete For Structures
Item 510	Pipe
Section 510.2(8)(o)	Corrugated Metal Pipe (CMP)

City of Round Rock Standard Details

<u>Designation</u>	<u>Description</u>
Detail 501-1	Encasement Detail w/ Casing Spacers

American Society for Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
A-134	Specification for Pipe, Steel, Electric-Fusion (Arc)-Welded (Sizes NPS 16 and Over)
C-76/C-76M	Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

<i>RELATED</i> Cross Reference Materials

Standard Specification Item No. 505, "Encasement and Encasement Pipe"

TxDOT Specifications

<u>Designation</u>	<u>Description</u>
Item 421	Portland Cement Concrete
Section 421.9	Quality of Concrete
Section 421.2(8)	Mortar and Grout
Item No. 501	Jacking or Boring Pipe
Item No. 502	Tunneling
Item No. 506	Manholes
Item No. 507	Bulkheads
Item No. 593	Concrete Retards

City of Round Rock Standard Specification Items

<u>Designation</u>	<u>Description</u>
Section 510.2(8)(c)	Concrete pipe
Section 510.2(8)(m)	Steel Pipe

ITEM NO. 506 MANHOLES

506.1 Description

This item shall govern construction of manholes, complete in place, and the materials used therein, including excavation, installation, backfilling and surface restoration. It shall also include furnishing and installing rings, covers, and appurtenances, as well as any pumping and drainage necessary to complete the work. Wastewater manholes shall be 'acceptance tested' by the Contractor.

The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation in the Work are of the kind and quality that satisfies the specified functions and quality as specified or presented in the Drawings.

This specification is applicable for projects or work involving either SI or inch-pound units. Within the text and accompanying tables, the SI units are given preference followed by inch-pound units shown within parentheses.

506.2 Submittals

The submittal requirements of this specification item include:

- A. Type, size and manufacturer of manhole (diameter of water or wastewater manhole), structure (precast, cast in place; Standard, Tee, etc), and materials and equipment to be furnished (brick, concrete, seals, rings, covers, etc.)
- B. Aggregate types, gradations and physical characteristics for the Portland cement concrete mix.
- C. Proposed proportioning of materials for the mortar mix.
- D. Proposed Acceptance testing procedure and associated test equipment and materials. Type of structures and proposed adjustment technique (lowering, raising, lateral displacement).
- E. Proposed product for coating the interior surface of new and/or existing wastewater manholes.

Submittal of test Records is required and shall include as a minimum the following items. The test records shall also be included as part of the Project records turned in with the acceptance package.

Name of the manhole manufacturer
Interior surface coating type and application method for Wastewater Manholes
Model and manufacturer of vacuum tester
Date tested/date re-tested
Passed/failed and state what was done to correct the problem
Test Method Used
Location/station of manhole
Precast/cast-in- place bottom
Any repairs made to the joints.

506.3 Materials and Components

A. Concrete and Cement Stabilized Sand

All concrete shall conform to Standard Specification Item No. 403, "Concrete for Structures". Cast in place concrete shall be Class A, and precast concrete manhole base sections, riser sections and appurtenances shall conform to the requirements of ASTM C478/C478M, "Standard Specification for Precast Reinforced Concrete Manhole" with Class I concrete. All interior surfaces of wastewater manholes shall receive a coating by an application method acceptable to the Engineer or designated representative or shall be otherwise acceptably protected from the acidic effects of municipal wastewater. Concrete for backfill of over-excavated areas shall be Class A or Class J as indicated on the Drawings. Cement stabilized sand for bedding or backfilling, when indicated or required on the Drawings, shall contain 2 bags of Portland Cement per cubic yard (112 kilograms of Portland cement per cubic meter). The sand shall meet the requirements for "Fine Aggregate" in Standard Specification Item No. 403, "Concrete For Structures".

B. Mortar

The mortar shall be composed of one part Portland cement, one part masonry cement (or 1/4 part hydrated lime), and sand equal to 2-1/2 to 3 times the sum of the volumes of the cements and lime used. The sand shall meet the requirements for "Fine Aggregate" as given in Standard Specification Item No. 403 "Concrete For Structures".

C. Reinforcement

The reinforcing steel shall conform to the requirements of Standard Specification Item No. 406, "Reinforcing Steel".

D. Brick

The brick for ring adjustment courses and for stormwater manholes shall be of first quality, sound, hard burned, perfectly shaped brick conforming to the requirements of ASTM C 62, Grade SW, or concrete brick meeting the requirements of ASTM C 55, Grade N-1.

E. Rings and Covers

Rings and covers shall conform to the requirements of City of Round Rock Standard Specification Item No. 503 "Frames, Grates, Rings and Covers".

1. Replacement Rings and Covers, 24 in. (610 mm) Diameter Lids.

This ring and cover shall be used for the replacement of broken rings and covers, minor manhole adjustment, or as otherwise directed by the Engineer or designated representative.

2. Rings and Covers, 32 in. (813 mm) Diameter Lids.

This ring and cover shall be used for all new manhole construction, except as otherwise directed by the Engineer or designated representative.

F. Bulkheads.

Bulkheads shall meet the requirements of City of Round Rock Standard Specification Item No. 507 "Bulkheads".

G. Precast Base Sections, Riser Sections, and Cones.

Precast concrete base sections, riser sections, and cones shall conform to the requirements of ASTM C 478. The width of the invert shall be specifically sized for the connecting pipes. Inverts shall be "U" shaped with a minimum depth of three fourths of the largest pipe diameter. The invert shall have a minimum difference of 0.10 feet (30 mm) between the inlet and outlet. Where lines enter the manhole up to 24 inches (610 mm)) above the flowline of the outlet, the invert shall be filleted to prevent splashing and solids deposition. A drop pipe shall be provided for a sewer entering a manhole at more than 24 inches (610 mm) above the flowline of the outlet.

Joints for wastewater base sections, riser sections, and cones shall conform to the requirements of ASTM C 443. Additionally, joint dimensions for 48-inch (1.22 meters) inside diameter wastewater manhole sections and cones shall comply with City of Round Rock Standard Details. Precast bases for 48 inch (1.22 meters) inside diameter manholes shall have preformed inverts. Inserts acceptable to the Engineer or designated representative shall be embedded in the concrete wall of the manhole sections to facilitate handling; however, through-wall holes for lifting will not be permitted. Any voids between the pipe and invert shall be filled to the springline with a product recommended by the manhole manufacturer to prevent solids collection.

H. Precast Junction Boxes.

Precast junction boxes shall be allowed only where indicated on the Drawings or acceptable to the Engineer or designated representative. Joints for wastewater junction boxes shall conform to the requirements of ASTM C 443.

I. Pipe-to-Manhole/Junction Box Assemblies

Precast bases and precast junction boxes shall have flexible, resilient and non-corrosive boot connectors or ring waterstops acceptable to the Engineer or designated representative conforming to the requirements of ASTM C 923 on all wastewater pipe connections.

J. Precast Flat-Slab Transition/Junction Box Lids.

Unless more stringent requirements are specified on the Drawings, precast slab transitions and lids shall be designed to safely resist pressures resulting from loads which might result from any combination of forces imposed by an HS-20 loading as defined by the American Association of State Highway and Transportation Officials (AASHTO). The joints of precast slab transitions and of lids for wastewater applications shall conform to the requirements of ASTM C443.

K. Precast-Prefabricated Tee Manholes.

Tee manholes shall be allowed only where indicated on the Drawings or as directed by the Engineer or designated representative. The main pipe section shall conform to the requirements of City of Round Rock Standard Specification Item No. 510, "Pipe". The vertical manhole portion (tee) above the main pipe shall conform to the requirements of the precast components.

The manhole tee shall have a minimum inside diameter of 48 inches (1.22 meters) and shall rise vertically centered or tangent to the main pipe, as indicated on the Drawings or as directed by the Engineer or designated representative. An access hole less than 48-inches (1.22 meters) in diameter shall be cut into the main pipe to allow a ledge for support of access ladders. Unless otherwise specified on the Drawings, the main pipe portion of the tee manhole shall be paid subsidiary to the unit tee manhole price.

L. Grade Rings

Rings shall be reinforced Class A or I concrete, or as indicated on City of Round Rock Standard Details.

1. Grade Rings, 24-1/2 inches (622 mm) Inside Diameter:

This adjustment ring shall be used only for adjusting existing manholes with 24 inch (610 mm) lids and for Wastewater Access Device. Inside to outside diameter dimension of ring shall be 6 inches (152 mm) with a thickness of 3 inches to 6 inches (76 mm to 152 mm).

2. Grade Rings, 35 inches (889 mm) Inside Diameter:

This adjustment ring shall be used for all new manhole construction with 32 inches (813 mm) lids. Inside to outside diameter dimension of ring shall be 6 inches (152 mm)) with a thickness of 4 inches to 6 inches (102 mm to 152 mm).

M. New Manhole Construction and Minor Manhole Adjustment:

New manhole construction and minor manhole adjustments shall be performed as indicated on City of Round Rock Standard Details, and shall consist of adding grade rings to adjust the manhole to final grade.

For new manhole construction, the maximum vertical allowable ring adjustment, including the depth of the ring casting, shall be limited to 18 inches (450 mm). For adjustments of existing manholes that fall within the limits of overlay and street reconstruction projects, the maximum vertical allowable, including the depth of the ring casting, shall be limited to two feet (600 mm). All other existing manholes shall have a maximum allowable ring adjustment, including the depth of the ring casting, of one foot (300 mm). Any adjustment that will exceed these requirements shall be accomplished as described below in subsection (N). All manholes not located in paved areas shall have bolted covers.

N. Major Manhole Adjustment:

Any adjustment that exceeds the requirements of subsection (M) Minor Manhole Adjustments, shall be accomplished as indicated and shall consist of any combination of removing the concrete rings, and/or the manhole cone section, and/or the straight riser section of the manhole in order to bring the manhole to final grade. All manholes not located in paved areas shall have bolted covers.

O. Waterproofing Joint Materials.

O-rings and wedge seals for the joints of all wastewater manholes, and for stormwater manholes when indicated on the Drawings, shall conform to the requirements of ASTM C443. Cold applied preformed plastic gaskets for stormwater manholes shall be as specified in City of Round Rock Standard Specification Item No. 510, "Pipe". The connections between reinforced concrete wastewater manhole structures and pipes shall meet the requirements of ASTM C923.

P. Interior Surface Coatings for Wastewater Manholes

The interior surfaces of all wastewater manholes shall be coated with a product as specified on City of Round Rock Standard Details.

Q. Abandonment of Existing Manholes

When designated on the Drawings for abandonment, existing manholes shall be removed to a level not less than four feet (1.2 meters) below grade. The inlets and outlets shall be securely plugged and the structure filled with material in accordance with the Drawings or as directed by the Engineer or designated representative.

506.4 Construction

All manholes shall have a minimum inside diameter of 48 inches (1.22 meters). Manhole base section or junction box dimension shall be appropriately increased to accommodate all converging pipe. A minimum horizontal clearance of 12 inches (300 mm) shall be maintained between adjacent pipes. Pipe ends within the base section or junction box walls shall not be relied upon to support overlying manhole dead and live load weights. All wastewater branch connections to new or existing mains shall be made at manholes with the influent pipe crown installed at the elevation of the effluent pipe crown. Where lines enter the manhole up to 24 inches (600 mm) above the flowline of the outlet, the invert shall be sloped upward to receive the flow, thus preventing splashing or solids deposition. Where the springline of an influent pipe is 24 inches (600 mm) or more above the springline of the effluent pipe, a drop manhole shall be used. Construction of extensions to existing systems shall require placement of bulkheads at locations indicated or directed by the Engineer or designated representative. Unless otherwise indicated on the Drawings, stormwater manholes shall have eccentric cones; wastewater manholes shall have concentric cones, except on manholes over large mains where an eccentric cone shall be situated to provide access to an invert ledge. Eccentric cones may be used where conflicts with other utilities dictate. Flat-slab tops may be used where clearance problems exist [see

506.3(J) above].

Manholes shall be founded at the established elevations on uniformly stable subgrade. Unstable subgrade shall be over-excavated a minimum of 12 inches (300 mm) and replaced with a material acceptable to the Engineer or designated representative. Precast base units shall be founded and leveled on a 6 inch (150 mm) coarse aggregate bedding. A pipe section with a prefabricated tee manhole and half the length of the adjoining pipe sections on each side shall be founded on a minimum of 6 inch (150 mm) unreinforced Class A concrete (City of Round Rock Standard Specification Item No. 403, "Concrete For Structures). The cast-in-place concrete cradle shall be placed against undisturbed trench walls up to the pipe's springline.

All adjustments shall be completed prior to the placement of the final surface.

Manhole components to be reused shall be carefully removed and the contact areas shall be cleaned of all mortar, concrete, grease and sealing compounds. Any items broken in the process of removal and cleaning shall be replaced in kind by the Contractor at his expense.

If the adjustment involves lowering the top of a manhole, a sufficient depth of grade rings shall be removed to permit reconstruction. The mortar shall be cleaned from the top surface remaining in place and from all brick or concrete rings to be reused and the manhole rebuilt to the required elevation. The manhole ring and cover shall then be installed with the top surface conforming to the proposed grade.

If the adjustment involves raising the elevation of the top of the manhole in accordance with 506.3 (M), "New Manhole Construction and Minor Manhole Adjustment", the top shall be cleaned and built up vertically to the new elevation, using new grade rings and the ring and cover installed with the top surface conforming to the proposed grade.

Cast-in-place foundations shall have a minimum depth of 12 inches (300 mm) at the invert flowline. The widths of all manhole inverts shall be specifically sized for the connecting pipes. Inverts shall be "U" shaped with a minimum depth of three fourths of the largest pipe diameter. The invert shall have a minimum fall of 0.10 of a foot (30 mm) between the inlet and outlet. The lowermost riser section may be set in the Portland cement concrete, while still green, after which the foundation shall be cured a minimum of 24 hours prior to proceeding with construction of the manhole up to 12 feet (3 2/3 meters) in depth. The foundation shall be cured an additional 24 hours prior to continuing construction above the 12 foot (3 2/3 meters) level. Manhole depth shall be measured from the invert flowline to the finish surface elevation.

Wastewater manholes having cast in place foundations may be constructed over existing wastewater pipes, and the top of the pipe removed to facilitate invert construction. Existing pipes shall be anchored sufficiently so that they are not displaced during manhole construction. The manhole bottom shall rise from the springline elevation of the pipe, approximately one inch for each 12 inches (80 mm per meter) of run (8%). Wastewater manholes with lines larger than 18 inches (450 mm) shall require precast bases; manholes constructed over in-service mains however, may be built on cast-in-place foundations if the flow cannot be interrupted. Precast and cast-in-place wastewater junction boxes shall be allowed only where indicated on the Drawings or

acceptable to the Engineer or designated representative. The floors of stormwater manholes also, shall rise outwardly from the springline on a slope of 1:12 or 80 mm per meter (8%).

Wastewater lines, except reinforced concrete pipe, set in cast-in-place foundations, shall require a waterstop seal or gasket acceptable to the Engineer or designated representative around the outside perimeter of the pipe. It shall be approximately centered under the manhole section wall.

Cast-in-place stormwater manholes, junction boxes and flat-slab transitions shall be reinforced, Class A concrete (Standard Specification Item No. 403, "Concrete for Structures"). All structural concrete work shall conform to Standard Specification Item No. 410, "Concrete Structures". Forms will be required for all cast-in-place walls and foundation. Where the surrounding material can be trimmed to a smooth vertical face, outside forms may be omitted.

Backfilling for manholes shall conform to the density requirements of City of Round Rock Standard Specification Item No. 510, "Pipe". Manhole construction in roadways may be staged to facilitate base construction. Manholes constructed to interim elevations shall be covered with steel plates of sufficient thickness to support vehicular traffic. Steel plates on wastewater manholes shall be set in mortar or other provisions, acceptable to the Engineer or designated representative, shall be made to minimize inflow. Manholes shall be completed to finish elevation prior to placement of the roadway's finish surface. The excavation for completion of manhole construction shall be backfilled with cement stabilized sand with 2 sacks of cement per cubic yard (112 kilograms of cement per cubic meter) up to the bottom of Portland Cement pavement slabs or to within 2 inches (50 mm) of finish elevation of asphaltic concrete pavements. The cement stabilized sand shall be a minimum of 12 inches (300 mm) thick.

After rings and covers are set to grade, the inside and outside of the concrete rings shall be wiped with mortar so placed as to form a durable water-tight joint, smooth and even with the manhole cone section. No grouting shall be performed when the atmospheric temperature is at or below 40°F (5°C), and when necessary, because of a sudden drop in temperature, joints shall be protected against freezing for at least 24 hours.

506.5 Acceptance Testing of Wastewater Manholes

Manholes shall be tested separately and independently of the wastewater lines.

A. Test by the Vacuum Method:

A vacuum test shall be performed by the Contractor prior to backfilling manholes where detouring of vehicular traffic is required. A second vacuum test will not be required after backfilling and compaction is complete unless there is evidence that the manhole has been damaged or disturbed subsequent to the initial vacuum test.

For manhole installations which do not require detouring of vehicular traffic, the vacuum method is recommended and may be used by the Contractor prior to backfilling the manhole to insure proper installation so that defects may be located and repaired; however, a vacuum test shall be performed after

backfilling, and compaction are complete. Testing after backfill and compaction are complete will be the basis for acceptance of the manhole.

1. Equipment:

- a) The manhole vacuum tester shall be a device approved for use by the Engineer or designated representative.
- b) Pipe sealing plugs shall have a load resisting capacity equal to or greater than that required for the size of the connected pipe to be sealed.

2. Procedures - applicable to new 4'-0" (1.22 meter) diameter manholes.

- a) Manhole section interiors shall be carefully inspected; units found to have through-wall lift holes, or any penetration of the interior surface by inserts provided to facilitate handling, will not be accepted. Coating shall be applied after the testing unless coating is applied before installation or unless it is applied at the factory. All lift holes and exterior joints shall be plugged with an acceptable non-shrink grout. No grout shall be placed in horizontal joints.
- b) After cleaning the interior surfaces of the manhole, the Contractor shall place and inflate pneumatic plugs in all of the connecting pipes to isolate the manhole; sealing pressure within the plugs shall be as recommended by the plug manufacturer. Plugs and the ends of pipes connected by flexible boots shall be blocked to prevent their movement during the vacuum test.
- c) The vacuum test head shall be placed on the top of the cone section or, inside of the top of the manhole cone section, and the compression seal band inflated to the pressure recommended by its manufacturer. The vacuum pump shall be connected to the outlet port with the valve open. When a vacuum of 10 inches (254 mm) of mercury [(-5 psig) {-35 kPa}] has been attained, the valve shall be closed and the time noted. Tampering with the test equipment will not be allowed.
- d) The manhole shall have passed the test if the vacuum does not drop below 9 inches (229 mm) of mercury [(-4.5 psig){-31 kPa}] within three (3) minutes of the time the valve was closed. The actual vacuum shall be recorded at the end of the three (3) minutes during which the valve was closed.
- e). When the standard vacuum test cannot be performed because of design or material constraints (examples: T-Type manholes, T-Lock Liners, or other reasons acceptable to the Engineer or designated representative), testing of individual joints shall be performed as directed by the Engineer or designated representative.

B. Test by the Exfiltration Method:

At the discretion of the Engineer or designated representative, the Contractor may substitute the Exfiltration Method of testing for the Vacuum test described in Section 506.5. A above. This method may only be used when ground water is not present. If ground water is present a Vacuum Test shall be used unless otherwise directed by the Engineer or designated representative. All backfilling and compaction shall be completed prior to the commencement of testing.

The procedures for the test shall include the following:

1. Manhole section interiors shall be carefully inspected; units found to have through-wall lift holes, or any penetration of the interior surface by inserts provided to facilitate handling, will not be accepted. Coating shall be applied after the testing unless coating is applied before field assembly, or at the factory. All lift holes and exterior joints shall be plugged with an acceptable non-shrink grout. No grout shall be placed in horizontal joints.
2. After cleaning the interior surface of the manhole, the Contractor shall place and inflate pneumatic plugs in all of the connecting pipes to isolate the manhole; sealing pressure within the plugs shall be as recommended by the plug manufacturer.
3. Concrete manholes shall be filled with water or otherwise thoroughly wetted for a period of 24 hours prior to testing.
4. At the start of the test, the manhole shall be filled to the top with water. The test time shall be 1 hour (60 minutes). The Construction Inspector must be present for observation during the entire time of the test. Permissible loss of water in the 1 hour test time is 0.025 gallons per diameter foot, per foot of manhole depth (1.0 liter per diameter in meters, per meter of manhole depth). For a 4 foot (1.22 meter) diameter manhole, this quantity converts to a maximum permissible drop in the water level (from the top of the manhole cone) of 0.05 inches per foot (4 mm per meter) of manhole depth or 0.5 inches for a 10 foot (12.5 mm for a 3 meter) deep manhole.

C. Failure to Pass the Test - Records of Tests.

If the manhole fails to pass the initial test method as described in (A) Test by the Vacuum Method and, if allowed, (B) Test by the Exfiltration Method, or if visible groundwater leakage into the manhole is observed, the Contractor shall locate the leak, if necessary by disassembly of the manhole. The Contractor shall check the gaskets and replace them if necessary. The Contractor may re-lubricate the joints and re-assemble the manhole, or the Contractor may install an acceptable exterior joint sealing product on all joints and then retest the manhole. If any manhole fails the vacuum and/or exfiltration test twice, the Contractor shall consider replacing that manhole. If the Contractor chooses to attempt to repair that manhole, the manhole must be retested until it passes. In no case shall cold applied preformed plastic gaskets be used for repair. Records of all manhole testing shall be made available to the Engineer or designated

representative at the close of each working day, or as otherwise directed by the Engineer or designated representative. Any damaged or visually defective products, or any products out of acceptable tolerance shall be removed from the site.

D. Inspection.

The Engineer or designated representative shall make a visual inspection of each manhole after it has passed the testing requirements and is considered to be in its final condition. The inspection shall determine the completeness of the manhole; any defects shall be corrected to the satisfaction of Engineer or designated representative.

506.6 Measurement

All junction boxes and manholes of the type indicated shall be measured as units complete in place.

New manholes constructed to interim elevations to facilitate stage construction shall be measured as one unit regardless of the number of interim elevations constructed. All labor, materials and other expenses necessary for the stage construction shall be considered subsidiary to the completed unit. Abandonment of existing manholes shall be considered subsidiary to the completed unit, unless a specific pay item is indicated on the Drawings and identified on the Bid Form.

506.7 Payment

Payment for completed junction boxes and manholes of the type indicated shall be made at the unit bid price for each. The unit bid price shall include all labor, equipment, materials, time and incidentals necessary to complete the work. When indicated in the Drawings, abandonment of existing manholes shall be made at the unit price for abandonment.

The intended use of each item shall be designated by a two-letter code (Wastewater = WW; Stormwater =SW) in the spaces provided after the pay item number:

New Manhole Construction, ____ Dia.	Per Each
Special Manhole, ____ Dia.	Per Each
Drop Manhole, ____ Dia.	Per Each
Centered Tee Manhole, ____ Dia. x ____ Dia.	Per Each
Tangent Tee Manhole, ____ Dia. x ____ Dia.	Per Each
Junction Box, ____ Ft x ____ Ft	Per Each
Major Manhole Adjustment, ____ Dia.	Per Each
Minor Manhole Adjustment, ____ Dia.	Per Each
Abandonment of existing Manholes:	Per Each

End

<u>SPECIFIC</u> Cross Reference Materials

Standard Specification Item No. 506, "Manholes"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item 403	Concrete For Structures
Item 410	Concrete Structures
Item 406	Reinforcing Steel
Item 503	Frames, Grates, Rings and Covers
Item 504	Adjusting Structures
Item 507	Bulkheads
Item 510	Pipe

American Society for Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
ASTM C 55	Specification for Concrete Building Brick
ASTM C478/C478M	Standard Specification for Precast Concrete Manhole
ASTM C443/C443M	Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C923/C923M	Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures Pipes

<u>RELATED</u> Cross Reference Materials

Standard Specification Item No. 506, "Manholes"

American Society for Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
ASTM C 62	Specification for Building Brick (Solid Units Made from Clay or Shale)
ASTM C478/C478M	Specification for Precast Reinforced Concrete Manhole Sections

American Association of State Highway and Transportation Officials (AASHTO)

<u>Designation</u>	<u>Description</u>
M306	Standard Specifications for Drainage Structure Castings

ITEM NO. 507 BULKHEADS

507.1 Description

This item shall govern furnishing and installing plywood or end caps as a temporary utility plug at locations indicated on the Drawings or as directed by the Engineer or designated representative. The work will be placed in conjunction with installation of a pipe where a continuation of the utility system will be performed later.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

507.2 Submittals

The submittal requirements of this specification item include the type (wood, plastic, rubber, etc.) and application (pipe characteristics and location) of bulkheads.

507.3 Material

Plywood shall be construction grade, 3/4 inch (19 mm) thick and need not be new or treated. End caps may be plastic, vitrified clay pipe, rubber or concrete.

507.4 Construction Methods

After installation of the utility requiring temporary bulkheading, an end cap or a section of plywood, having dimensions at least 6 inches (150 mm) in excess of the outside pipe diameter shall be attached to the exposed bell or spigot and backfilled immediately after installation. Care shall be exercised to prevent the backfill material from entering the pipe.

Bulkheads used with staged construction shall be sound, reasonably free of knots and warps and have a 3 inch (75 mm) nominal thickness.

507.5 Measurement and Payment

Bulkheading will not be measured and paid for separately but shall be considered subsidiary to the pipe or manhole for which payment is made.

END

<u>RELATED</u> Cross Reference Materials

Standard Specification Item No. 507, "Bulkheads"

City of Round Rock Standard Specification

<u>Designation</u>	<u>Description</u>

Item No. 506	Manholes

Item No. 510	Pipe

ITEM NO. 508
MISCELLANEOUS STRUCTURES AND APPURTENANCES

508.1 Description

This item governs the construction of miscellaneous structures and appurtenances, complete in place or to the stage detailed and/or indicated in the Drawings, using the materials specified herein, including the excavation, installation, backfilling, placement of concrete and when required, the furnishing and installation of frames, grates, rings, covers, safety end treatment and any concrete curb and gutter indicated on the Drawings.

This specification is applicable for projects or work involving either SI or inch-pound units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses

508.2 Submittals

The submittal requirements of this specification item include:

- A. Type of structure and appurtenances (inlets, headwalls, frames, grates, energy dissipators, etc.), construction methods and sequence (precast, cast in place), materials (bolts, nuts, plates, angles, etc.)
- B. Aggregate types, gradations and physical characteristics for Portland cement concrete mix.
- C. Proposed proportioning of materials for mortar mix.
- D. Analysis and thickness calculations for temporary steel covers.

508.3 Types

The various types of structures and appurtenances such as inlets, headwalls, energy dissipators, etc., are designated on the Drawings for the particular design of structure to be constructed in accordance with the details indicated on the Drawings. Unless otherwise indicated on the Drawings, the Contractor may have the option of furnishing cast in place or precast structures.

508.4 Materials

- A. Portland Cement Concrete

Portland cement concrete shall conform to Item No. 403, "Concrete For Structures", with the following classes:

Cast in Place Concrete	Class	A
Precast Concrete	Class C	

- B. Mortar

Mortar shall be composed of 1 part Portland cement and 2 parts clean, sharp mortar sand suitably graded for the purpose by conforming in other respects to the provisions of Standard Specification Item No. 403, "Concrete for Structures"

for fine aggregate. Hydrated lime or lime putty may be added to the mix, but in no case shall it exceed 10 percent by weight (mass) of the total dry mix.

C. Reinforcement and Steel

Reinforcing Steel shall conform to Standard Specification Item No. 406, "Reinforcing Steel".

Structural Steel shall conform to Standard Specification Item No. 720, "Metal for Structures".

D. Frames, Grates, Rings and Covers

Frames, grates, rings and covers shall conform to City of Round Rock Standard Specification Item No. 503, "Frames, Grates, Rings and Covers".

E. Safety End Treatment for Structures

The safety end treatment for structures shall conform to TxDOT Specification Item No. 467, "Safety End Treatment".

1. Bolts and Nuts. All bolts, nuts and associated hardware shall meet the specifications of ASTM A 307.
2. Plates and Angles. All plates and similar angles and brackets shall meet the specifications of ASTM A 36.
3. Pipe Runners. Pipe Runners shall conform to the requirements of ASTM A53, Grade B.
4. Galvanizing. All hardware including nuts, bolts and plates listed above shall be galvanized conforming to ASTM A 123 or A 153.

F. Miscellaneous Items

Cast iron for supports, steps and inlet units shall conform to the shape and dimensions indicated on the Drawings. The casting shall be clean and perfect, free from sand or blowholes or other defects. Cast iron castings shall meet the requirements of ASTM A 48, Class 30. Steel for temporary covers when used with stage construction shall be adequate for the loads imposed.

508.5 Construction Methods

All concrete work shall be performed in accordance with Standard Specification Item No. 410, "Concrete Structures". Forms will be required for all cast-in-place concrete walls, except where the nature of the surrounding material is such that it can be trimmed to a smooth vertical face (the outside form for concrete bases). Where cast in place concrete is used in wall construction of storm sewers, the steps shall be cast into the wall when the concrete is placed.

Inlets shall be completed, as soon as is practicable after installation is complete of the lines to the inlet. All lines shall be cut neatly at the inside face of the walls of the inlet and pointed up with mortar.

Bases for cast in place inlets may be placed prior to, or at the Contractor's option, after the line is constructed.

Manholes may be constructed prior to backfilling or if the Contractor so elects, the manhole opening may be covered temporarily with a steel plate to facilitate the compaction of backfill for the sewer as a whole. Thereafter, required excavation for the manhole shall be made and the manhole constructed and backfilled.

The inverts in inlets shall be shaped and grouted across the floor of the inlet as indicated on the Drawings. This shaping may be accomplished by adding shaping mortar or concrete after the base is cast or by placing the required additional material with the base.

All miscellaneous structures shall be completed in accordance with the details indicated on the Drawings. Backfilling shall be in accordance with the provisions of the appropriate items and as directed by the Engineer or designated representative.

Energy dissipators and headwalls shall be constructed in accordance with the Drawings.

508.6 Measurement

All miscellaneous structures and safety end treatments satisfactorily completed as indicated on the Drawings will be measured as completed units per each.

Concrete removal, excavation and backfill, riprap, pipe, headwalls, wing walls, collars and apron slabs will not be measured under this item but will be considered subsidiary to the other items.

Frames, grates, rings, covers, safety end treatment and any concrete curb and gutter indicated will not be measured and paid for but shall be considered subsidiary to one of the pay items identified in the bid.

508.7 Payment

A. Inlets

Payment for Inlets of the type indicated in place in accordance with these specifications and measured as prescribed above will be made at the unit bid price for each Inlet, of the type specified.

B. Energy Dissipators and Headwalls

Payment will be made at the unit price bid per each.

C. Safety End Treatment

Payment for Safety End Treatment, complete in place, will be made at the unit bid price for each unit of the type indicated on the Drawings.

Payment will be made under one of the following:

Energy Dissipators, _____ In. Dia. -	Per Each.
Headwalls, Type _____, ____ In. Dia. Pipe -	Per Each.
_____ Grate Inlet -	Per Each.
Safety End Treatment, Type ____ Size ____	Per Each
_____ Foot Standard Inlet -	Per Each.

End

<u>SPECIFIC</u> Cross Reference Materials
Standard Specification Item No. 508, "Miscellaneous Structures and Appurtenances"

City of Round Rock Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 403	Concrete For Structures
Item No. 406	Reinforcing Steel
Item No. 410	Concrete Structures
Item No. 720	Structural Steel
Item No. 503	Frames, Grates, Rings and Covers

TxDOT Standard Specifications For Construction And Maintenance
Of Highways, Streets, And Bridges

<u>Designation</u>	<u>Description</u>
Item 467	Safety End Treatment

American Society for Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
ASTM A36/36M	Specification for Structural Steel
ASTM A48	Specification for Gray Iron Castings
ASTM A53	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
ASTM A123	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	Specifications for Carbon Steel Externally Threaded Standard Fasteners
ASTM C913	Specifications for Precast Concrete Water and Wastewater Structures

<u>RELATED</u> Cross Reference Materials
Standard Specification Item No. 508, "Miscellaneous Structures and Appurtenances"

City of Round Rock Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 501	Jacking or Boring Pipe
Item No. 502	Tunneling
Item No. 504	Adjusting Structures
Item No. 506	Manholes
Item No. 507	Bulkheads
Item No. 510	Pipe

TxDOT Specifications

<u>Designation</u>	<u>Description</u>
Item 420	Concrete Structures
Item 421	Portland Cement Concrete
Section 421.2(5)	Fine Aggregate
Item 424	Precast Concrete Structures (Fabrication)
Item 440	Reinforcing Steel
Item 466	Headwalls and Wingwalls
Item 467	Safety End Treatment
Item 471	Frames, Grates, Rings and Covers
Item 529	Concrete Curb, Gutter and Combined Curb and Gutter

ITEM NO. 509

TRENCH SAFETY SYSTEMS

509.1 Description

This item shall govern the following:

- A. Designing, furnishing, and installing a Trench Safety System for trench excavation;
- B. Dewatering the area as specified on the Drawings and/or required; and
- C. Maintenance and removal of the trench safety systems as determined by Contractor's Trench Safety Engineer and/or Contractor's Competent Person(s).

This Item also includes special clearing, excavation and backfilling for safety systems. At a minimum, this work shall conform to United States Department of Labor Rules 29 CFR, Part 1926 Occupational Safety and Health Administration (OSHA). The Competent Person(s) shall be on the project whenever workers are in an excavation trench.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

509.2 Trench Safety System Plan Submittal

Prior to, or at the Pre-Construction Conference, the Contractor shall submit to the Owner/Developer a Trench Safety System Plan sealed by a registered Professional Engineer licensed in the State of Texas. Notice to Proceed with construction will not be issued by the Owner until the Contractor has submitted a Trench Safety System Plan to the Owner/Developer.

The Trench Safety System Plan at a minimum shall conform to OSHA standards for sloping of sides, utilization of trench boxes, and/or utilization of shoring, sheeting and bracing methods. The Contractor shall be responsible for obtaining the geotechnical information necessary for the design of the Trench Safety System Plan [normally acquired from borings taken at 500 foot (150 meter) intervals along the proposed centerline to a minimum depth of five feet (1.5 meters) below proposed flowline]. If the geotechnical information for the design of the improvements is acquired by the Owner/Developer or designated representative, it shall be provided to the Contractor for information purposes subject to the provisions of the Contract.

The Trench Safety System Plan submittal shall include:

- A. A Drawing or plan indicating specific designation of areas in which each type of system will be used, including the length of trench to be opened, the length of time that the trench will remain open, the means of egress, the storage of materials, allowable loads on trench walls, the methods for placing/compacting bedding/backfill within the safety system, any equipment restrictions and the subsequent removal of system,
- B. Drawings or manufacturer's data, as applicable, that describe the various elements of the Trench Safety System in sufficient detail that the workers can properly install the Trench Safety System,

- C. Recommendations and limitations for using systems.
- D. Sealed engineering calculations and/or equipment manufacturer's certifications, as applicable, that confirm that the system is designed to withstand the anticipated loadings and that it can be fully installed/implemented in the designated space easement provided.
- E. A Certificate of Insurance of the Trench Safety Engineer's Professional Liability Insurance coverage meeting the requirements of the Contract.
- F. Certificate of Completion of an OSHA-approved program indicating that the Contractor's Competent Person(s) has received training in "Excavation Safety".

509.3 Trench Safety System Plan Review

The review of the Trench Safety System Plan that will be conducted by the Owner/Developer or designated representative shall only relate to general conformance with OSHA standards and regulations. The Owner's/Developer's failure to note exception(s) to the submittal shall not relieve the Contractor of any or all responsibility or liability for the Trench Safety System Plan. The Contractor shall remain solely and completely responsible for all trench safety systems and for the associated means, methods, procedures, and materials.

509.4 Construction Methods

The Contractor's Competent Person(s) shall be responsible for the maintenance of a copy of appropriate OSHA regulations onsite and the implementation of OSHA trenching safety regulations at the work site. Trenching shall be completed to the lines and grades indicated on the Drawings or as specified in various technical standard specification items requiring excavation and trenching and/or backfilling. The Contractor shall perform all trenching in a safe manner and shall maintain safety systems to prevent death or injury to personnel or damage to structures, utilities or property in or near the excavation.

If evidence of possible cave-ins or earthen slides is apparent or an installed trench safety system is damaged, the work in the trench shall immediately cease, personnel evacuated from hazardous area and the Owner/Developer notified. Personnel shall not be allowed to re-enter the excavation until necessary repairs or replacements are completed and are inspected and approved by the Contractor's Competent Person(s). Repair and replacement of damaged safety system shall be at the Contractor's sole expense.

509.5 Changed Conditions

When changed conditions require modifications to the Trench Safety System, the Contractor shall provide to the Owner/Developer or designated representative a new design or an alternate Trench Safety System that is proposed by the Contractor's Trench Safety Engineer to address the changed conditions encountered. Copies of the new design or alternate system shall be provided to the Owner/Developer or designated representative in accordance with the requirements of section 509.2, "Trench Safety

System Plan Submittal". A copy of the most current Trench Safety System shall be maintained on site and made available to inspection and enforcement officials at all times.

Any changes to the Trench Safety System Plan that are initiated by the Contractor for operational efficiency or as a result of changed conditions, that could be reasonably anticipated, will not be cause for contract time extension or cost adjustment. When changes to the Trench Safety System Plan are necessitated by severe and uncharacteristic natural conditions or other conditions totally out of the control of the Contractor, the Contractor may make a written request to the Owner/Developer for a Change Order to address the anticipated work. The Contractor shall notify the Owner/Developer in writing within 24 hours of the occurrence of changed conditions that the Contractor anticipates the submittal of a claim for additional compensation. Under "Changed Conditions" the work deemed immediately necessary by the Contractor to protect the safety of workers and public, equipment or materials may only be accomplished until the Owner/Developer or designated representative has a reasonable opportunity to investigate the Contractor's written request for a Change Order and respond in writing to the request.

509.6 Measurement

Trench Safety Systems shall be measured by lineal foot (meter: 1 meter equals 3.281 feet) through manholes and other appurtenances along the centerline of trench conforming to the Drawings and specifications.

509.7 Payment

Payment for Trench Safety Systems, measured as prescribed above, will be made at unit bid price per centerline lineal foot of trench per the Drawings and specifications. The unit bid price shall include full compensation for designing, furnishing, installing the system; for dewatering, maintenance, replacement and removal of the Trench Safety Systems and for sloping, special clearing, and excavation necessary to safely implement the Trench Safety System Plan.

Payment will be made under the following:

Trench Safety Systems (all depths)	Per Lineal Foot.

END

<u>RELATED</u> Cross Reference Materials

Standard Specification Item No. 509, "Trench Safety Systems

Texas Department of Transportation Standard Specifications
For Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item 104	Removing Concrete
Item 110	Excavation
Item 402	Trench Excavation Protection

City of Round Rock Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 110	Street Excavation
Item No. 111	Excavation
Item No. 130	Borrow
Item No. 132	Embankment
Item No. 201	Subgrade Preparation
Item No. 402	Controlled Low Strength Material
Item No. 501	Jacking or Boring Pipe
Item No. 502	Tunneling
Item No. 503	Frames, Grates, Rings and Covers
Item No. 504	Adjusting Structures
Item No. 505	Concrete Encasement and Encasement Pipe
Item No. 506	Manholes
Item No. 507	Bulkheads
Item No. 510	Pipe
Item No. 511	Water Valves
Item No. 593	Concrete Retards
Item No. 594	Gabions and Revet Mattresses

ITEM NO. 510 PIPE

510.1 Description

This item shall consist of furnishing and installing all pipe and/or materials for constructing pipe mains, sewers, laterals, stubs, inlet leads, service connections and culverts, including all applicable Work such as excavating, bedding, jointing, backfilling materials, tests, concrete trench cap, concrete cap and encasement, etc., prescribed under this item and in accordance with the provisions of the Edwards Aquifer Protection Ordinance, when applicable. The pipe shall be of the sizes, types, class and dimensions indicated or as designated by the Engineer or designated representative and shall include all joints or connections to new or existing mains, pipes, sewers, manholes, inlets, structures, etc., as may be required to complete the Work in accordance with specifications and published standard practices of the trade associations for the material specified and to the lines and grades indicated. This item shall include any pumping, bailing, drainage and Item No. 509, "Trench Safety Systems" for trench walls, when indicated or applicable. Unless otherwise provided, this item shall consist of the removal and disposition of trees, stumps and other obstructions, old structures or portions thereof such as house foundations, old sewers, masonry or concrete walls, the plugging of the ends of abandoned piped utilities cut and left in place and the restoration of existing utilities damaged in the process of excavation, cutting and restoration of pavement and base courses, the furnishing and placing of select bedding, backfilling and cement or lime stabilized backfill, the hauling and disposition of surplus materials, bridging of trenches and other provisions for maintenance of traffic or access as indicated.

510.2 Materials

The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation into the Work is of the kind and quality that satisfies the specified functions and quality.

(1) Concrete

Concrete shall conform to Item No. 403, "Concrete for Structures".

(2) Coarse Aggregate

Coarse aggregate shall conform to Item No. 403, "Concrete for Structures" or one of the following:

(a) Pipe Bedding Stone

Pipe bedding stone shall be clean gravel, crushed gravel or crushed limestone, free of mud, clay, vegetation or other debris, conforming to ASTM C 33 for stone quality. Size gradation shall conform to ASTM C-33 No. 57 or No. 67 or the following Table:

SIEVE SIZE	% RETAINED BY WEIGHT
1-1/2"	0
1"	0-10
1/2"	40-85
#4	90-100
#8	95-100

(b) Foundation Rock

Foundation rock shall be well graded coarse aggregate ranging in size from 2 to 8 inches.

(c) Flexible Base

Flexible base shall conform to Item No. 210, "Flexible Base".

(3) Fine Aggregate

(a) Concrete and Mortar Sand

Fine aggregate shall conform to Item No. 403, "Concrete for Structures".

(b) Bedding Sand

Sand for use as pipe bedding shall be clean, granular and homogeneous material composed mainly of mineral matter, free of mud, silt, clay lumps or clods, vegetation or debris. The material removed by decantation TxDOT Test Method Tex-406-A, plus the weight of any clay lumps, shall not exceed 4.5 percent by weight.

The resistivity shall not be less than 3000 ohms-cm as determined by TxDOT Test Method Tex-129-E. Size gradation of sand for bedding shall be as follows:

GRADATION TABLE	
SIEVE SIZE	% RETAINED BY WEIGHT
1/4"	0
#60	75-100
#100	95-100

(c) Stone Screenings

Stone screenings shall be free of mud, clay, vegetation or other debris, and shall conform to the following Table:

SIEVE SIZE	% PASSING
3/8"	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100	2 to 10

All screenings shall be the result of a rock crushing operation.

(4) Controlled Low Strength Material

Controlled Low Strength Material (CLSM) shall conform to Item No. 402, "Controlled Low Strength Material.

(5) Pea Gravel

Pea gravel bedding shall be clean washed material, hard and insoluble in water, free of mud, clay, silt, vegetation or other debris. Stone quality shall meet ASTM C 33. Size gradation shall be as follows:

SIEVE SIZE	% RETAINED BY WEIGHT
3/4"	0
1/2"	0-25
1/4"	90-100

(6) Select Backfill or Borrow

This material shall consist of borrow or suitable material excavated from the trench. It shall be free of stones or rocks over 8 inches and shall have a plasticity index of less than 20. The moisture content at the time of compaction shall be within 2 percent of optimum as determined by TxDOT Test Method Tex-114-E. Sandy loam borrow will not be allowed unless shown on the Drawings or authorized by the Engineer or designated representative.

All suitable materials from excavation operations not required for backfilling the trench may be placed in embankments, if applicable. All unsuitable materials that cannot be made suitable shall be considered surplus excavated materials as described in 510.3(13). The Contractor may, if approved by the engineer, modify unsuitable materials to make them suitable for use. Modification may include drying, removal or crushing of over-size material, and lime or cement treatment.

(7) Cement Stabilized Backfill

When indicated or directed by the Engineer or designated representative, backfill shall be with cement-stabilized backfill rather than the usual materials. Unless otherwise indicated, cement stabilized backfill material shall consist of a mixture of the dry constituents described for Class J Concrete. The cement and aggregates shall be thoroughly dry mixed with no water added to the mixture except as may be directed by the Engineer or designated representative.

(8) Pipe

General

Fire line leads and fire hydrant leads shall be ductile iron. Domestic water services shall not be supplied from fire service leads, unless the domestic and fire connections are on separately valved branches with an approved backflow prevention device in the fire service branch. All wastewater force mains shall be constructed of ductile iron pipe Pressure Class 250 minimum for pipe greater than 12-inch size and Pressure Class 350 for pipe 12-inch size and smaller. Wastewater pipe shall have a corrosion resistant interior lining acceptable to the Owner/Developer.

For pipes 16" and larger all pipe manufacturers and suppliers shall be certified by the American National Standards Institute (ANSI) for ISO 9000 compliance. It is the intent of this certification that all appropriate tests be documented with sampling criteria, frequency of testing, date of testing and date in which every piece was manufactured. A copy of the testing data to include results shall be sent with the shipment with appropriate identification as it relates to the specific shipment.

The quality of materials, the process of manufacture and the finished pipe shall be subject to inspection and approval by the Engineer or designated representative at the pipe manufacturing plant and at the project site prior to and during installation. Plant inspections shall be conducted at the discretion of the Owner/Developer and shall require only 48 hours of advance notice to the manufacturer. Only manufacturers and suppliers meeting this certification will be considered as approved providers of products.

All water distribution pipe and fittings shall be listed in the Fire Protection Equipment Directory published by the Underwriter's Laboratories, Inc., or shall be Factory Mutual approved for fire service.

(a) Reserved

(b) Iron Pipe

Iron pipe shall be ductile iron pipe meeting all requirements of standards as follows:

-For push-on and mechanical joint pipe: AWWA C-151

-For flanged pipe: AWWA C-115

Barrels shall have a nominal thickness required by Table 1 of AWWA C-115, which thickness corresponds to Special Class 53 in sizes through 54 inch, and Class 350 in 60 and 64-inch sizes. Flanges shall be ductile iron (gray iron is not acceptable); they shall be as shown in ANSI/AWWA C115/A21.15 and shall conform to dimensions shown in Table 2 and Figure 1 of AWWA C115. These flanges are the same in all respects as flanges shown in ANSI/AWWA C110/A21.10 for fittings and are standard for all flanges used with pipe, valve, and equipment units in the City of Round Rock water distribution and wastewater force main systems. Flanges shall be fabricated and attached to the pipe barrels by U.S. fabricators using flanges and pipe barrels of U.S. manufacture. If fabrication is to be by other than the pipe barrel manufacturer, a complete product submittal and approval by the City of Round Rock will be required. Additionally, such fabricator shall furnish certification that each fabricated joint has been satisfactorily tested hydrostatically at a minimum pressure of 300 psi.

-Linings and Coating:

Interior surfaces of all iron water pipe shall be cement-mortar lined and seal coated as required by AWWA C104. Interior surfaces of all iron wastewater line and force main pipe shall be coated with a non-corrosive lining material as approved by the City of Round Rock. Pipe exteriors shall be coated as required by the applicable pipe specification. The type and brand of interior lining shall be clearly marked on the outside of the pipe and fittings. Except as authorized by the Engineer or designated representative, only one type and brand of pipe lining shall be used on a given project.

Except as described above for flanged pipe (Thickness Class 53) and where not otherwise indicated, ductile iron pipe shall be minimum Class 250 as defined by ANSI/AWWA C150/A21.50-current; all ductile iron pipe and flanges shall meet the following minimum physical requirements:

Grade 60-42-10:

- Minimum tensile strength: 60,000 psi (414 mPa).
- Minimum yield strength: 42,000 psi (290 mPa).
- Minimum elongation: 10 percent.

The flanges for AWWA C115 pipe may be also be made from:

Grade 70-50-05:

- Minimum tensile strength: 70,000 psi (483 mPa).
- Minimum yield strength: 50,000 psi (345 mPa).
- Minimum elongation: 5 percent.

1. Ductile Iron Fittings:

Fittings shall be push-on, flanged or mechanical joint as indicated or approved and shall meet all requirements of standards as follows:

- Sizes 4 inch through 24 inch: AWWA C-110 or AWWA C-153

- Sizes larger than 24 inch: AWWA C-110.

- Lining and Coating:

Interior surfaces of all iron water pipe fittings shall be lined with cement-mortar and seal coated as required by AWWA C104. Interior surfaces of all iron wastewater and force main fittings shall be coated with a non-corrosive lining material acceptable to the City of Round Rock. Fitting exteriors shall be coated as required by the applicable pipe specification.

2. Joint Materials

Gaskets for mechanical joints shall conform to ANSI/AWWA A21.11/C-111.

Joining of slip joint iron pipe shall, without exception, be accomplished with the natural or synthetic rubber gaskets of the manufacturer of that particular pipe being used. A joint lubricant shall be used and applicable recommendations of the manufacturer shall be followed.

Gaskets for flanged joints shall be continuous full face gaskets, of 1/8 inch minimum thickness of natural or synthetic rubber, cloth-reinforced rubber or neoprene material, preferably of deformed cross section design and shall meet all applicable requirements of ANSI/AWWA A21.11/C-111 for gaskets. They shall be manufactured by, or satisfy all recommendations of, the manufacturer of the pipe/fittings being used and be fabricated for use with Class 125 ANSI B16.1 flanges.

Tee-head bolts, nuts and washers for mechanical joints shall be high strength, low alloy, corrosion resistant steel stock equal to "COR-TEN A" having UNC Class 2 rolled threads or alloyed ductile iron conforming to ASTM A 536; either shall be fabricated in accordance with ANSI/AWWA A21.11/C-111.

Hex head bolts and nuts shall satisfy the chemical and mechanical requirements of ASTM A449 SAE Grade 5 plain, and shall be fabricated in accordance with ASTM B 18.2 with UNC Class 2 rolled threads.

Either Tee-Head or Hex-Head bolts, nuts and washers as required, shall be protected with bonded fluoro-polymer corrosion resistant coating where specifically required by the Engineer or designated representative.

All threaded fasteners shall be marked with a readily visible symbol cast, forged or stamped on each nut and bolt, which will identify the fastener material and grade. The producer and the supplier shall provide adequate literature to facilitate such identification; painted markings are not acceptable.

3 Polyethylene Film Wrap

All iron pipe, fittings and accessories shall be wrapped with standard 8 mil (minimum) low density polyethylene film or 4-mil (minimum) cross laminated high-density polyethylene conforming to AWWA C-105, with all edges overlapped and taped securely with duct tape to provide a continuous wrap to prevent contact between the piping and the surrounding backfill. All punctures of the polyethylene, including those caused by the placement of bedding aggregates, shall be repaired with duct tape to restore the continuous protective wrap before backfilling.

4. Marking

Each pipe joint and fitting shall be marked as required by the applicable AWWA specification. This includes in all cases: Manufacturer's identification, Country where cast, year of casting, and "DUCTILE" or "DI". Barrels of flanged pipe shall show thickness class; others shall show pressure class. The flanges of pipe sections shall be stamped with the fabricators identification; fittings shall show pressure rating, the nominal diameter of openings and the number of degrees for bends. Painted markings are not acceptable.

(c) Concrete

1. General

Pipe shall conform to ASTM C 76 for Circular Pipe. Concrete pipe smaller than 12 inches in diameter shall conform to ASTM C 14, Extra Strength. All pipe shall be machine made or cast by a process which will provide uniform placement of the concrete in the form and compaction by mechanical devices, which will assure a dense concrete. Concrete shall be mixed in a central batch plant or other approved batching facility from which the quality and uniformity of the concrete can be assured. Transit mixed concrete shall not be acceptable for use in precast pipe. The pipe shall be Class III or the class indicated. Storm sewer pipe shall be of the tongue and groove or O-ring joint design. Wastewater pipe shall be of the O-ring joint design; it shall be acceptably lined for corrosion protection.

2. Marking

Each joint of pipe shall be marked with the pipe class, the date of manufacture, the manufacturer's name or trade mark, diameter of pipe and orientation, if required.

Pipe marking shall be waterproof and conform to ASTM C 76.

3. Minimum Age for Shipment

Pipe shall be considered ready for shipment when it conforms to the tests specified in ASTM C 76.

4. Joint Materials

When constructing storm sewers, the Contractor shall have the option of making joints with either of the following materials:

a. Mortar

Mortar for joints shall meet the requirements set forth below in "Mortar".

b. Cold Applied Preformed Plastic Gaskets

Cold Applied Plastic Gaskets shall be suitable for sealing joints of tongue and groove concrete pipe. The gasket sealing the joint shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler and shall contain no solvents, irritating fumes or obnoxious odors. The gasket joint sealer shall not depend on oxidizing, evaporating or chemical action for its adhesive or cohesive strength and shall be supplied in extruded rope form of suitable cross section. The size of the plastic gasket joint sealer shall be in accordance with the manufacturer's recommendations and sufficient to obtain squeeze-out around the joint. The gasket joint sealer shall be protected by a suitable removable wrapper that may be removed longitudinally without disturbing the joint sealer to facilitate application.

The chemical composition of the gasket joint sealing compound as shipped shall meet the following requirements:

Composition (% by weight)	Test Method	Typical Analysis
Bitumen (petroleum plastic content)	ASTM D 4	50-70
Ash-inert Mineral Water	Tex-526-C	30-50
Volatile Matter (at 325° F)	Tex-506-C	2.0 Maximum

The gasket joint sealing compound when immersed for 30 days at ambient room temperature separately in 5 percent solution of caustic potash, a mixture of 5 percent hydrochloric acid, a 5 percent solution of sulfuric acid and a saturated H₂S solution shall show no visible deterioration.

The physical properties of the gasket joint sealing compound as shipped shall meet the following requirements:

Property	Test Method	Typical Analysis	
		Minimum	Maximum
Specific Gravity at 77° F	ASTM D 71	1.20	1.35
Ductility at 77° F (cm) Minimum	Tex-503-C	5.0	
Softening point	Tex-505-C	275° F	
Penetration:			
32° F (300 g) 60 sec	Tex-502-C	75	
77° F (150 g) 5 sec	Tex-502-C	50	120
115° F (150 g) 5 sec	Tex-502-C		150
Flashpoint C.O.C. F	Tex-504-C	600° F	
Fire Point C.O.C. F	Tex-504-C	625° F	

When constructing wastewater lines, the Contractor shall use O-ring gasket joints conforming to ASTM C 443. Just before making a joint, the ends of the pipe shall be clean, dry, free of blisters or foreign matter and shall be wire brushed. For O-ring joints, the gasket and the inside surface of the bell shall be lubricated with a light film of soft vegetable soap compound to facilitate assembly of the joint. The rubber O-ring gasket shall be stretched uniformly in the joint. Wedge seal type ("Forsheda" pre-lubricated) gaskets may be used if joint details submitted are approved; installation of such gaskets shall be in strict accordance with the manufacturer's recommendations, and shall be the sole element depended upon to make the joint flexible and watertight.

In wastewater lines no horizontal or vertical angles in the alignment of pipes shall be permitted unless indicated. The spigot shall be centered in the bell, the pipe pushed uniformly home and brought into true alignment. Bedding material shall be placed and tamped against pipe to secure the joint.

5. Bends

When horizontal or vertical angles in the alignment of storm sewers are indicated, the bend or angle shall be constructed by use of prefabricated bends meeting the specification requirements. All bends shall be watertight, have a smooth flow line and be equal or greater in strength to the adjacent pipe.

Horizontal or vertical changes in alignment in wastewater lines shall be accomplished by use of manholes. With the Engineer's or designated representative's approval, horizontal changes in alignment may be made

by the "Joint Deflection" method. Joint deflection is limited by regulations of the Texas Commission on Environmental Quality (TCEQ) to 80 percent of the maximum recommended by the manufacturer; such deflection may not exceed 5 degrees at any joint. Changes in alignment using pipe flexure shall not be allowed.

6. Sulfide and Corrosion Control

All concrete pipe used for wastewater installations shall be protected from sulfide and corrosion damage by using limestone aggregate.

(d) Concrete Steel Cylinder (CSC) Pipe

1. General Requirements

The Contractor shall submit to the Engineer or designated representative for approval along with other required data a tabulated layout schedule with reference to the stationing and grade lines to be used.

The manufacturer shall furnish all fittings and special pieces required for closures, bends, branches, manholes, air valves, blow offs and connections to main line valves and other fittings as indicated.

Each pipe length, fitting and special joint shall have plainly marked on the bell end of the pipe the head condition for which it is designed. In addition, marking shall be required to indicate the location of each pipe length or special joint in the line and such markings will be referenced to the layout schedules and drawings submitted for approval.

Concrete steel cylinder fittings shall be tested as required by the applicable AWWA Standards.

2. Design and Inspection

Where not otherwise indicated, concrete steel cylinder pipe shall be Class 200, designed to withstand a vacuum of not less than 28 feet of water. Valve reducers, tees and outlets from a pipe run shall be designed and fabricated so that all stresses are carried by the steel forming the fitting or outlet.

Concrete steel cylinder pipe shall meet one of the following specifications:

AWWA C-301 - Any Size

AWWA C-303 - 24-inch maximum size

All pipe flanges shall conform to AWWA C-207, requirements for standard steel flanges of pressure classes corresponding to the pipe class.

Pipe to be installed in a tunnel or encasement shall be manufactured with 1 inch thick by 24-inch wide skid bands of mechanically impacted mortar in addition to the normal coating.

All concrete steel cylinder fittings shall be constructed of steel plate of adequate strength to withstand both internal pressure and external loading. Rod reinforcing shall not be used to figure the required steel area.

The fittings shall have a concrete lining and 1 inch minimum coating of cement mortar, except that centrifugally spun lining need not be reinforced.

Minimum lining thickness shall be 1/2 inch for 16-inch pipe and 3/4 inch for sizes larger than 16-inch pipe. Where it is impractical to place such concrete protection on interior surfaces of small outlets, 2 coats of "Bitumastic Tank Solution" shall be applied.

No fitting shall be made by cutting of standard pipe, except that outlets of less than 75 percent of the pipe diameter may be placed in a standard pipe. Beveled spigots may be placed on standard pipe.

3. Joint Materials

Joints shall be of the rubber gasket type conforming to the applicable standards. The inside and outside recesses between the bell and spigot shall be completely filled with Cement Grout in accordance with the pipe manufacturer's recommendations. Grout materials for jointing such pipe, unless otherwise indicated, shall be as described herein.

(e) In Place Pipe Rehabilitation

1. In Place Sliplining With or Without Pipe Destruction /Replacement.

This item shall consist of installing a high-density polyethylene pipe, by use of a pipe insertion machine into an existing line.

a. Material Requirements

The polyethylene pipe shall meet the following specifications:

ASTM F 714

Plastic Pipe Institute PE3408

Unless otherwise specified, the Contractor shall furnish the polyethylene pipe in accordance with the following table:

Depth of Cover in Feet	SDR of Pipe
0 – 16	17
Greater than 16	11

b. Functional Requirements

The polyethylene pipe shall be assembled and joined at the site using the thermal butt fusion method. All equipment and procedures shall be in strict compliance with the manufacturer's recommendations. Fusing shall be accomplished by personnel certified as fusion technicians by a manufacturer of polyethylene pipe and/or fusing equipment.

The complete joint shall be in true alignment and have a uniform double roll back bead resulting from the use of proper temperature and pressure. The joint shall be allowed adequate cooling time

before removal of pressure. Joints shall be made smooth on the inside by removal of the projecting weld bead using appropriate equipment; maximum projection of the weld bead on the exterior of the pipe shall be approximately 3/16 inch. The fused joint shall be watertight and shall have a tensile strength equal to that of the pipe. All joints shall be subject to acceptance by the Engineer or his/her representative prior to placement. All defective joints shall be cut out and replaced.

Any section of the pipe with a gash, abrasion, nick or scar greater in depth than 10 percent of the wall thickness, or containing concentrated ridges, discolorization, excessive spot roughness, pitting, variable wall thickness, or any other defect of manufacturing or handling as determined by the Engineer or his/her representative, shall be discarded and removed from the site.

Terminal sections of pipe that are joined within the insertion pit shall be connected with a full circle pipe repair clamp with a minimum length of one and one half times the nominal inside pipe diameter. The butt gap between pipe ends shall not exceed 1/10 of the nominal inside diameter of the pipe.

c. Installation Procedure

The Contractor shall carry out his operations in strict accordance with all OSHA and manufacturer's safety requirements.

The Contractor shall provide for the flow of water and wastewater around the section or sections of pipe designated for rehabilitation including active services in the rehabilitation section. The bypass shall be made by plugging the line at an existing upstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the flow. The Contractor shall take all necessary steps to prevent flooding of any private property and shall be liable for damages incurred by the flooding. No sewage or water shall be allowed to drain into earthen sump pits.

New polyethylene pipe shall be inserted immediately behind the expansion and insertion equipment in accordance with the manufacturer's procedures. The expansion and insertion equipment shall be equipped with all controls necessary to place the pipe on proper line and grade according to the Drawings.

The Contractor shall install all pulleys, rollers, bumpers, alignment control devices and other equipment required to protect existing manholes and to protect the pipe from damage during installation.

Lubrication may be used as recommended by the pipe manufacturer. Under no circumstances shall the pipe be stressed beyond its elastic limit.

All active service connections shall be identified by video inspection or other means and connected to the new main in accordance with the plan details.

Upon commencement, insertion, from manhole to manhole, shall be continuous without interruption except as approved by the Engineer or designated representative.

The installed pipe shall be allowed the manufacturer's recommended amount of time to provide for complete shrinkage or relaxation of the pipe prior to any connection of service lines, sealing of the annular space where the pipe enters the manhole, or backfilling of the insertion pit. Sufficient excess length of pipe shall be allowed to provide for this shrinkage.

The pipe bedding in the insertion pit shall be either pea gravel or pipe bedding stone. Bedding and backfill shall conform to the specification requirements of Section 510.3(14) contained herein. All street repairs and pavement replacement shall conform to City of Round Rock Criteria.

The relaxed pipe shall be cut so that it projects 4 inches inside of the manhole and any annular space shall be sealed. Sealing shall be with material approved by the Engineer or designated representative. The sealant shall completely fill the void between the pipe and the manhole wall and shall extend 3 inches beyond the annulus on the inside wall of the manhole. The sealant shall form a smooth transition from the pipe onto the manhole. The complete joint shall be uniform and watertight. A concrete invert shall be poured in place and shaped to form a smooth flow channel through the manhole.

2. Cured Resin Pipe Lining

This method of rehabilitation shall consist of the insertion of a resin-impregnated flexible tube into an existing pipe by the inversion method given in ASTM F 1216 or by a comparable approved method.

a. Material Requirements

Certified copies of all test reports on the properties of the selected resin and on the initial structural properties of the Cured in Place Pipe (CIPP) system—and later, on the field samples from designated inversion lengths as required by Section 8 of ASTM F 1216—shall be submitted to the Owner's/Developer's Engineer or designated representative. All testing costs are incidental to, and shall be included in, the unit price bid for CIPP.

The CIPP system shall have minimum initial structural properties as follows:

Flexural Strength (ASTM D 790)	4,500 psi
Tensile Strength (ASTM D 638)	2,500 psi
Flexural Modulus (ASTM D790)	250,000 psi

The results of tests by an independent laboratory of specimens taken by the Contractor as required by Section 8 of ASTM F 1216 and to demonstrate compliance with the above minimum values, shall be made available to the Owner's/Developer's Engineer or designated representative at the completion of testing.

b. Installation Procedure

Insertion of a resin-impregnated flexible tube into an existing pipe shall be by an inversion method as given in ASTM F 1216 and the manufacturer's recommendations.

The Contractor shall carry out his operations in strict accordance with all OSHA and manufacturer's safety requirements.

Measures shall be taken to reduce atmospheric styrene concentration to an acceptable level at all times during the CIPP installation procedure. The percent lower explosive limit, temperature and styrene concentration shall be measured and recorded for each inversion taken to ensure the following conditions are met:

Percent Lower Explosive Limit (LEL) shall not exceed 2% using an atmospheric monitor calibrated within at least six (6) months of the day reading is taken. The LEL shall be measured at the top of the downstream manhole adjacent to the section of pipe being lined.

No process water shall be discharged until cooled to below 100 degrees Fahrenheit in accordance with Section 7.1 of ASTM F 1216.

Atmospheric styrene levels shall not exceed 50 ppm as measured by a Drager Tube 67 23 301 Styrene 10/a five feet above and within 3 feet downwind of the downstream manhole adjacent to the section of pipe being lined.

Contractor shall be responsible for satisfactorily resolving customer complaints involving styrene odors.

Any necessary repairs to the pipeline shall be performed by the Contractor. Inspection of pipeline by the Contractor shall be performed by experienced personnel trained in locating breaks, obstacles and service connections by closed circuit television. The interior of the pipe shall be carefully inspected to determine the location of any conditions which may prevent proper installation into the pipe and these conditions shall be corrected. A videotape and

log shall be made by the Contractor and provided to the Owner/Developer upon completion of the project.

The Contractor shall provide for the flow of water and wastewater around the section or sections of pipe designated for rehabilitation, including active services in the rehabilitation section. The bypass shall be made by plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the flow. The Contractor shall take all necessary steps to prevent flooding of any private property and shall be liable for any damages incurred by the flooding. No sewage or water shall be allowed to drain into earthen sump pits.

The Contractor shall designate a location where the uncured resin in the original containers and the unimpregnated fiber-felt tube shall be vacuum impregnated prior to installation. The Contractor shall allow the Engineer or designated representative to inspect the materials and "wet out" procedure. The quantities of the liquid thermosetting materials shall be per manufacturer's standards to provide the wall thickness specified.

Water for the Work shall be metered and furnished by the Contractor in accordance with the Contract Documents. The wet out fiber-felt tube shall be inserted through an existing manhole or other approved access by means of an inversion process and the application of a hydrostatic head sufficient to fully extend it to the next designated manhole.

Any defect which will affect, in the foreseeable future, or warranty period, the integrity or strength of the pipe liner shall be repaired at the Contractor's expense, in a manner satisfactory to the Engineer or designated representative.

If, due to broken or misaligned pipe at a manhole wall, the pipe liner fails to make a tight seal, the Contractor shall apply a seal at that point. The seal shall be of a resin mixture compatible with pipe liner.

After the pipe liner has been cured in place, and allowed to cool down and normalize to ambient temperature, the Contractor shall connect new services or reconnect existing service piping as designated and identified in the proposal. After the Work is completed, the Contractor shall provide the Engineer or designated representative with a videotape showing both the before and after conditions including the restored connections.

(f) Polyethylene Tubing

1. General

All polyethylene (PE) tubing shall be high density, high molecular weight

plastic tubing meeting ASTM D2737; it shall be pressure rated at 200 psi working pressure and must bear the National Sanitation Foundation seal of approval for potable water service.

When tested for Environmental Stress Cracking, the PE tubing shall not show any loss of pressure in the 6 specimens tested for 3 hours in accordance with the requirements of ASTM D 2737 using the test pressure of 400 psi at 73.4° F.

The minimum burst pressure shall be 630 psi at 73.4° F determined in accordance with ASTM D 1599, latest revision. The time of testing of each specimen shall be between 60 and 70 seconds.

The tubing shall not fail, balloon, burst or weep as defined in ASTM D 1598, latest revision, when tested in accordance with the Sustained Pressure Test Method of ASTM D 2737 but under the following test conditions:

Temperature	Time	Pressure
73.4° F	1,000 hours	400 psi
100° F	1,000 hours	330 psi

2. Markings

Permanent marking on the tubing shall include the following at intervals of not more than 5 feet:

Nominal tubing size.

Type of plastic material, i.e., PE 3408.

Standard Dimension Ratio (SDR) and pressure rating in psi for water at 73.4° F (e.g., SDR-9, 200 psi).

ASTM D 2737 designation.

Manufacturer's name or trademark, code and seal of approval (NSF mark) of the National Sanitation Foundation.

3. Tube Size

PE tubing shall be standard copper tube size outside diameter, with Standard Dimension Ratio (SDR) of 9. Standard sizes, dimensions and tolerances shall be as follows:

Nominal Tube Size (inches)	Outside Diameter, inches		Wall Thickness, inches	
	Average	Tolerance	Minimum	Tolerance
3/4	0.875	±0.004	0.097	+0.010
1	1.125	±0.005	0.125	+0.012
1 1/4	1.375	±0.005	0.153	+0.015
1 1/2	1.625	±0.006	0.181	+0.018
2	2.125	±0.006	0.236	+0.024

(g) Copper Tubing

All copper service tubing shall be annealed seamless Type K water tube meeting ASTM B88 and rated at 150 psi working pressure. The tubing shall be homogenous throughout and free from cracks, holes, crimping, foreign inclusions or other defects. It shall be uniform in density and other physical properties.

Nominal Tube Size, inches	Outside Diameter, inches		Wall Thickness, inches	
	Average	Tolerance	Average	Tolerance
3/4	0.875	± 0.003	0.065	± 0.0045
1	1.125	± 0.0035	0.065	± 0.0045
1 1/4	1.375	± 0.004	0.065	± 0.0045
1 1/2	1.625	± 0.0045	0.072	± 0.005
2	2.125	± 0.005	0.083	± 0.007

(h) Service Connection Fittings

All fittings used in customer service connection - tapping mains, connecting meters, etc. - must be approved by the City of Round Rock.

(i) Brass Goods

All brass valves, couplings, bends, connections, nipples and miscellaneous brass pipe fittings and accessories used in meter connections, service lines, air release piping assemblies, and wherever needed in the water distribution system, shall conform to the City of Round Rock Standards Details, and AWWA C-800, and, shall be approved by the City of Round Rock

Unless otherwise noted, the goods described herein shall be fabricated of standard Red Brass (Waterworks Brass) meeting ASTM B62 or B584, alloy 83600, consisting of 85 percent copper and 5 percent each of tin, lead and zinc.

Exposed threads shall be covered with plastic caps or sheeting to protect the threads.

Brass goods of each type and class shall be compatible with other fittings in common usage for similar purposes. Where not otherwise indicated, all such materials shall meet the following requirements:

Inlet threads of corporation valves shall be AWWA iron pipe (IP) thread (male); outlets of service saddles shall be tapped with AWWA IP thread (female). AWWA IP threads shall conform to ANSI/ASME B1.20.1 as required by AWWA C800 for "General Purpose (Inch) Pipe Threads". For 3/4" and 1" sizes only, corporation valve inlet threads, and the internal threads of saddles may be the AWWA taper thread conforming to AWWA C800 Figure 1 and Table 6. External threads of corporation valve inlet must be compatible with internal threads of the service saddle.

Connections of all new tubing, and of tubing repairs wherever possible, shall be by flared fittings. Flare connections - and compression connections when permitted - shall be designed to provide a seal and to retain the tubing, without slippage, at a working water pressure of 150 psig.

Flanges shall conform to ANSI B16.1, Class 125, as to dimensions, drillings, etc. Copper tubing, when used, shall be Type K tubing having dimensions and weights given in Table A.1 of AWWA C800.

Brass pipe shall conform to the weights and dimensions for Extra Strong pipe given in Table A.2 of AWWA C800.

All fittings shall be suitable for use at hydrostatic working pressures up to 150 psig (hydrostatic testing of installed systems is at 200 psig).

(j) Reserved

(k) Polyvinyl Chloride Water Pipe

1. General

All polyvinyl chloride (PVC) water pipe shall be of the rigid (UNPLASTICIZED) type and must bear the National Sanitation Foundation seal of approval for potable water pipe. Each joint of pipe shall consist of single continuous extrusion; bells or other components attached by solvent welding are not acceptable. Pipe shall be pressure rated at 200 psi (SDR-14).

Pipe shall have push-on, rubber gasket joints of the bell and spigot type with thickened integral bells with rubber gasket joints. The wall thickness of each pipe bell and joint coupling must be greater than the standard pipe barrel thickness. Clearance must be provided in every gasket joint for both lateral pipe deflection and for linear expansion and contraction. Concrete thrust blocking shall be placed behind bends and tees. Concrete support cradles or blocking shall be required for support of all fire hydrants, valves and AWWA C110 fittings; such support shall be provided for AWWA C153 fittings when required by the Engineer or designated representative.

2. Applicable Specifications

Except as modified or supplemented herein, PVC pipe shall meet the following standards:

AWWA C-900, SDR 14 for PVC Pressure Pipe, in 4, 6, 8 and 12 inch nominal sizes, having Cast Iron Pipe size outside diameters.

Fittings used with PVC Pressure pipe shall be AWWA C-110 or AWWA C-153 compact ductile iron fittings.

Standard sizes, dimensions and tolerances shall be as follows:

			SDR-14	
Nominal Size	Outside Diameter, inches		Wall Thickness, inches	
(inches)	Avg.	Tolerance	Min.	Tolerance
4	4.800	+ 0.009	0.343	+ 0.041
6	6.900	+ 0.011	0.493	+ 0.059
8	9.050	+ 0.015	0.646	+ 0.078
12	13.200	+ 0.015	0.943	+ 0.113

All pipe 4 inches and larger must be approved by Underwriter's Laboratories for use in buried water supply and fire protection systems.

3. Material Requirements

All pipe and fittings shall be made from clean, virgin, NSF approved, Class 12454B PVC. Clean reworked materials generated from the manufacturers own production may be used within the current limits of the referenced AWWA C-900.

4. Marking

Permanent marking on each joint of pipe shall include the following at intervals of not more than 5 feet:

Nominal pipe size and OD base (e.g., 4 CIPS).

Type of plastic material (e.g., PVC 12454B).

Standard Dimension Ratio and the pressure rating in psi for water at 73° F (e.g., SDR 14, 200 psi).

AWWA designation with which the pipe complies (e.g., AWWA C-900).

Manufacturer's name or code and the National Sanitation Foundation (NSF) mark.

5. Tracer Tape

For all non-metallic pipe, directly above the centerline of the pipe and a minimum of 12 inches below the subgrade, or a minimum of 18 Inches below finished grade on areas outside the limits of pavement, shall be placed Inductive Tracer Detection Tape in accordance with the manufacturer's requirements. The tape shall be encased in a protective, inert, plastic jacket and color-coded in accordance with APWA Uniform Color Code.

(I) Polyvinyl Chloride (PVC) Pipe (Nonpressure) and Fittings

1. General

Where PVC sewer or wastewater pipe is indicated, it shall conform to ASTM D 3034. Cell Class shall be as required by applicable ASTM pipe specification; pipe stiffness shall be 115 psi minimum for pipe to 15" size, or 72 psi minimum for larger pipe.

2. Joint Material

PVC pipe and fitting shall have elastomeric gasket joints conforming to ASTM D 3212; gaskets to ASTM F 477.

3. Pipe Markings

Permanent marking on the pipe shall include the following at intervals of not more than 5 feet:

Manufacturer's name and/or trademark.

Nominal pipe size.

PVC cell classification per ASTM D 1784.

ASTM designation and legend:

For pipe 6 inch to 15-inch size: ASTM D 3034, type PSM, SDR-26 PVC Sewer Pipe.

For pipe 18 inches and larger: ASTM F 679. T-1 wall PVC sewer pipe.

4. Fitting Markings

Fittings shall be clearly marked as follows:

Manufacturer's name or trademark,

Nominal size,

The material designation "PVC",

PSM, and

The designation, "Specification D3034".

5. Tracer Tape

For all non-metallic pipe, directly above the centerline of the pipe and a minimum of 12 inches below the subgrade, or a minimum of 18 inches below finished grade on areas outside the limits of pavement, shall be placed Inductive Tracer Detection Tape in accordance with the manufacturer's requirements. The tape shall be encased in a protective, inert, plastic jacket and color-coded in accordance with APWA Uniform Color Code.

(m) Steel Pipe

1. Standard Weight
ASTM A 53, Schedule 40.
2. Extra Heavy Weight
Seamless ASTM A 53, Schedule 80.
3. Encasement Pipe
Welded or Seamless pipepiles ASTM A-252, Grade 2.
4. Fittings
Nipples and fittings extra strong Federal Specification WW-N 351 or WW-P 521.
5. Coatings
Black or galvanized as indicated.

(n) Welded Steel Pipe and Fittings for Water Pipe

1. General Reference Standards Specification.
Specifications of the American Water Works Association (AWWA) listed below shall apply to this Section.
 - C-200 Steel Water Pipe 6 inches and larger.
 - C-205 Cement-Mortar Protective Lining and Coating for Steel Water Pipe, 4 inches and larger, Shop Applied.
 - C-206 Field Welding of Steel Water Pipe.
 - C-207 Steel Pipe Flanges for Waterworks Services, Sizes 4 inches through 144 inches.
 - C-208 Dimensions for Steel Water Pipe Fittings.
 - C-602 Cement-Mortar Lining of Water Pipelines, 4 inches and larger in Place.
2. Submittals
Furnish Shop Drawings, product data, design calculations and test reports as described below:
 - a. Certified copies of mill tests confirming the type of materials used in steel plates, mill pipe flanges and bolts and nuts to show compliance with the requirements of the applicable standards.
 - b. Complete and dimensional working drawings of all pipe layouts. Shop Drawings shall include the grade of material, size, wall thickness of the pipe and fittings, type and location of fittings and the type and limits of the lining and coating systems of the pipe and fittings.

- c. Product data to show compliance of all couplings, supports, fittings, coatings and related items.
- 3. Job Conditions
 - a. The internal design pressure of all steel pipe and fittings shall be as indicated.
 - b. The interior of all steel pipe for potable water, 4 inches and larger, shall be cement-mortar lined.
- 4. Manufacturing
 - a. Description

Pipe shall comply with AWWA C-200.

 - (1) Circumferential deflection of all pipe in-place shall not exceed 2.0 percent of pipe diameter.
 - (2) Diameter

Nominal pipe diameter shall be the inside diameter of lining or pipe barrel, unless otherwise designated in Job Conditions.
 - b. Wall Thickness
 - (1) Steel pipe wall thickness shall be designed for the internal and external loads specified in this section. The cylinder thickness needed to resist internal pressure shall be based on an allowable stress in the steel equal to 1/2 the minimum yield stress of the material used.
- 5. Fittings
 - a. Welded

Fabricated steel fittings shall be of the same material as pipe and shall comply with AWWA C-208.
- 6. Flanges
 - a. Flanges shall comply with the requirements of AWWA C-207, Class D or Class E. The class shall be based on operating conditions and mating flanges of valves and equipment.
 - b. Gaskets shall be cloth-inserted rubber, 1/8 inch thick.
 - c. Flanges shall be flat faced with a serrated finish.
- 7. Pipe Joints
 - a. Lap Joints for Field Welding
 - (1) Lap joints for field welding shall conform to AWWA C-206. This item applies only to pipes 72 inches in diameter and larger.

- (2) The bell ends shall be formed by pressing on a hydraulic expander or a plug die. After forming, the minimum radius of curvature of the bell end at any point shall not be less than 15 times the thickness of the steel shell. Bell ends shall be formed in a manner to avoid impairment of the physical properties of the steel shell. Joints shall permit a lap at least 1 1/2 inches when assembled. The longitudinal or spiral weld on the inside of the bell end and the outside of the spigot end on each section of pipe shall be ground flush with the plate surface. The inside edge of the bell and the outside edge of the spigot shall be scarfed or lightly ground to remove the sharp edges or burrs.

b. Bell and Spigot Joints with O-Ring Gasket

- (1) Bell and spigot joints with rubber gasket shall conform to AWWA C-200.
- (2) The bell and spigot ends shall be so designed that when the joint is assembled, it will be self-centered and the gasket will be confined to an annular space in such manner that movement of the pipe or hydrostatic pressure cannot displace it. Compression of the gasket when the joint is completed shall not be dependent upon water pressure in the pipe and shall be adequate to ensure a watertight seal when subjected to the specified conditions of service. Bell and spigot ends shall be welded on preformed shapes. The bell and spigot ends shall conform to the reviewed Shop Drawings.

8. Interior and Exterior Protective Surface Coatings

- a. Exterior Surface to be mortar coated shall conform to AWWA C-205 for shop application and AWWA C-602 for field application. Pipe materials shall be the product of an organization, which has had not less than 5 years successful experience manufacturing pipe materials, and the design and manufacture of the pipe, including all materials, shall be the product of one company.
- b. All surfaces except as noted in c and d below shall receive shop application of mortar lining and coating.
- c. Field Welded Joints. After installation, clean, line and coat unlined or uncoated ends adjacent to welded field joints, including the weld proper, as specified for pipe adjacent to the weld.
- d. Machined Surfaces. Shop coat machined surfaces with a rust preventative compound. After jointing surfaces, remaining exposed surfaces shall be coated per a) and b) above.

(o) Corrugated Metal Pipe

1. General

Pipe shall be corrugated continuous lock or welded seam helically corrugated pipe. Corrugated metal pipe may be galvanized steel, aluminized steel or aluminum conforming to the following:

Galvanized Steel	AASHTO M 218
Aluminized Steel	AASHTO M 274
Aluminum	AASHTO M 197

Where reference is made herein to gage of metal, the reference is to U.S. Standard Gage for uncoated sheets. Tables in AASHTO M 218 and AASHTO M 274 list thickness for coated sheets in inches. The Tables in AASHTO M 197 list thickness in inches for clad aluminum sheets.

Sampling and testing of metal sheets and coils used for corrugated metal pipe shall be in accordance with TXDOT Test Method Tex-708-I.

Damaged spelter coating shall be repaired by thoroughly wire brushing the damaged area and removing all loose, cracked or weld-burned spelter coating. The cleaned area shall be painted with a zinc dust-zinc oxide paint conforming to Federal Specifications TT-P 641b. Damaged pipe shall be rejected and removed from the project.

Damaged aluminized coating shall be repaired in accordance with the manufacturer's recommendations.

The following information shall be clearly marked on each section of pipe:

Thickness and corrugations
Trade Mark of the manufacturer
Specification compliance

2. Fabrication

a. Steel Pipe

Galvanized or aluminized steel pipe shall be full circle or arch pipe conforming to AASHTO M 36, Type I or Type II as indicated.

It may be fabricated with circumferential corrugations; lap joint construction with riveted or spot welded seams or it may be fabricated with helical corrugations with continuous helical lock seam or ultra high frequency resistance butt-welded seams.

b. Aluminum Pipe

Pipe shall conform to AASHTO M 196, Type I, circular pipe or Type II, pipe arch as indicated. It may be fabricated with circumferential corrugations; lap joint construction with riveted or spot welded seams or it may be fabricated with helical corrugations with a continuous helical lock seam.

Portions of aluminum pipe that are to be in contact with high chloride concrete or metal other than aluminum, shall be insulated from these materials by a coating of bituminous material. The coating applied to the pipe or pipe arch to provide insulation between the aluminum and other material shall extend a minimum distance of 1 foot beyond the area of contact.

3. Selection of Gages

The pipe diameter, permissible corrugations and required gages for circular pipe shall be as indicated on the drawings.

For pipe arch, the span, rise, gage, corrugation size and coating thickness shall be as shown on the drawings. A tolerance of plus or minus 1 inch or 2 percent of equivalent circular diameter, whichever is greater, will be permissible in span and rise, with all dimensions measured from the inside crests of the corrugations.

4. Joint Material

Except as otherwise indicated, coupling bands and other hardware for galvanized or aluminized steel pipe shall conform to AASHTO M 36 for steel pipe and AASHTO M 196 for aluminum pipe. Field joints for each type of corrugated metal pipe shall maintain pipe alignment during construction and prevent infiltration of soil material during the life of the installation.

Coupling bands shall be not more than 3 nominal sheet thickness lighter than the thickness of the pipe to be connected and in no case lighter than 0.052 inch for steel or 0.048 inch for aluminum.

Coupling bands shall be made of the same base metal and coating (metallic or otherwise) as the pipe.

Coupling bands shall lap equally on each of the pipes being connected to form a tightly closed joint after installation.

Pipes furnished with circumferential corrugations shall be field jointed with corrugated locking bands. This includes pipe with helical corrugations, which has reformed circumferential corrugations on the ends. The locking bands shall securely fit into at least one full circumferential corrugation on each of the pipe ends being coupled. The minimum width of the corrugated locking bands shall be as shown below for the corrugation which corresponds to the end circumferential corrugations on the pipes being joined:

10 1/2 inches wide for 2 2/3 inches x 1/2-inch corrugations.

12 inches wide for 3 inches x 1 inch or 5 inches x 1-inch corrugations.

Helical pipe without circumferential end corrugations will be permitted only when it is necessary to join a new pipe to an existing pipe, which was

installed with no circumferential end corrugations. In this event, pipe furnished with helical corrugations at the ends shall be field jointed with either helically corrugated bands or with bands with projections or dimples. The minimum width of helically corrugated bands shall conform to the following:

12 inches wide for pipe diameters up to and including 72 inches.

14 inches wide for 1 inch deep helical end corrugations.

Bands with projections shall have circumferential rows of projections with one projection for each corrugation. The width of bands with projections shall be not less than the following:

12 inches wide for pipe diameters up to and including 72 inches.

The bands shall have 2 circumferential rows of projections.

16 1/4 inches wide for pipe diameters of 78 inches and greater.

The bands shall have 4 circumferential rows of projections.

Unless otherwise indicated, all bolts for coupling bands shall be 1/2-inch diameter. Bands 12 inches wide or less shall have a minimum of 2 bolts and bands greater than 12 inches wide shall have a minimum of 3 bolts.

Galvanized bolts may be hot dip galvanized conforming to AASHTO M 232, mechanically galvanized to provide the same requirements as AASHTO M 232 or electro-galvanized per ASTM A 164 Type RS.

5. Additional Coatings or Linings

a. Bituminous Coated

Bituminous Coated pipe or pipe arch shall be as indicated both as to base metal and fabrication and in addition shall be coated inside and out with a bituminous coating which shall meet the performance requirements set forth herein. The bituminous coating shall be 99.5 percent soluble in carbon bisulphide. The pipe shall be uniformly coated inside and out to a minimum thickness of 0.05 inch, measured on the crests of the corrugations.

The bituminous coating shall adhere to the metal tenaciously, shall not chip off in handling and shall protect the pipe from deterioration as evidenced by samples prepared from the coating material successfully meeting the Shock Test and Flow Test in accordance with Test Method Tex-522-C.

b. Paved Invert

Where a Paved Invert is indicated, the pipe or pipe arch, in addition to the fully coated treatment described above, shall receive additional bituminous material of the same specification as above, applied to the bottom quarter of the circumference to form a smooth pavement with a minimum thickness of 1/8 inch above the crests of the corrugations.

c. Cement Lined

(1) General

Except as modified herein, pipe shall conform to AASHTO M 36 for lock seam or welded helically corrugated steel pipe. Pipe shall be of full circle and shall be fabricated with two annular corrugations for purposes of joining pipes together with band couplers. Lock seams shall develop the seam strength as required in Table 3 of AASHTO M 36. Concrete lining shall conform to the following:

Composition

Concrete for the lining shall be composed of cement, fine aggregate and water that are well mixed and of such consistency as to produce a dense, homogeneous, non-segregated lining.

Cement

Portland Cement shall conform to AASHTO M 85.

Aggregate

Aggregates shall conform to AASHTO M 6 except that the requirements for gradation and uniformity of gradation shall not apply.

Mixture

The aggregates shall be sized, graded, proportioned and thoroughly mixed with such proportions of cement and water as will produce a homogenous concrete mixture of such quality that the pipe will conform to the design requirements indicated. In no case, however, shall the proportions of Portland Cement, blended cement or Portland Cement plus pozzolanic admixture be less than 470 lb/cu. yd of concrete.

Thickness

The lining shall have a minimum thickness of 1/8 inch above the crest of the corrugations.

Lining Procedures

The lining shall be plant applied by a machine traveling through a stationary pipe. The rate of travel of the machine and the rate of concrete placement shall be mechanically regulated so as to produce a homogenous nonsegregated lining throughout.

Surface Finish

The lining machine shall also mechanically trowel the

concrete lining as the unit moves through the pipe.

Certification

Furnish manufacturer's standard certification of compliance upon request of the Owner/Developer.

Joints

Pipe shall be joined together with coupling bands made from steel sheets to an indicated thickness of 0.064 inch (12 ga.). Coupling bands shall be formed with two corrugations that are spaced to provide seating in the third corrugation of each pipe end without creating more than 1/2 inch $\pm$ annular space between pipe ends when joined together.

Bands shall be drawn together by two 1/2 inch galvanized bolts through the use of a bar and strap suitably welded to the band.

When O-ring gaskets are indicated they shall be placed in the first corrugation of each pipe and shall be compressed by tightening the coupling band. Rubber O-ring gaskets shall conform to Section 5.9, ASTM C 361.

(2) Causes for Rejection

Pipe shall be subject to rejection on account of failure to conform to any of the requirements. Individual sections of pipe may be rejected because of any of the following:

Damaged ends, where such damage would prevent making satisfactory joint.

Defects that indicate poor workmanship and could not be easily repaired in the field.

Severe dents or bends in the metal itself.

If concrete lining is broken out, pipe may be rejected or at the discretion of the Engineer or designated representative, repaired in the field in accordance with the manufacturer's recommendation.

Hairline cracks or contraction cracks in the concrete lining are to be expected and does not constitute cause for rejection.

d. Fiber Bonded

Where fiber bonded pipe is indicated, the pipe or pipe arch shall be formed from sheets whose base metal shall be as indicated. In addition, the sheets shall have been coated with a layer of fibers, applied in sheet form by pressing them into a molten metallic

bonding. If a paved invert is indicated it shall be in accordance with the procedure outlined above. The test for spelter coating above is waived for fiber bonded pipe.

6. Slotted Drain Storm Sewers

The pipes for the slotted drain and slotted drain outfall shall be helically corrugated, lock seam or welded seam pipe. Materials and fabrication shall be in accordance with the above. The metal thickness shall be a minimum 16 gage.

The chimney assemblies shall be constructed of 3/16 inch welded plate or machine formed 14 gage galvanized steel sheets. The height of the chimney required shall be as indicated. Metal for the welded plate slot shall meet the requirements of ASTM A 36 and the completed plate slot shall be galvanized after fabrication in accordance with ASTM A 123.

Weld areas and the heat affected zones where the slot is welded to the corrugated pipe shall be thoroughly cleaned and painted with a good quality asphalt base aluminum paint.

7. Mortar

Mortar shall be composed of 1 part Type I Portland Cement and 2 parts clean, sharp mortar sand suitably graded for the purpose and conforming in other respects to the provisions for fine aggregate of Item No. 403, "Concrete for Structures". Hydrated lime or lime putty may be added to the mix, but in no case shall it exceed 10 percent by weight of the total dry mix.

510.3 Construction Methods

(1) General

Prior to commencing this Work, all erosion control and tree protection measures required shall be in place and all utilities located and protected. Clearing the site shall conform to Item No. 102, "Clearing and Grubbing". Maintenance of environmental quality protection shall comply with all requirements of the Contract and Item No. 601, "Salvaging and Placing Topsoil".

The Contractor shall conduct his Work such that a reasonable minimum of disturbance to existing utilities will result. Particular care shall be exercised to avoid the cutting or breakage of all existing utilities. If at any time the Contractor damages the utilities in place through his operations, the Contractor shall immediately notify the owner of the utility to make the necessary repairs. When active wastewater sewer lines are cut in the trenching operations, temporary flumes shall be provided across the trench while open and the lines shall be restored when the backfilling has progressed to the original bedding lines of the sewer so cut.

The Contractor shall inform utility owners sufficiently in advance of the Contractor's operations to enable such utility owners to reroute, provide temporary detours or to make other adjustments to utility lines in order that the

Contractor may proceed with his Work with a minimum of delay and expense. The Contractor shall cooperate with all utility owners concerned in effecting any utility adjustments necessary and shall not hold the Owner/Developer liable for any expense due to delay or additional Work because of conflicts arising from existing utilities.

The Contractor shall do all trenching in accordance with the provisions and the directions of the Engineer or designated representative as to the amount of trench left unfilled at any time. All excavation and backfilling shall be accomplished as indicated and in compliance with State Statutes.

Where excavation for a pipeline is required in an existing City street, a street cut permit is required and control of traffic shall be as indicated in accordance with the Texas Manual on Uniform Traffic Control Devices.

Wherever existing utility branch connections, sewers, drains, conduits, ducts, pipes or structures present obstructions to the grade and alignment of the pipe, they shall be permanently supported, removed, relocated or reconstructed by the Contractor through cooperation with the owner of the utility, structure or obstruction involved. In those instances where their relocation or reconstruction is impractical, a deviation from line and grade will be ordered by the Engineer or designated representative and the change shall be made in the manner directed.

Adequate temporary support, protection and maintenance of all underground and surface utility structures, drains, sewers and other obstructions encountered in the progress of the Work shall be furnished by the Contractor, at his expense and as approved by the Engineer or designated representative.

Where traffic must cross open trenches, the Contractor shall provide suitable bridges. For trenches less than 2 feet in width, sheet steel plates having a minimum thickness of 1/2 inch shall be used. For trenches up to 4 feet in width, sheet steel plates having a minimum thickness of 3/4 inches shall be used. In all cases, the plates shall overlay the top of the trench a minimum of 18 inches on both sides and be secured by asphalt. Adequate provisions shall be made for the flow of sewers; drains and watercourses encountered during construction and any structures, which may have been disturbed, shall be satisfactorily restored upon completion of Work.

When rainfall or runoff is occurring or is forecast by the U.S. Weather Service, the Contractor shall not perform or attempt any excavation or other earth moving Work in or near the flood plain of any stream or watercourse or on slopes subject to erosion or runoff, unless given specific approval by the Engineer or designated representative. When such conditions delay the Work, an extension of time will be allowed in accordance with conditions contained in the Contract.

(2) Water Line/New Wastewater Line Separation

Installation of new water or wastewater lines shall conform to the following:

Where feasible, water and wastewater lines shall be no closer to each other than 9 feet between outside diameters in all directions and shall be in separate trenches.

If the 9 foot separation cannot be achieved, any portion of a new gravity wastewater line within 9 feet in any direction (between OD's) of a potable water line, shall be in a separate trench and constructed of material (pipe and joints) with a rating of 150 psi minimum.

If the lines are parallel, they shall not be closer than 4 feet horizontally or 2 feet vertically between OD's with the wastewater lower than the water line. If the lines cross, they may be no closer than 6 inches vertically between OD's with the sewer below the water line and one standard 20 foot joint of 150 psi rated wastewater pipe shall be centered at the point of crossing the water line.

Unless wastewater manholes and the connection to the sewer can be made completely watertight and tested for no leakage, they must be installed so as to provide a minimum of 9 feet of horizontal clearance from an existing or proposed water line.

(3) Utility and Storm Sewer Crossings

When the Contractor installs a pipe that crosses under a utility structure or storm sewer and the top of the pipe is within 18 inches of the bottom of the utility structure, the pipe shall be encased as specified in Item No. 505, "Concrete Encasement and Encasement Pipe", for a distance of at least 1 foot on either side of the ditch line of the utility structure or the storm sewer. Unless otherwise specified by the Engineer or designated representative, concrete encasement will not be required for ductile iron, AWWA C-900 (SDR-18) 150 psi rated PVC in sizes to 12 inch, or AWWA C-905 (SDR-25) 165 psi rated PVC in sizes larger than 12 inches. When the Contractor installs a pipe that crosses over a utility structure or storm sewer and the top of the utility structure or storm sewer is within 18 inches of the bottom of the pipe, the pipe shall be either ductile iron, AWWA C-900 (SDR-18) 150 psi rated PVC in sizes to 12 inch, or AWWA C-905 (SDR-25) 165 psi rated PVC in sizes larger than 12 inches, unless otherwise specified by the Engineer or designated representative..

Where trenches wider than 12 inches cross under existing wastewater lines, the sewer lines shall be replaced with one 20 foot joint of ductile iron, AWWA C-900 (SDR-18) 150 psi rated PVC in sizes to 12 inch, or AWWA C-905 (SDR-25) 165 psi rated PVC in sizes larger than 12 inches, centered over the trench.

(4) Trench Excavation

Underground piped utilities shall be constructed in an open cut in accordance with Federal regulations, applicable State Statutes and conforming to Item No. 509, "Trench Safety Systems" and with a trench width and depth described below. When pipe is to be constructed in fill above the natural ground, Contractor shall construct embankment to an elevation not less than one foot above the top of the pipe, after which trench is to be excavated. Required vertical sides shall be sheeted and braced as indicated to maintain the sides of the required vertical excavation throughout the construction period. Adequacy of the design of sheeting and bracing shall be the responsibility of the Contractor's design professional. The Contractor shall be responsible for installation as indicated.

After the pipe has been laid and the backfill placed and compacted to 12 inches above the top of the pipe, any sheeting, shoring and bracing required may be removed with special care to insure that the pipe is not disturbed. As each piece of sheeting is removed, the space left by its removal must be thoroughly filled and compacted with suitable material and provisions made to prevent the sides of the trench from caving until the backfill has been completed. Any sheeting left in place will not be paid for and shall be considered subsidiary to the pipe item bid.

(5) Trench Width

Trenches for water and wastewater lines shall have a clear width on each side beyond the outside surfaces of the pipe bell or coupling of not less than 6 inches nor more than 12 inches.

Trenches for Storm Sewers up to 42 inches shall have a width of 1 foot on each side beyond the outside surfaces of the pipe. Pipes more than 42 inches shall have a trench width of 18 inches on each side beyond the outside surfaces of the pipe.

If the trench width within the pipe zone exceeds widths above, the entire pipe zone shall be refilled with approved backfill material, thoroughly compacted to a minimum of 95 percent of maximum density as determined by TxDOT Test Method Tex-114-E and then re-excavated to the proper grade and dimensions. Excavation along curves and bends shall be so oriented that the trench and pipe are approximately centered on the centerline of the curve, using short lengths of pipe and/or bend fittings if necessary.

For all utilities to be constructed in areas to be filled above natural ground, the embankment shall first be constructed to an elevation not less than 1 foot above the top of the utility after which excavation for the utility shall be made.

(6) Trench Depth and Depth of Cover

All pipe and in-line appurtenances shall be laid to the grades indicated. The depth of cover shall be measured from the established finish grade, natural ground surface (if natural grade is to remain), subgrade for staged construction, street or other permanent surface to the top or uppermost projection of the pipe.

(a) Where not otherwise indicated, all water piping shall be laid to the following minimum depths:

1. Water piping installed in unpaved areas shall be laid with at least 42 inches of cover.
2. Water piping installed in existing streets, roads or other traffic areas shall be laid with at least 48 inches of cover below finish grade.
3. Unless approved by the Engineer or designated representative, installation of water piping in proposed new streets or traffic areas will not be permitted until paving and drainage plans have been approved and the roadway traffic areas excavated to the specified or standard paving subgrade, with all parkways and sidewalk areas

graded according to any applicable provisions of the drainage plans or sloped upward from the curb line to the right of way line at a minimum slope of 1/4 inch per foot. Piping and appurtenances installed in such proposed streets shall be laid with at least 30 inches of cover below the actual subgrade.

(b) Where not otherwise indicated, all wastewater piping shall be laid to the following minimum depths:

1. Wastewater piping installed in unpaved areas shall be laid with at least 48 inches of cover.
2. Wastewater piping installed in existing streets, roads or other traffic areas shall be laid with at least 66 inches of cover.
3. Wastewater piping installed in proposed streets or traffic areas shall be laid with at least 48 inches of cover below the actual subgrade.

(7) Classification of Excavation

Excavation will not be considered or paid for as a separate item of Work, therefore excavated material will not be classified as to type or measured as to quantity. Full payment for all excavation required for the construction shall be included in the various unit or lump sum Contract prices for the various items of Work installed, complete in place. No extra compensation, special treatment or other consideration will be allowed due to rock, pavement, caving, sheeting and bracing, falling or rising water, working under and in the proximity of trees or any other handicaps to excavation.

(8) Dewatering Excavation

Underground piped utilities shall not be constructed or the pipe laid in the presence of water. All water shall be removed from the excavation prior to the pipe placing operation to insure a dry firm granular bed on which to place the underground piped utilities and shall be maintained in such unwatered condition until all concrete and mortar is set. Removal of water may be accomplished by bailing, pumping or by a well-point installation as conditions warrant.

In the event that the excavation cannot be dewatered to the point where the pipe bedding is free of mud, a seal shall be used in the bottom of the excavation. Such seal shall consist of Class B concrete, conforming to Item No. 403, "Concrete for Structures", with a minimum depth of 3 inches.

(9) Trench Conditions

Before attempting to lay pipe, all water, slush, debris, loose material, etc., encountered in the trench must be pumped or bailed out and the trench must be kept clean and dry while the pipe is laid and backfilled. Where needed, sump pits shall be dug adjoining the trench and pumped as necessary to keep the excavation dewatered.

Backfilling shall closely follow pipe laying so that no pipe is left exposed and unattended after initial assembly. All open ends, outlets or other openings in the

pipe shall be protected from damage and shall be properly plugged and blocked watertight to prevent the entrance of trench water, dirt, etc. The interior of the pipeline shall at all times be kept clean, dry and unobstructed.

Where the soil encountered at established footing grade is a quicksand, saturated or unstable material, the following procedure shall be used unless other methods are indicated:

All unstable soils shall be removed to a depth of a minimum 2 feet below bottom of piped utility or as required to stabilize the trench foundation. Such excavation shall be carried out for the entire trench width.

All unstable soil so removed shall be replaced with a concrete seal, foundation rock or coarse aggregate materials placed across the entire trench width in uniform layers not to exceed 6 inches, loose measure and compacted by mechanical tamping or other means which shall provide a stable foundation for the utility.

Forms, sheathing and bracing, pumping, additional excavation and backfill required in unstable trench conditions shall be subsidiary to pipe bid.

(10) Blasting

All blasting shall conform to the provisions of the Contract and applicable local and state codes.

(11) Removing Old Structures

When out of service masonry structures or foundations are encountered in the excavation, such obstructions shall be removed for the full width of the trench and to a depth of 1 foot below the bottom of the trench. When abandoned inlets or manholes are encountered and no plan provision is made for adjustment or connection to the new sewers, such manholes and inlets within the construction limits shall be removed completely to a depth 1 foot below the bottom of the trench. In each instance, the bottom of the trench shall be restored to grade by backfilling and compacting by the methods provided above. Where the trench cuts through storm or wastewater sewers which are known to be abandoned, these sewers shall be cut flush with the sides of the trench and blocked with a concrete plug in a manner satisfactory to the Engineer or designated representative. When old structures are encountered, which are not visible from the existing surface and are still in service, they shall be protected and adjusted as required to the finished grade.

(12) Lines and Grades

Grades, lines and levels shall conform to the Drawings. Any damage to the above by the Contractor shall be re-established at the Contractor's expense. The Contractor shall furnish copies of all field notes and "cut sheets" to the City.

The location of the lines and grades indicated may be changed only by direction of the Engineer or designated representative and it is understood that the Contractor will be paid on the basis of his unit Contract prices bid for such Work

actually performed and shall make no claim for damages or loss of anticipated profits due to the change of location or grade.

The Contractor shall furnish, at his expense, all necessary batter boards or electronic devices for controlling the Work. Batter boards shall be of adequate size and material and shall be supported substantially. The boards and all location stakes must be protected from possible damage or change of location. The Contractor shall furnish good, sound twilled lines for use in achieving lines and grades and the necessary plummets and graduated poles.

The Contractor shall submit to the Engineer or designated representative at least 6 copies of any layout Drawings from the pipe manufacturer for review and approval. The Contractor shall submit the layout Drawings at least 30 days in advance of any actual construction of the project. The Engineer or designated representative will forward all comments of the review to the Contractor for revision. Revisions shall be made and forwarded to the Engineer or designated representative for his acceptance. Prior to commencement of the Project, reviewed layout Drawings will be sent to the Contractor marked for construction.

Should the Contractor's procedures not produce a finished pipe placed to grade and alignment, the pipe shall be removed and relayed and the Contractor's procedures modified to the satisfaction of the Engineer or designated representative. No additional compensation shall be paid for the removal and relaying of pipe required above.

(13) Surplus Excavated Materials

Excess material or material which cannot be made suitable for use in embankments will be declared surplus by the Engineer or designated representative and shall become the property of the Contractor to dispose of off site at a permitted fill site, without liability to the City or any individual. Such surplus material shall be removed from the Work site promptly following the completion of the portion of the utility involved.

(14) Pipe Bedding Envelope

Pipe shall be installed in a continuous bedding envelope of the type shown on the drawings or as described herein. The envelope shall extend the full trench width, to a depth of 6 inches below the pipe and shall rise at least to the top of storm water pipe and to 12 inches above water and wastewater pipe.

(a) Standard Bedding Materials

USE / PIPE MATERIAL	Cement Stabilized Backfill	Natural or Mf'd Sand	Pea Gravel	PIPE BEDDING STONE			
				Uncrushed Gravel	Crushed Gravel	Crushed Stone	Stone Screenings
WATER							
Welded Steel	X					X	
Service Tubing 3/4" to 2-1/2"		X	X				X
WATER and WASTEWATER							
Up to 15 Inch ID		X	X	X	X	X	X
Larger Than 15 Inch ID			X	X	X	X	
STORMWATER							
Concrete		X	X	X	X	X	X
Metal		X	X	X			X

(b) General requirements and limitations governing bedding selection.

- (1) Crushed gravel or crushed stone shall not be used with polyethylene tubing or polyethylene film wrap.
- (2) Uncrushed gravel may be used with polyethylene film wrap in trenches up to 6 feet deep and in deeper trenches where ample trench width, a tremmie, or conditions will allow controlled placement of the gravel without damaging the polyethylene wrap.
- (3) Bedding shall be placed in lifts not exceeding 8 inches loose thickness and compacted thoroughly to provide uniform support for the pipe barrel and to fill all voids around the pipe.
- (4) Pea Gravel or bedding stone shall be used in blasted trenches.

(c) Requirements to prevent particle migration.

Bedding material shall be compatible with the materials in the trench bottom, walls and backfill so that particle migration from, into or through the bedding is minimized. The Engineer or Designated representative may require one or more of the following measures to minimize particle migration: use of impervious cut-off collars; selected bedding materials, such as pea gravel or bedding stone mixed with sand; filter fabric envelopment of the bedding; cement stabilized backfill; or other approved materials or methods. Measures to minimize particle migration will be shown on the Drawings or designated by the Engineer or designated representative, and, unless provisions for payment are provided in the contract documents, the cost of these measures shall be agreed by change order. The following limitations shall apply.

- (1) Sand, alone, shall not be used in watercourses, in trenches where groundwater is present, or in trenches with grades greater than 5 percent.
- (2) Pea gravel or bedding stone, alone, shall not be used in the street right-of-way within 5 feet of subgrade elevation in trenches that are 3 feet or wider.
- (3) Pea gravel or bedding stone, alone, shall not be used where the trench bottom, sides, or backfill is composed of non-cementitious, silty or sandy soils having plasticity indices less than 20, as determined by the Engineer or designated representative.

(15) Laying Pipe

No pipe shall be installed in the trench until excavation has been completed, the bottom of the trench graded and the trench completed as indicated.

Laying of corrugated metal pipes on the prepared foundation shall be started at the outlet end with the separate sections firmly joined together, with outside laps of circumferential joints pointing upstream and with longitudinal laps on the sides. Any metal in joints, which is not protected by galvanizing, shall be coated with suitable asphaltum paint. Proper facilities shall be provided for hoisting and lowering the sections of pipe into the trench without damaging the pipe or disturbing the prepared foundation and the sides of the trench. Any pipe which is not in alignment or which shows any undue settlement after laying or damage, shall be taken up and re-laid without extra compensation.

Multiple installations of corrugated pipe or arches shall be laid with the centerlines of individual barrels parallel. When not otherwise indicated, clear distances of 2 feet between outer surfaces of adjacent pipes shall be maintained.

No debris shall remain in the drainways or drainage structures.

All recommendations of the manufacturer shall be carefully observed during handling and installation of each material. Unless otherwise indicated, all materials shall be delivered to the project by the manufacturer or agent and unloaded as directed by the Contractor. Each piece shall be placed facing the proper direction near to where it will be installed.

The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter at all times and stored in a manner that will protect them from damage. Stockpiled materials shall be stacked so as to minimize entrance of foreign matter.

The interior of all pipeline components shall be clean, dry and unobstructed when installed.

Piping materials shall not be skidded or rolled against other pipe, etc. and under no circumstances shall pipe, fittings or other accessories be dropped or jolted.

During handling and placement, materials shall be carefully observed and inspected and any damaged, defective or unsound materials shall be marked,

rejected and removed from the job site. Minor damage shall be marked and repaired in a manner satisfactory to the Engineering or designated representative. Joints, which have been placed, but not joined, backfilled, etc., shall be protected in a manner satisfactory to the Engineer or designated representative.

(16) Assembling of Pipe

Angular spacing of all joints shall meet the manufacturer's recommendations for the pipe and accessories being used. Side outlets shall be rotated so that the operating stems of valves shall be vertical when the valves are installed. Pressure pipe shall be laid with bell ends facing the direction of pipe installation. Pipe end bells shall be placed upgrade for all wastewater lines.

Orientation marks, when applicable, shall be in their proper position before pipe is seated.

Before joining any pipe, all foreign matter, lumps, blisters, excess coal tar coating, oil or grease shall be removed from the ends of each pipe and the pipe ends shall then be wire brushed and wiped clean and dry. Pipe ends shall be kept clean until joints are made.

Every precaution shall be taken to prevent foreign material from entering the pipe during installation. No debris, tools, clothing or other materials shall be placed in the pipe.

(17) Joints

(a) Mortar (Storm Drain joints only)

Pipe ends shall be clean, free of asphalt or other contaminants, which will inhibit the bond of the mortar to the pipe. The pipe ends shall be moistened immediately prior to placing the mortar in the joint.

b) Cold Applied Preformed Plastic Gaskets (Storm Drain joints only)

The pipe ends shall be clean and the joint material applied to the dry pipe. In cold weather, the joint material shall be heated to facilitate the seal of the joint.

(c) O-Ring and Push-on Joints

Just before making a joint the ends of the pipe shall be clean, dry, free of any foreign matter, lump blisters, excessive coal tar coating and grease or oil and shall be wire brushed. The gasket and the inside surface of the bell shall be lubricated with a light film of soft vegetable soap compound (Flax Soap) to facilitate telescoping the joints. The rubber gasket if not factory installed shall be stretched uniformly as it is placed in the spigot groove to insure a uniform volume of rubber around the circumference of the groove. The spigot shall be centered in the bell, the pipe pushed home uniformly and brought into true alignment. Bedding material shall be placed and tamped against pipe to secure the joint. Care should be taken to prevent dirt or foreign matter from entering the joint space.

(d) Bolted Joints

All flanged, mechanical or other bolted joints shall be joined with nuts and bolts and be coated as indicated above in Iron Pipe.

(18) Pressure Pipe Laying

(a) Grout for Concrete Steel Cylinder Pipe (CSC) and Welded Steel Pipe

Aggregate, cement, etc., shall be as indicated in "Mortar" herein.

Grout shall be poured into the recess between the bell and spigot on the outside of the pipe and contained by a joint wrapper ("diaper") recommended by the pipe manufacturer. The wrapper shall have a minimum width of 7 inches for 30 inch and smaller and 9 inches for larger pipe, secured to the pipe by "Band Iron" steel straps. The grout shall be poured in one continuous operation in such manner that after shrinkage and curing the joint recess shall be completely filled.

Mortar for the inside recess shall be of the consistency of plaster. The inside recess between the bell and spigot shall be filled with mortar after the pipe joint on either side of the recess has been backfilled and well tamped with no less than one pipe joint installed ahead of the pipe forming the recess. The mortar shall completely fill the recess and shall be trowelled and packed into place and finished off smooth with the inside of the pipe.

The Contractor shall inspect the joint after the mortar has set and make repairs of any pockets, cracks or other defects caused by shrinkage to the satisfaction of the Engineer or designated representative. The inside surface shall be cleared of any mortar droppings, cement, water, slurry, etc., before they have become set and shall be cleared of any other foreign matter. The inside surface of the pipe shall be left clean and smooth.

Pipe shall be handled at all times with wide non abrasive slings, belts or other equipment designed to prevent damage to the coating and all such equipment shall be kept in such repair that its continued use is not injurious to the coating. The use of tongs, bare pinch-bars, chain slings, rope slings without canvas covers, canvas or composition belt slings with protruding rivets, pipe hooks without proper padding or any other handling equipment, which the Engineer or designated representative deems to be injurious to the coating, shall not be permitted. The spacing of pipe supports required to handle the pipe shall be adequate to prevent cracking or damage to the cement mortar lining.

(19) Placing Pipe in Tunnels and Encasements

Piping installed as a carrier pipe in a tunnel, encasement pipe, etc., shall have uniform alignment, grade, bearing and conform to the reviewed Shop Drawings. All necessary casing spacers, bedding material, grout cradle or paving, bracing, blocking, etc., as stipulated by the Contract or as may be required to provide and

maintain the required pipe alignment and grade, shall be provided by the Contractor at no cost except as provided by the Bid Items. This shall include casing spacers acceptable to the City Round Rock attached to the carrier pipe in accordance with the manufacturer's recommendations. The insertion pushing forces shall not exceed the pipe manufacturer's recommendation. Such carrier piping shall have flexible bolted or gasketed push-on joints or Concrete Steel Cylinder pipe installed as follows:

(a) 21 Inch Pipe and Smaller

Prior to placing the pipe in the tunnel, the inside joint recess at the bell shall be buttered with cement mortar.

After the joint is engaged, the excess mortar shall be smoothed by pulling a tight fitting swab through the joint. Cement mortar protection shall then be placed in the normal manner to the exterior of the joint and allowed to harden sufficiently to avoid dislodgment during installation. If time is of the essence, a quick setting compound may be used.

(b) 24 Inch Pipe and Larger

Each length of pipe shall be pushed into the tunnel as single units. A flexible mastic sealer shall be applied to the exterior of the joint prior to joint engagement. The surfaces receiving the mastic sealer shall be cleaned and primed in accordance with the manufacturer's recommendation. Sufficient quantities of the mastic sealer shall be applied to assure complete protection of all steel in the joint area. The interior of the joint shall be filled with cement mortar in the normal manner after the pipe is in its final position within the tunnel.

(20) Temporary Pipe Plugs, Caps, Bulkheads and Trench Caps

Temporary plugs, caps or plywood bulkheads shall be installed to close all openings of the pipe and fittings when pipeline construction is not in progress.

All temporary end plugs or caps shall be secured to the pipe as provided under Item No. 507, "Bulkheads".

Trench caps shall be reinforced Class D concrete as indicated.

(21) Corrosion Control

(a) Protective Covering

Unless otherwise indicated, all flanges, nuts, bolts, threaded outlets and all other iron or steel components buried and in contact with earth or backfill shall be wrapped with 8-mil (minimum) polyethylene film meeting ANSI/AWWA C-105 to provide a continuous wrap.

(22) Pipe Anchorage, Support and Protection

Pressure pipeline tees, plugs, caps and bends 22-1/2 degrees and more and other bends as directed shall be securely anchored by suitable concrete thrust blocking or by approved metal harness. Unless otherwise indicated, on 24 inch or

larger piping, all bends greater than 11 1/4 degrees shall be anchored as described herein.

Storm sewers on steep grades shall be lugged as indicated.

(a) Concrete Thrust Blocking

Concrete for use as reaction or thrust blocking shall be Class B conforming to Item No. 403, "Concrete for Structures".

Concrete blocking shall be placed between solid ground and the fitting to be anchored. The area of bearing on the pipe and on the ground shall be as indicated or directed by the Engineer or designated representative. The blocking shall, unless otherwise indicated, be so placed that the pipe, fittings and joints will be accessible for repair.

The trench shall be excavated at least 6 inches outside the outermost projections of the pipe or appurtenance and the trench walls shaped or undercut according to the detail Drawings or as required to provide adequate space and bearing area for the concrete.

The pipe and fittings shall be adequately weighted and laterally braced to prevent floating, shifting or straining of the pipeline while the concrete is being placed and taking initial set. The Contractor shall be solely responsible for the sufficiency of such restraints.

(b) Metal Thrust Restraint

Fabricated thrust restraint systems such as those described below may be approved for use instead of concrete blocking. To obtain approval, the project Drawings must include sufficient drawings, notes, schedules, etc., to assure that the proposed restraints as installed will be adequate to prevent undesirable movement of the piping components. Such restraint systems may only be used where and as specifically detailed and scheduled on approved Project Drawings.

1. Thrust Harness

A metal thrust harness of tie rods, pipe clamps or lugs, turnbuckles, etc., may be approved. All carbon steel components of such systems, including nuts and washers, shall be hot-dip galvanized; all other members shall be cast ductile iron. After installation, the entire assembly shall be wrapped with 8-mil polyethylene film, overlapped and taped in place with duct tape to form a continuous protective wrap.

2. Restrained Joints

Piping or fitting systems utilizing integral mechanically restrained joints may be approved. All components of such systems shall be standard manufactured products fabricated from cast ductile iron, hot-dip galvanized steel, brass or other corrosion resistant materials and the entire assembly shall be protected with a continuous film wrap as described for 1. above.

Location, configuration and description of such products shall be specifically detailed on the Drawings. (Add-on attachments such as retainer glands, all-thread rods, etc., are not acceptable.)

(c) Concrete Encasement, Cradles, Caps and Seals

When trench foundation is excessively wet or unstable or installation of water or wastewater pipe will result in less than 30 inches of cover, Contractor shall notify the Engineer or designated representative. The Engineer or designated representative may require Contractor to install a concrete seal, cradle, cap, encasement or other appropriate action.

All concrete cap, etc., shall be continuous and begin and end as specified. Concrete cap, cradle and encasement shall conform to the Drawings. The pipe shall be well secured to prevent shifting or flotation while the concrete is being placed.

(d) Anchorage Bulkheads

Concrete bulkheads keyed into the undisturbed earth shall be placed as indicated to support and anchor the pipe and/or backfill against end thrust, slippage on slopes, etc. Concrete material and placement shall be Class A, Item No. 403, "Concrete for Structures".

(e) Trench Caps, Concrete Rip-Rap and Shaped Retards

Where called for by the Contract or as directed by the Engineer or designated representative, concrete trench caps, concrete rip-rap and/or shaped retards shall be placed as detailed by the Drawings as protection against erosion. Concrete material and placement shall be Class B, Item No. 403, "Concrete for Structures".

(23) Wastewater Connections

(a) Connections to Mains 12 Inches and Smaller

All branch connections of new main lines shall be made by use of manholes.

Service stubs shall be installed as indicated. Minimum grade shall be 1 percent downward to main and minimum cover shall be 4 1/2 feet at the curb. Standard plugs shall be installed in the dead end before backfilling.

Where a service connection to a main 12 inches or smaller is indicated, a sanitary tee or double wye shall be installed.

Where a service connection to a main 15 inches or larger is indicated, a field tap may be made with the pipes installed crown to crown. The tap should be made conforming to the pipe manufacturer's recommendations with the Engineer or designated representative's approval.

Where not otherwise indicated, (wastewater) service connections shall be installed so that the outlet is at an angle of not more than 45 degrees above horizontal at the main line.

(b) Connections to the Existing System

Unless otherwise specified by the Engineer or designated representative, all connections made to existing mains shall be made at manholes with the crown of the inlet pipe installed at the same elevation as the crown of the existing pipe. Service stubs installed on the existing system shall be installed by use of tapping saddles unless otherwise approved by the Engineer or designated representative. Extreme care shall be exercised to prevent material from depositing in the existing pipe as the taps are being made.

When connections to existing mains are made, a temporary plug approved by the Engineer or designated representative must be installed downstream in the manhole to prevent water and debris from entering the existing system before Final Completion. These plugs shall be removed after the castings are adjusted to finish grade or prior to Final Completion.

(24) Water System Connections

The Contractor shall, at his expense, make all necessary connections of new piping or accessories to the existing water system. To minimize any inconvenience from outages, the Contractor shall schedule all such connections in advance and such schedule must be approved by the Engineer or designated representative before beginning any Work.

(a) Shutoffs

The City will make all shutoffs on existing water mains. The Contractor shall be required to notify the Engineer or designated representative on the job at least 72 hours prior to the desired time for any shutoff. The Engineer or designated representative will notify any affected utility customers at least 24 hours prior to the shutoff. The Water Utility will make the shutoff after ensuring that all appropriate measures have been taken to protect the water system, customers and employees.

The City will operate all valves to fill existing mains. Where a newly constructed main has not been placed in service and has only one connection to the public water supply, the Contractor may operate one valve to fill the main after approval has been obtained from the Water Utility. The operation of the valve is to be conducted under the immediate supervision of the Engineer or designated representative.

Water for the Work shall be metered and furnished by the Contractor in accordance with Section 01500 of the Standard Contract Documents.

(b) Wet Connections to Existing Water System

The Contractor shall make all wet connections called for by the Contract or required to complete the Work. Two connections to an existing line performed during the same shutout, at the same time and at a distance less than 50 linear feet apart, will be considered one wet connection. Two connections to an existing line performed during the same shutout, at the

same time and at a distance equal to, or greater than 50 linear feet will be considered two wet connections. A wet connection shall include draining and cutting into existing piping and connecting a new pipeline or other extension into the existing pressure piping, forming an addition to the water transmission and distribution network.

The Contract price for wet connections shall be full payment for all necessary shutoffs, excavation, removing plugs and fittings, pumping water to drain the lines, cutting in new fittings, blocking and anchoring piping, bedding and backfilling, placing the lines and service and all site cleanup.

No water containing detectable amounts of chlorine may be drained, released or discharged until specific planning and appropriate preparations to handle, dilute and dispose of such chlorinated water are approved in advance by the City and the disposal operations will be witnessed by an authorized representative from the City.

(c) Pressure Taps to Existing Water System

The Contractor shall make all pressure taps called for by the Contract Documents or required to complete the Work. A pressure tap shall consist of connecting new piping to the existing water system by drilling into the existing pipe while it is carrying water under normal pressure without taking the existing piping out of service.

Unless otherwise provided by the Contract, the Contractor shall, at his expense, perform all necessary excavation, furnish and install the tapping sleeve, valve and accessories, provide the tapping machine, drill the tap and shall block, anchor and backfill the piping, valve and all accessories, place the new piping in service and perform all site cleanup. When the City makes the tap, City forces are not obligated or expected to perform any Work except to provide tapping machine and drill the actual hole. If City crews are to make the tap, fiscal arrangements must be made in advance at the Taps Office, Waller Creek Center, 625 East 10th Street.

If a private Contractor makes the tap, a W-WW Inspector must be present. "Size on size" taps will not be permitted, unless made by use of an approved full circle gasket tapping sleeve. Concrete blocking shall be placed behind and under all tap sleeves 24 hours prior to making the wet tap.

(d) Service Connections

Service connection taps into PVC or AC pipe or into CI or DI pipe 12 inches or smaller shall be made using either a service clamp or saddle or a tapping sleeve as recommended by the pipe manufacturer and as approved by the Engineer or designated representative. Direct tapping of these pipes will not be permitted.

All water service connections shall be installed so that the outlet is at an angle of not more than 45 degrees above horizontal at the main line.

Precautions should be taken to ensure that the tapping saddle or sleeve is placed on the pipe straight to prevent any binding or deformation of the PVC pipe. The mounting chain or U-bolt strap must be tight.

Tapping shall be performed with a sharp shell type cutter so designed that it will smoothly penetrate heavy walled PVC DR14 and 200 psi AC and will retain and extract the coupon from the pipe.

(25) Backfilling

(a) General

Special emphasis is placed upon the need to obtain uniform density throughout the backfill material. The maximum lift of backfill shall be determined by the compaction equipment selected and in no case shall it exceed 18 inches, loose measurement.

No heavy equipment, which might damage pipe, will be allowed over the pipe until sufficient cover has been placed and compacted. All internal pipe bracing installed or recommended by the manufacturer shall be kept in place until the pipe bedding and trench backfill have been completed over the braced pipe section. Testing of the completed backfill in streets and under and around structures shall meet the specified density requirements. Initial testing shall not be at Contractor's expense and shall conform to the "General Conditions."

(b) General Corrugated Metal Pipe

After the corrugated metal pipe structure has been completely assembled on the proper line and grade and headwalls constructed where indicated; selected material free from rocks over 8 inches in size from excavation or borrow, as approved by the Engineer or designated representative, shall be placed along both sides of the completed structures equally, in uniform layers not exceeding 6 inches in depth (loose measurement), sprinkled if required and thoroughly compacted between adjacent structures and between the structures and the sides of the trench.

Backfill material shall be compacted to the same density requirements as indicated for the adjoining sections of embankment in accordance with the governing specifications thereof. Above the 3/4 point of the structure, the fill shall be placed uniformly on each side of the pipe in layers not to exceed 12 inches, loose measure.

Prior to adding each new layer of loose backfill material, until a minimum of 12 inches of cover is obtained over the crown of the pipe, an inspection will be made of the inside periphery of the corrugated metal structure to determine if any floating, local or unequal deformation has occurred as a result of improper construction methods.

(c) Backfill Materials

The Engineer or designated representative may approve any of the following well graded materials:

1. Select trench material
2. Sand
3. Crushed rock cuttings
4. Rock cuttings
5. Foundation Rock
6. Blasted material with fines and rock
7. Cement stabilized material
8. Borrow

Within the 100-year flood plain, sand will not be permitted for backfilling. The Engineer or designated representative will approve the topsoil for areas to be seeded or sodded.

(d) Backfill in Street Right of Way

Placement of backfill under existing or future pavement structures and within 2 feet of any structures shall be compacted to the required density using any method, type and size of equipment, which will give the required compaction without damaging the pipe or bedding. Placement of backfill greater than 2 feet beyond structures in Right of Way shall be conform to (g) below. The depth of layers, prior to compaction, shall depend upon the type of sprinkling and compacting equipment used and the test results thereby obtained. Prior to and in conjunction with the compaction operation, each layer shall be brought to the moisture content necessary to obtain the required density and shall be kept level to insure uniform compaction over the entire layer. Testing for density shall be in accordance with Test Method Tex-114-E and Test Method Tex-115-E.

Each layer of backfill must provide the density as required herein. Swelling soils (soils with plasticity index of 20 or more) shall be sprinkled as required to provide not less than optimum moisture nor more than 2 percent over optimum moisture content and compacted to the extent necessary to provide not less than 95 percent nor more than 102 percent of the density as determined in accordance with Test Method Tex-114-E. Non-swelling soils (soils with plasticity index less than 20) shall be sprinkled as required and compacted to the extent necessary to provide not less than 95 percent of the density as determined in accordance with Test Method Tex-114-E.

After each layer of backfill is complete, tests may be made by the Engineer or designated representative. If the material fails to meet the density indicated, the course shall be reworked as necessary to obtain the indicated compaction and the compaction method shall be altered on subsequent Work to obtain indicated density.

At any time, the Engineer or designated representative may order proof rolling to test the uniformity of compaction of the backfill layers. All irregularities, depressions, weak or soft spots that develop shall be corrected immediately by the Contractor.

Should the backfill, due to any reason, lose the required stability, density or finish before the pavement structure is placed, it shall be recompacted and refinished at the sole expense of the Contractor. Excessive loss of moisture in the subgrade shall be prevented by sprinkling, sealing or covering with a subsequent backfill layer or granular material. Excessive loss of moisture shall be construed to exist when the subgrade soil moisture content is more than 4 percent below the optimum of compaction ratio density. Backfill shall be placed from the top of the bedding material to the existing grade, base course, subgrade or as indicated. The remainder of the street backfill shall be Flexible Base, Concrete or Hot Mix Asphalt Concrete as indicated or to be replaced in kind to the surface removed to construct the pipe.

(e) Backfill in County Street or State Highway Right of Way

All Work within the right of way shall meet the requirements of (d) above, as a minimum and shall meet the requirements of the permit issued by the County when their requirements are more stringent. Prior to the start of construction, the Contractor shall be responsible for contacting the appropriate TxDOT office or County Commissioner's Precinct Office and for coordinating his activities with the operating procedures in effect for utility cut permits and pavement repair under their jurisdiction. Approval for all completed Work in the State or County right of way shall be obtained from the appropriate Official prior to final payment by the Owner.

(f) Backfill in Railroad Right of Way

All Work within the railroad right of way shall meet the requirements of (d) above, as a minimum and shall meet the requirements of the permit issued by the Railroad Owner when their requirements are more stringent. Approval for all completed Work in the railroad right of way shall be obtained from the Railroad prior to Final Completion.

(g) Backfill in Easements

Where not otherwise indicated, Contractor may select whatever methods and procedures may be necessary to restore entire Work area to a safe, useful and geologically stable condition with a minimum density of 85 percent or a density superior to that prior to construction.

In and near flood plain of all streams and watercourses, under or adjacent to utilities, structures, etc. all backfill shall be compacted to a density of not less than 95 percent conforming to TxDOT Test Method Tex-114-E, unless otherwise directed by Engineer or designated representative.

All soil areas disturbed by construction shall be covered with top soil and seeded conforming to Item No. 604, "Seeding for Erosion Control". All turf, drainways and drainage structures shall be constructed or replaced to their original condition or better. No debris shall remain in the drainways or drainage structures.

(26) Quality Testing for Installed Pipe

(a) Wastewater Pipe Acceptance Testing

After construction is complete, Engineer or designated representative will determine whether the pipeline is to be tested for infiltration, exfiltration or by the low-pressure air test method. In addition, plastic pipe 18 inches and larger in diameter shall be deflection tested.

Wastewater pipe installed in the City of Round Rock and its ETJ areas shall be tested for exfiltration or infiltration as described below in "Exfiltration Test" and "Infiltration Test" or by acceptable low pressure air test, as described below. At the conclusion of either test series, the Work shall be further tested for pipeline settlement and also for deflection as described below. The Contractor shall be solely responsible for making proper repairs to those elements, which do not pass these test requirements.

(b) Exfiltration Test

Water for the Work shall be metered and furnished by the Contractor in accordance with Section 01500 of the Standard Contract Documents.

The pipeline shall be completely filled with water for its complete length or by sections as determined by the Engineer or designated representative. If tested for its complete length, the maximum head at any point shall not exceed 25 feet unless otherwise indicated. If tested in sections, the manholes in the test section shall be completely filled with water. After the pipeline has been filled and allowed to stand for 24 hours, the amount of exfiltration shall be calculated. Any amount in excess of 200 gallons per inch of inside pipe diameter per mile per day shall be cause for rejection.

For portions of lines located within the Edwards Aquifer Recharge Zone or within any recharge area or recharge feature within the Edwards Aquifer Transition Zone, the minimum head during testing shall not be less than 2 feet and the leakage rate shall not exceed 50 gallons per inch of inside pipe diameter per mile per day. This rate shall apply for the entire portion of the line extending up to the first manhole located outside the recharge zone, recharge area, or recharge features indicated on Drawings and shall also be applicable for any recharge areas or recharge features which may be identified during construction. For construction within the 25-year flood plain, the exfiltration rate shall not exceed 10 gallons per inch diameter per mile of pipe per 24 hours at the same minimum test head.

(c) Infiltration Test

When the pipe placed in easements is completed, the upper portion of the trench backfill shall be removed to a depth of not less than 18 inches below the finished surface and width equal to the original trench width. The trench shall then be flooded with water until it is completely saturated and water stands in the ditch a minimum of 12 inches deep. In cases of steep terrain, earthen dikes shall be used to assure that water will stand

over the trench. After it is apparent that the trench is completely saturated, the main shall then be inspected with closed-circuit television for infiltration. Any section of the main or any service stub that indicates infiltration above the maximum quantity specified shall be cause for rejection.

This procedure shall not be used for pipes installed in areas where the Plasticity Index (P.I.) of the surrounding material is 20 or higher or where the backfill material has a P.I. of 20 or more.

For portions of lines located within the Edwards Aquifer Recharge Zone or within any recharge area or recharge feature within the Edwards Aquifer Transition Zone, the total infiltration as determined by water test, must be at a rate not greater than 50 gallons per inch of pipe diameter per mile of pipe per 24 hours at a minimum test head of two feet. This rate shall apply for the entire portion of the line extending up to the first manhole located outside the recharge zone, recharge area, or recharge features indicated on Drawings and shall also be applicable for any recharge areas or recharge features which may be identified during construction. For construction within the 25-year flood plain, the infiltration rate shall not exceed 10 gallons per inch diameter per mile of pipe per 24 hours at the same minimum test head.

If the quantity of infiltration exceeds the maximum quantity specified, remedial action must be undertaken in order to reduce the infiltration to an amount within the limits specified.

(d) Pipeline Settlement Test

During the infiltration test or after the exfiltration test, the pipe will be TV inspected for possible settlement. When air testing has been used, water shall be flowed into the pipe to permit meaningful observations. Any pipe settlement which causes excessive ponding of water in the pipe shall be cause for rejection. Excessive ponding shall be defined as a golf ball (1-5/8" dia.) submerged at any point along the line.

(e) Low Pressure Air Test of Plastic Gravity Flow Wastewater Lines

(1) General

Wastewater lines, at the discretion of the Engineer or designated representative, shall be air tested between manholes. Backfilling to grade shall be completed before the test and all laterals and stubs shall be capped or plugged by the Contractor so as not to allow air losses, which could cause an erroneous, test result. Manholes shall be plugged so they are isolated from the pipe and cannot be included in the test.

All plugs used to close the sewer for the air test shall be capable of resisting the internal pressures and must be securely braced. Place all air testing equipment above ground and allow no one to enter a manhole or trench where a plugged sewer is under pressure.

Release all pressure before the plugs are removed. The testing equipment used must include a pressure relief device designed to relieve pressure in the sewer under test at 10 psi or less and must allow continuous monitoring of the test pressures in order to avoid excessive pressure. Use care to avoid the flooding of the air inlet by infiltrated ground water. (Inject the air at the upper plug if possible.) Use only qualified personnel to conduct the test.

(2) Ground Water

Since the presence of ground water will affect the test results, test holes shall be dug to the pipe zone at intervals of not more than 100 feet and the average height of ground water above the pipe (if any) shall be determined before starting the test.

(3) Test Procedure

The Engineer or designated representative may, at any time, require a calibration check of the instrumentation used. Use a pressure gauge having minimum divisions of 0.10 psi and an accuracy of 0.0625 psi. (One ounce per square inch.) All air used shall pass through a single control panel. Clean the sewer to be tested and remove all debris where indicated. Wet the sewer prior to testing. The average back pressure of any groundwater shall be determined (0.433 psi) for each foot of average water depth (if any) above the sewer.

Add air slowly to the section of sewer being tested until the internal air pressure is raised to 4.0 psig greater than the average back pressure of any ground water that may submerge the pipe. After the internal test pressure is reached, allow at least 2 minutes for the air temperature to stabilize, adding only the amount of air required to maintain pressure. After the temperature stabilization period, disconnect the air supply. Determine and record the time in seconds that is required for the internal air pressure to drop from 3.5 psig to 2.5 psig greater than the average backpressure of any ground water that may submerge the pipe. Compare the time recorded with the specification time for the size and length of pipe as given in the following table:

Table For Low Pressure Air Testing of Plastic Pipe:

Minimum Specified Time Required For 1.0 psig Pressure Drop For Size and Length of Pipe Indicated								
Diameter of Pipe, (in.)	Specification Time (min: sec) for length shown							
	100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

- NOTES:**
1. Specification times are as given in UNI-B-6 RECOMMENDED PRACTICE FOR LOW-PRESSURE TESTING OF INSTALLED PIPE -- by Uni-Bell PVC Pipe Association, 2655 Villa Creek Dr., Ste. 155, Dallas Texas 75234.
 2. Pipe Sizes acceptable by City of Round Rock are as given in the Water and Wastewater Utility's Standard Products List (SPL's) WW-227 and WW-227A.

Any drop in pressure, from 3.5 psig to 2.5 psig (adjusted for groundwater level), in a time less than that required by the above table shall be cause for rejection. When the line tested includes more than one size pipe, the minimum time shall be that given for the largest size pipe included.

Test procedure for wastewater pipe located in the Edwards Aquifer Recharge Zone or identified recharge areas or recharge features within the Edwards Aquifer Transition Zone:

Low-pressure air tests must conform to the procedure described in ASTM C-924 or other equivalent procedures. For safety reasons, air testing of pipe sections will be limited to line sizes of 36 inches inside diameter or less. Lines that are 36 inches or larger inside diameter may be air tested at each joint. The minimum time allowable for the pressure to drop from 3.5 pounds per square inch to 2.5 pounds per square inch gauge during a joint test, regardless of pipe size, shall be twenty (20) seconds.

For sections of pipe less than 36-inch inside diameter, 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 must be computed by the following equation:

$T = 0.0850 (D)(K)/(Q)$, where

T = time for pressure to drop 1.0 pounds per square inch gauge in seconds;

K = $0.000419(D)(L)$, but not less than 1.0

D = nominal inside diameter in inches;

L = length of line of same pipe size in feet; and

Q = rate of loss, assume 0.0015 cubic feet per minute per square foot ($\text{ft}^3/\text{min}/\text{ft sq}$) of internal surface area.

Any drop in pressure, from 3.5 psig to 2.5 psig, in a time less than that required by the above formula shall be cause for rejection. When the line tested includes more than one size of pipe, the minimum time shall be that calculated for the largest size pipe included.

Manholes must be tested separately and independently. All manholes must be hydrostatically tested with a maximum loss allowance of 0.025 gallon per foot diameter per foot of head per hour.

When lines are air tested, manholes are to be tested separately by exfiltration or vacuum method (see Standard Specification Item No. 506, "Manholes").

(f) Deflection Test

Deflection tests shall be performed by the Contractor on all flexible and semi-rigid wastewater pipes. The tests shall be conducted after the final backfill has been in place at least 30 days. Testing for in-place deflection shall be with a pipe mandrel or rigid ball sized at 95% of the inside diameter of the pipe. A second test of flexible and semi-rigid wastewater pipes 18 inch size and larger, also with a pipe mandrel or ball sized at 95% of the inside diameter of the pipe, shall be conducted by the Contractor 30 days prior to expiration of his warranty on the Work.

Contractor shall submit his proposed pipe mandrels or testing balls to the Engineer or his designated representative for concurrence prior to testing the line.

Test(s) must be performed without mechanical pulling devices and must be witnessed by the Engineer or his designated representative.

Any deficiencies noted shall be corrected by the Contractor and the test(s) shall be redone.

(27) Pressure Pipe Hydrostatic Testing

After the pipe has been installed and backfilled and all service laterals, fire hydrants and other appurtenances installed and connected, a pressure test, followed by a leakage test, will be conducted by the City. The City will furnish the pump and gauges for the tests. The Contractor shall be present and shall furnish all necessary assistance for conducting the tests. The specified test pressures will be based on the elevation of the lowest point of the line or section under test. Before applying the specified test pressure, all air shall be expelled from the pipe.

If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points.

All drain hydrant and fire hydrant leads, with the main 6-inch gate valve open, the hydrant valve seats closed and nozzle caps open, shall be included in the test.

(a) Pressure Test

The entire project or each valved section shall be tested, at a pressure of 200 psi for a sufficient period (approximately 10 minutes) to discover all leaking or defective materials. Repairs shall be made by the Contractor to correct any leaking or defective materials.

(b) Pressure Pipe Leakage Test

A leakage test will follow the pressure test and be conducted on the entire project or each valved section. The leakage test shall be at 150 psi for at least 1 hour.

(1) Allowable Leakage

Leakage shall be defined as the quantity of water that must be supplied into any test section of pipe to maintain the specified leakage test pressure (see above, "Pressure Pipe Leakage Test") after the air in the pipeline has been expelled and the pipe has been filled with water.

No pipe installation will be accepted if the leakage exceeds 25 gallons/24 hours/mile of pipe/inch nominal pipe diameter.

$$\frac{(25 \text{ gpd})}{(\text{in.} - \text{mi.})}$$

(2) Location and Correction of Leakage

If such testing discloses leakage in excess of this specified allowable, the Contractor, at his expense, shall locate and correct all defects in the pipeline until the leakage is within the indicated allowance.

All visible leakage in pipe shall also be corrected by Contractor at his own expense.

(28) Service Charges for Testing

Initial testing performed by City forces for the Contractor will be at the City's expense. Retesting, by City forces, of Contractor's work that fails initial testing will be at the Contractor's expense. The City's charge for retests will be \$265.00, plus \$50.00 for each hour over four hours. On City-funded projects, the charges incurred by the City for retesting will be deducted from funds due the Contractor. On non-City-funded projects, the charges incurred by the City for retesting will be billed to the Contractor. The City will withhold acceptance of the Contractor's work until the Contractor has paid the City for the retesting costs.

(29) Disinfection of Potable Water Lines

(a) Preventing Contamination

The Contractor shall protect all piping materials from contamination during storage, handling and installation. Prior to disinfection, the pipeline interior shall be clean, dry and unobstructed. All openings in the pipeline shall be closed with watertight plugs when pipe laying is stopped at the close of the day's work.

(b) Cleaning

Prior to disinfection the Contractor shall clean the pipeline to remove foreign matter. For pipelines 16" in diameter or smaller, cleaning shall consist of flushing the pipeline. For pipelines greater than 16" in diameter, cleaning shall be performed by operating hydrants and blow-offs located at low points in the pipeline, or by mechanical means (sweeping or pigging). Water for the Work shall be metered and furnished by the Contractor in accordance with Section 01500 of the Standard Contract Documents.

(c) Procedure and Dosage

The Contractor, at its expense, will supply the test gauges and the Sodium Hypochlorite conforming to ANSI/AWWA B300, which contains approximately 5 percent to fifteen percent available chlorine, and will submit for approval a written plan for the disinfection process. Calcium Hypochlorite conforming to ANSI/AWWA B300, which contains approximately 65 percent available chlorine by weight, may be used in granular form or in 5 g tablets for 16" diameter or smaller lines, if it is included as part of the written plan of disinfection that is approved by the City of Round Rock. The Contractor, at its expense, shall provide all other equipment, supplies and the necessary labor to perform the disinfection under the general supervision of the City.

One connection to the existing system will be allowed with a valve arranged to prevent the strong disinfecting dosage from flowing back into the existing water supply piping. The valve shall be kept closed and locked in a valve box with the lid painted red. No other connection shall be made until the disinfection of the new line is complete and the water samples have met the established criteria. The valve shall remain closed at all times except when filling or flushing the line and must be manned during these operations. Backflow prevention in the form of a reduced pressure backflow assembly must be provided if the valve is left unattended. The new pipeline shall be filled completely with disinfecting solution by feeding the concentrated chlorine and approved water from the existing system uniformly into the new piping in such proportions that every part of the line has a minimum concentration of 50 mg/liter available chlorine.

The disinfecting solution shall be retained in the piping for at least 24 hours and all valves, hydrants, services, stubs, etc. shall be operated so

as to disinfect all their parts. After this retention period, the water shall contain no less than 25 mg/liter chlorine throughout the treated section of the pipeline.

For pipelines larger than 16" in diameter, the Contractor may use the AWWA C-651 "Slug Method" for disinfecting the pipeline. Chlorine shall be fed at a constant rate and at a sufficient concentration at one end of the pipeline to develop a slug of chlorinated water having not less than 100 mg/liter of free chlorine. The Contractor shall move the slug through the main so that all interior surfaces are exposed to the slug for at least three (3) hours. The chlorine concentration in the slug shall be measured as it moves through the pipeline. If the chlorine concentration drops below 50 mg/liter, the Contractor shall stop the slug and feed additional chlorine to the head of the slug to restore the chlorine concentration to at least 100 mg/liter before proceeding. As the slug flows past fittings and valves, related valves and hydrants shall be operated so as to disinfect appurtenances and pipe branches.

Unless otherwise indicated, all quantities specified herein refer to measurements required by the testing procedures included in the current edition of "Standard Methods". The chlorine concentration at each step in the disinfection procedure shall be verified by chlorine residual determinations.

(d) Final Flushing

The heavily chlorinated water shall then be carefully flushed from the potable water line until the chlorine concentration is no higher than the residual generally prevailing in the existing distribution system. Proper planning and appropriate preparations in handling, diluting, if necessary, and disposing of this strong chlorine solution is necessary to insure that there is no injury or damage to the public, the water system or the environment. The plans and preparations of the Contractor must be approved by the City before flushing of the line may begin. Additionally the flushing must be witnessed by an authorized representative of the City.

Approval for discharge of the diluted chlorine water or heavily chlorinated water into the wastewater system must be obtained from the Water and Wastewater Utility Department. The line flushing operations shall be regulated by the Contractor so as not to overload the wastewater system or cause damage to the odor feed systems at the lift stations. The City shall designate its own representative to oversee the work.

Daily notice of line discharging must be reported to the Water and Wastewater Utility Dispatch office.

(e) Bacteriological Testing

After final flushing of the strong disinfecting solution, two (2) sets of water samples from the line, that are taken at least twenty-four (24) hours apart, will be tested for bacteriological quality by the City and must be found free

of coliform organisms before the pipeline may be placed in service. Each set shall consist of one (1) sample that is drawn from the end of the main and additional samples that are collected at intervals of not more than 1000 feet along the pipeline. All stubs shall be tested before connections are made to existing systems.

The Contractor, at its expense, shall install sufficient sampling taps at proper locations along the pipeline. Each sampling tap shall consist of a standard corporation cock installed in the line and extended with a copper tubing gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use.

Samples for bacteriological analysis will only be collected from suitable sampling taps in sterile bottles treated with sodium thiosulfate. Samples shall not be drawn from hoses or unregulated sources. The City, at its expense, will furnish the sterile sample bottles and may, at its discretion, collect the test samples with City personnel.

If the initial disinfection fails to produce acceptable sample test results, the disinfection procedure shall be repeated at the Contractor's expense. Before the piping may be placed in service, two (2) consecutive sets of acceptable test results must be obtained.

An acceptable test sample is one in which: (1) the chlorine level is similar to the level of the existing distribution system; (2) there is no free chlorine and (3) total coliform organisms are absent. An invalid sample is one, which has excessive free chlorine, silt or non-coliform growth as defined in the current issue of the "Standards Methods." If unacceptable sample results are obtained for any pipe, the Contractor may, with the concurrence of the Inspector, for one time only flush the lines and then collect a second series of test samples for testing by the City. After this flushing sequence is completed, any pipe with one or more failed samples must be disinfected again in accordance with the approved disinfection procedure followed by appropriate sampling and testing of the water.

The City of Round Rock Water Quality Laboratory will notify the assigned City of Round Rock Inspector in writing of all test results. The Inspector will subsequently notify the Contractor of all test results. The Water Quality Laboratory will not release test results directly to the Contractor.

(30) Cleanup and Restoration

It shall be the Contractor's responsibility to keep the construction site neat, clean and orderly at all times. Cleanup shall be vigorous and continuous to minimize traffic hazards or obstructions along the streets and to driveways. Trenching, backfill, pavement repair (as necessary), and cleanup shall be coordinated as directed by the City. The Engineer or designated representative will regulate the amount of open ditch and may halt additional trenching if cleanup is not adequate to allow for orderly traffic flow and access.

Materials at the site shall be stored in a neat and orderly manner so as not to

obstruct pedestrian or vehicular traffic. All damaged material shall be removed from the construction site immediately and disposed of in a proper manner. All surplus excavated materials become the property of the Contractor for disposal at his expense. After trenching, the Contractor shall immediately remove all excavated materials unsuitable for or in excess of, backfill requirements. Immediately following the pipe laying Work as it progresses, the Contractor shall backfill, grade and compact all excavations as provided elsewhere and shall immediately clean up and remove all unused soil, waste and debris and restore all surfaces and improvements to a condition equal or superior to that before construction began and to an appearance which complements the surroundings. The Contractor shall grade and dress the top 6 inches of earth surfaces with soil or other material similar and equal to the surrounding, fill and smooth any visible tracks or ruts, replace and re-establish all damaged or disturbed turf or other vegetation and otherwise make every effort to encourage the return of the entire surface and all improvements to a pleasant appearance and useful condition appropriate and complementary to the surroundings and equal or similar to that before construction began.

Permanent pavement replacement, if necessary, shall begin immediately after all testing of each segment of piping is satisfactorily completed.

510.4 Measurement

Pipe will be measured by the linear foot for the various types, sizes and classes. Parallel lines will be measured individually.

Where a line ties into an existing system, the length of the new line will be measured from the visible end of the existing system at the completed joint. Unless otherwise indicated, the length of water and wastewater lines will be measured along pipe horizontal centerline stationing through fittings, valves, manholes, and other appurtenances.

Unless otherwise provided, ductile fitting 24-inch and smaller will be measured by the ton and paid for in accordance with the schedule in Standard Product List WW-27C. Unless otherwise provided, fittings larger than 24 inch sizes will be subsidiary to the pipe. Steel cylinder concrete pipe fittings and welded steel pipe fittings will not be measured separately. These will be subsidiary to the bid item Pipe.

Stormwater pipe will be measured along the slope of the pipe. Where drainage pipe ties into inlets, headwalls, catch basins, manholes, junction boxes or other structures that length of pipe tying into the structure wall will be included for measurement but no other portion of the structure length or width will be so included.

Excavation and backfill, when included as pipe installation will not be measured as such but shall be included in the unit price bid for constructing pipe and measured as pipe complete in place including excavation and backfill.

When pay items are provided for the other components of the system, measurement will be made as addressed hereunder.

510.5 Payment

Payment for pipe, measured as prescribed above, will be made at the unit price bid per linear foot for the various sizes of pipe, of the materials and type indicated, unless unstable material is encountered or trench excavation and backfill is bid as a separate item.

The concrete seal, foundation rock or coarse aggregate when used as directed in unstable material will be paid for at the unit price bid per cubic yard, which shall be full payment for all excavation and removal of unsuitable material and furnishing, placing and compacting the foundation rock, coarse aggregate or other approved material all complete in place.

Excavation and backfill, when included as a separate pay item, will be paid for by Pay Item No. 510-E or 510-F.

(1) Pipe

Payment for pipe, measured as prescribed above, will be made at the unit price bid per linear foot complete-in-place as designed and represented in the Drawings and other Contract documents. Unless otherwise provided herein, as separate pay item(s), subsidiary items to the bid price per linear foot of pipe shall include the following:

- a. clearing
- b. constructing any necessary embankment
- c. excavation
- d. disposal of surplus or unusable excavated material
- e. furnishing, hauling and placing pipe
- f. fittings larger than 24 inch
- g. field constructed joints, collars, temporary plugs, caps or bulkheads
- h. all necessary lugs, rods or braces
- i. pipe coatings and protection
- j. connections to existing systems or structures, concrete blocking and thrust blocks and restrained joints
- k. preparing, shaping, pumping for dewatering, and shoring of trenches
- l. bedding materials
- m. backfill materials
- n. hauling, placing and preparing bedding materials
- o. particle migration measures
- p. hauling, moving, placing and compacting backfill materials
- q. temporary and permanent pavement repairs and maintenance
- r. temporary and permanent removal and replacement of pavement, curb, drainage structures, driveways, sidewalks and any other improvements damaged or removed during construction
- s. cleanup
- t. vertical stack on deep wastewater services
- u. all other incidentals necessary to complete the pipe installation as indicated.

No separate payment will be made for thrust restraint measures.

Steel cylinder concrete pipe fittings and welded steel pipe fittings will not be paid for separately. These will be subsidiary to the bid item Pipe.

(2) Concrete Cradles and Seals

When called for in the Bid, concrete cradles and seals will be paid for at the unit Contract price bid per linear foot for the size of pipe specified, complete in place.

(3) Concrete Retards

When called for in the Bid, Concrete retards will be paid under Item No. 593, Concrete Retards."

(4) Boring, Jacking and Tunneling

When called for in the Bid, boring, jacking and tunneling will be paid under Item 501, "Jacking or Boring Pipe" or Item 502, "Tunneling".

(5) Wet Connections to Water Mains

When called for in the bid, wet connections will be paid at the unit price bid per each, complete in place, according to the size of the main that is in service and shall be full compensation for all Work required to make the connection and place the pipe in service. (See subsection 510.3 'Construction Methods part (24) (b) 'Wet Connections to Existing Water System').

(6) Fittings

Cast iron and ductile iron fittings of the class indicated, furnished in accordance with these specifications will be paid for at the unit price bid per ton, complete in place, according to scheduled weights for mechanical joint fittings furnished, including glands, bolts and gaskets, as published in the following standards:

AWWA C-153 for all fittings 4-inch through-24 inch sizes, regardless of whether AWWA C-110 or

AWWA C-153 fittings are furnished or the type of end connections supplied.

AWWA C-110 for all fittings larger than 24-inch size.

Steel cylinder concrete pipe fittings and welded steel pipe fittings will not be paid for separately. The Contractor shall include these in his bid for pipe.

(7) Concrete Trench Cap and Encasement

Where the distance between the top of the concrete encasement and the top of the trench cap is less than 36 inches, the concrete cap and encasement shall be poured as one unit and paid for under this bid item at the Contract price bid per linear foot. When the distance above is greater than 36 inches or when the trench cap is placed separately, the trench cap shall be paid for as a separate item, per linear foot, complete in place.

(8) Cement-Stabilized Backfill

Cement-stabilized backfill will be paid for at the unit price bid per linear foot and shall be full payment to the Contractor for furnishing and installing the required material, mixed, placed and cured complete in place.

(9) Concrete Encasement

When called for in the Bid, Concrete Pipe Encasement will be paid under Item No. 505, "Encasement and Encasement Pipe".

(10) Pressure Taps

Pressure taps will be paid for at the unit price bid, complete in place, according to the size tap made and the size main tapped and shall be full payment for furnishing all necessary materials, including tapping sleeve and valve, making the tap, testing and placing the connection in service.

(11) Trench Safety Systems

When called for in Bid, Trench Safety Systems shall conform to Item No. 509, "Trench Safety Systems".

(12) In-Place Slip lining with or without In-Place Pipe Destruction/Replacement

As called for in the corresponding bid items, pipe slip lining with or without in-place pipe destruction/replacement will be paid for at the Contract price per linear foot for the specified liner and pipe size and type pipe, at all depths, complete in place.

Installation of new services, or reconnection of existing services, to the liner will be paid for at the Contract price per each for the specified size and type of service, at all depths, complete in place.

(13) Cured Resin Pipe Lining

When called for in the bid, cured resin pipe lining will be paid for per linear foot, for the size and type of pipe lined, at all depths, complete in place including all equipment set-ups, video inspection and cleaning of existing pipe. Installation of new services or reconnection of existing services to the relined pipe will be paid for per each, for the specified size and type of service, at all depths, complete in place.

Payment, when included as a Contract pay item, will be made under one of the following:

Pipe, ___Dia. ___(all depths), including Excavation and Backfill
Per Linear Foot.

In-Place Sliplining without In-Place Pipe Destruction/Replacement

(___ Dia. ___ Pipe Lining ___ in. Dia. Existing Pipe) Per Linear Foot.

In-Place Sliplining with Pipe Destruction/Replacement

(___ Dia. ___Replacement Pipe ___in. Dia. Existing Pipe) Per Linear Foot.

Installing or Reconnecting Lateral Service to Existing, Relined or Replaced Pipe (____Dia. ____Service) in. (____Dia. ____Pipe)	Per Each.
Pipe Excavation, ____Ft. Width	Per Linear Foot.
Pipe Trench Backfill, ____Ft. Width	Per Linear Foot.
Concrete Seal or Cradle, ____Dia. Pipe	Per Linear Foot.
Concrete Trench Cap, ____Ft. Width	Per Linear Foot.
Concrete Cap and Encasement, ____Dia. Pipe	Per Linear Foot.
Cement Stabilized Backfill, ____Dia. Pipe	Per Linear Foot.
Cured Resin Pipe Lining (for ____ Dia. Pipe)	Per Linear Foot.
Installing or Reconnecting Lateral Service to Cured Resin Lined Pipe, (____Dia. ____Service (for ____Dia. Main)	Per Each.
Pressure Taps, ____ Dia. X ____ Dia.	Per Each.
Wet Connections, ____ Dia. x ____ Dia.	Per Each.
Ductile Iron Fittings 4 inch through 24 inch	Per Ton.

A "W" after the pay item indicates the use for water.

A "WW" after the pay item indicates the use for wastewater.

End

Applicable References:

Standard Specifications Manual: Item Nos. Ref: 102, 210, 402, 403, 501, 502, 505, 506, 507, 509, 593, 601, 604

Standards Manual: Standard Detail Nos. 510-1, (520 - series).

Design Criteria Manuals: Utilities Criteria Manual, Section 5.

ITEM NO. 511

WATER VALVES

511.1 Description

This item shall govern the valves furnished and installed as indicated on the Drawings. Unless otherwise indicated on the Drawings, all valves 4 inches (102 mm) and larger shall be AWWA-type valves of suitable design and fully equipped for service buried in the earth, without need for further modification and shall be wrapped with 8-mil (0.2 mm) polyethylene film with all edges and laps securely taped to provide a continuous wrap. Where not indicated, the Contractor may use valves with any type end-joint allowed for fittings of the pipe class being used. Unless otherwise indicated on the Drawings, all valve stems shall be adjusted to situate the operating nut not more than 24 inches (0.6 meters) below the proposed ground or paving surface of the finished project.

This specification is applicable for projects or work involving either inch-pounds or SI units. Within the text, inch-pound units are given preference followed by SI units shown within parentheses.

511.2 Materials

The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation in the Work is of the kind and quality that satisfies the specified functions and quality. The City of Round Rock Water and Wastewater Utility Standard Products Lists (SPL) are considered to form a part of these Specifications. Contractors may, when appropriate, elect to use products from the SPL; however, submittal to the Engineer/Architect (E/A) is still required. If the Contractor elects to use any materials from these lists, each product shall be completely and clearly identified by its corresponding SPL number when making the product submittal. This will expedite the review process in which the E/A, and, if necessary, the Water and Wastewater Utility Standard Products Committee, decide whether the products meet the Contract requirements and the specific use foreseen by the E/A in the design of this engineered Project.

The SPL's should not be interpreted as being a pre-approved list of products necessarily meeting the requirements for a given construction Project. Items contained in the SPL cannot be substituted for items shown on the Drawings, or called for in the specifications, or specified in the Bidding Requirements, Contract Forms and Conditions of Contract, unless approved by the Engineer or designated representative in conjunction with the Water and Wastewater Utility Standard Products Committee. The Standard Product List current at the time of plan approval will govern.

(A) Samples, Inspection and Testing Requirements:

All tests and inspections called for by the applicable standards shall be performed by the manufacturer. Upon request, results of these tests shall be made available to the purchaser.

(B) Other Requirements:

Each submittal shall be accompanied by:

- (1) Complete data covering:
 - a) the operator, including type and size, model number, etc.,
 - b) the manufacturer's name and address of his nearest service facility,
 - c) the number of turns to fully open or close the valve.
- (2) detailed instructions for calibrating the limit stops for open and closed positions, and
- (3) any other information, that may be necessary to operate and maintain the operator.
- (4) Complete dimensional data and installation instructions for the valve assembly as it is to be installed, including the operator.
- (5) Complete replacement parts lists and drawings, identifying every part for both the valve and operator.

511.3 Valves

(A) Iron-Body Gate Valves

Unless otherwise indicated, Iron Body Gate Valves, 4" to 12" (102 mm to 305 mm), including Tapping Valves, shall conform to AWWA C509, "Resilient Seated Gate Valves for Water and Sewerage Systems".

Iron Body Gate Valves larger than 12" (305 mm), including Tapping Valves, shall be double disc, parallel seat valves meeting the requirements of AWWA C500.

16 (406 mm) Iron Body Resilient Seated Gate valves may be used if called for in the design and if indicated in the Standard Product List WW-282.

- (1) Stem Seals: All valves shall have approved O-ring type stem seals. At least two O-rings shall be in contact with the valve stem where it penetrates the valve body.
- (2) Operation: All valves shall have non-rising stems with a 2" (50 mm) square operating nut, or with a spoke type handwheel when so ordered, turning clockwise to close.
- (3) Gearing: Double disc gate valves in 16 inch (406 mm) and larger sizes shall be geared and, when necessary for proper bury depth and cover, shall be the horizontal bevel-geared type enclosed in a lubricated gear case.
- (4) Bypass: Unless otherwise indicated, 16 inch (406 mm) and larger gate valves shall be equipped with a bypass of the non-rising stem type which meets the same AWWA standard required for the main valve.
- (5) Valve Ends: Valve ends shall be push-on, flanged or mechanical joint, as indicated or approved.

Tapping valves shall have inlet flanges conforming to MSS SP-60, with boltholes drilled per ANSI B16.1 Class 125. Seat rings and body casting

shall be over-sized as required to accommodate full size cutters; the outlet end shall be constructed and drilled to allow the drilling machine adapter to be attached directly to the valve.

- (6) Gear Case: All geared valves shall have enclosed gear cases of the extended type, attached to the valve bonnet in a manner that makes it possible to replace the stem seal without disassembly and without disturbing the gears, bearing or gear lubricant. Gear cases shall be designed and fabricated with an opening to atmosphere so that water leakage past the stem seal does not enter the gear case.
- (7) Valve Body: Double disc gate valves in 16 inch (406 mm) and larger sizes installed in the horizontal position shall have bronze rollers, tracks, scrapers, etc.

(B) Butterfly Valves:

Unless otherwise indicated, all valves shall conform to the current "AWWA" Standard C-504, "Rubber-Seated Butterfly Valves", Class 150B, except as modified or supplemented herein.

(1) Functional Requirements

- a) Valves shall be the short body design and shall have flanged connections on both ends unless otherwise called for.
- b) Valves shall be of such design that the valve discs will not vibrate or flutter when operated in a throttled position. Valve discs shall be secured to the shafts by means of keys or pins so arranged that the valve discs can be readily removed without damage thereto. All keys and pins used in securing valve discs to shafts shall be stainless steel or monel. Valve discs shall be stainless steel or ductile iron, ASTM A 536, Grade 65-45-12 (448-310-12); seating edge shall be stainless steel or other corrosion resistant material.
- c) Valve shafts shall be constructed of wrought stainless steel or monel. The ends of the shaft shall be permanently marked to indicate the position of the disc on the shaft.
- d) All buried valves shall have approved manufacturer's O-ring type or split V type "Chevron" shaft seals. When O-ring seals are used, there shall be at least two O-rings in contact with the valve shaft where it penetrates the valve body.

On 24 inch (635 mm) and larger valves, the seat shall be completely replaceable and/or adjustable with common hand tools without disassembling the valve from the pipeline.

Rubber seats located on the valve disc shall be mechanically secured with stainless steel retainer rings and fasteners.

- e) Unless otherwise indicated, valves shall be provided with manual operators with vertical stems and 2 inches (50 mm) square

operating nut turning clockwise to close and equipped with a valve disc position indicator. All keys or pins shall be stainless steel or monel. Buried valves shall have the valve stems extended or adjusted to locate the top of the operating nut no more than 24 inches (0.6 meter) below finish grade.

- f) Unless otherwise indicated, motorized butterfly valves shall be equipped with 230/460 volt, 3-phase reversing motor operators, extended as required to locate the center line of the operator shaft approximately 4 feet to 4 feet, 6 inches (1.2 to 1.4 meters) above finish grade. Operators shall be equipped with cast iron or malleable iron manual override hand wheel with a valve position indicator, local push button controls, lighted status/position indicator, torque and travel limit switches and all switches, relays and controls (except external power and signal wiring) necessary for both local and remote operation.

(2) Performance Requirements

- a) Unless otherwise indicated, valve operators shall be sized to seat, unseat, open and close the valve with 150 psi (1 megapascal) shutoff pressure differential across the disk and allow a flow velocity of 16 feet (4.9 meters) per second past the disc in either direction.
- b) Motorized valve motors shall be capable of producing at least 140 percent of the torque required to operate the valves under conditions of maximum non-shock shutoff pressure without exceeding a permissible temperature rise of 131°F over 104°F ambient (55 degrees Celsius over 40 degrees Celsius ambient); they shall have a duty rating of not less than 15 minutes and shall be capable of operating the valve through 4 1/2 cycles against full unbalanced pressure without exceeding the permissible temperature rise. Motors shall be suitable for operating the valve under maximum differential pressure when voltage to motor terminals is 80 percent of nominal voltage. Motor bearings shall be permanently lubricated and sealed.

(C) Ball Valves:

Ball valves shall be brass, bronze, stainless steel or PVC as indicated on the Drawings or Details or as approved by the Engineer or designated representative.

(D) Air-Vacuum Release Valves

- (1) Valves shall be combination air-release, air-vacuum units having small and large orifice units contained and operating within a single body or assembled unit.

The small orifice system shall automatically release small volumes of air while the pipe is operating under normal conditions. The large air-vacuum

orifice system shall automatically exhaust large volumes of air while the pipe is being filled and shall permit immediate re-entry of air while being drained.

Valves shall be rated for at least 150 psi (1 megapascal) {maximum} normal service pressure.

(2) Material Requirements

Valve exterior bodies and covers shall be cast iron.

Internal bushings, hinge pins, float guide and retaining screws, pins, etc., shall be stainless steel or bronze.

Orifice seats shall be Buna-N rubber.

Floats shall be stainless steel, rated at 1000 psi (6.9 megapascals).

Unless otherwise indicated, these valves shall be as included in the Standard Products List (SPL WW-367 for water, WW-462 for wastewater force mains).

E) Fire Hydrants

All fire hydrants shall be Dry Barrel, Traffic Model (break-away), Post Type having Compression Type Main Valves with 5 1/4" (133 mm) opening, closing with line pressure. Approved models are listed on SPL WW-3 of the Water and Wastewater Utility Standard Products List.

(1) Applicable Specifications

AWWA C-502 current: "AWWA Standard for Dry-Barrel Fire Hydrants".

NFPA 1963: "National (American) Standard Fire Hose Coupling Screw Thread" and City of Round Rock 4 inch (102 mm) Fire Hose Connection Standard (Available upon request from Standards Committee Secretary at 322-2806).

ANSI A-21.11 current: "American National Standard for Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings".

(2) Functional Requirements

Design Working Pressure shall be 200 psi (1.38 megapascals) and a test pressure of 400 psi (2.76 megapascals).

Inlet shall be side connection hub end for mechanical joint (ANSI A-21.11-current). Shoe shall be rigidly designed to prevent breakage.

Lower Barrel shall be rigid to assure above ground break at traffic feature. Bury length of hydrant shall be four (4) feet (1.2 meters) minimum, five (5) feet (1.5 meters) maximum (hydrant lead pipe may be elbowed up from main using restrained joints; flanged joints in lead pipes are not allowed). Flange type connections between hydrant shoe, barrel sections and bonnet shall have minimum of 6 corrosion resistant bolts.

Hydrant Main Valve shall be 5 1/4 inch (133 mm) I.D. Valve stem design shall meet requirements of AWWA C502, with Operating Nut turning clockwise to close. Operating Nut shall be pentagonal, 1 1/2 inch (38 mm) point to flat at base, and 1 7/16 inches (36.5 mm) at top and 1 inch (25 mm) minimum height. Seat ring shall be bronze (bronze to bronze threading), and shall be removable with light weight stem wrench. Valve mechanisms shall be flushed with each operation of valve; there shall be a minimum of two (2) drain ports.

Traffic Feature shall have replaceable breakaway ferrous metal stem coupling held to stem by readily removable type 302 or 304 stainless steel fastenings. Breakaway flange or frangible lugs shall be designed to assure aboveground break. Breakaway or frangible bolts will not be acceptable.

Outlet Nozzles shall be located approximately 18 inches (450 mm) above ground. Each hydrant shall have two (2) 2 1/2 inch (63.5 mm) nozzles 180 degrees apart with National (American) Standard Fire Hose Coupling Screw Thread NFPA 1963 and one (1) 4 inch (102 mm) pumper nozzle with City of Round Rock standard thread—six (6) threads per inch (25 mm) "Higbee" cut, 4.8590 inch (123.4 mm) O.D., 4.6425 inch (117.9 mm) root diameter. Nozzles shall be threaded or cam-locked, O-ring sealed, and shall have type 302 or 304 stainless steel locking devices. Nozzle caps (without chains) and cap gaskets shall be furnished on the hydrant. The cap nut shall have the same configuration as the operating nut.

Hydrants shall be Dry-Top Construction, factory lubricated oil or grease with the lubricant plug readily accessible. The system shall be described for City approval.

A blue reflective delineator of a type approved by the Engineer shall be placed 2 to 3 feet (0.6 to 0.9 meters) offset from the centerline of paved streets, on the side of and in line with, all newly installed fire hydrants.

Hydrant shall have double O-ring seals in a bronze stem sheath housing to assure separation of lubricant from water and shall have a weather cap or seal, or both, as approved by the Owner, to provide complete weather protection.

(3) Material Requirements

All below ground bolts shall be corrosion resistant. The hydrant valve shall be Neoprene, 90 durometer minimum. The seat ring, drain ring, operating nut and nozzles shall be bronze, AWWA C-502 current, containing not over 16 percent zinc. Break-away stem coupling shall be of ferrous material; its retaining pins, bolts, nuts, etc. of type 302 or 304 stainless steel.

Coatings shall be durable and applied to clean surfaces. Exterior surfaces above ground shall receive a coating of the type and color specified in the applicable version of City of Round Rock SPL WW-3. The coating shall

be applied according to coating manufacturer's specifications. Other exposed ferrous metal shall receive asphalt-based varnish, or approved equal, applied according to the coating manufacturer's specifications.

(F) Pressure/Flow Control Valves:

All control valves to regulate pressure, flow, etc., in City lines shall be models listed in the City of Round Rock Water and Wastewater Standard Products List (SPL).

(G) Drain Valves:

Drain valve materials and installation shall conform to City of Round Rock Standard Detail No. 511-9.

511.4 Construction Methods

(A) Setting Valves, Drains and Air Releases

Unless otherwise indicated, main line valves, drain valves and piping, air and vacuum release assemblies and other miscellaneous accessories shall be set and jointed in the manner described for cleaning, laying, and jointing pipe.

Unless otherwise indicated, valves shall be set at the locations shown on the Drawings and such that their location does not conflict with other appurtenances such as curb ramps. Valves shall be installed so that the tops of operating stems will be at the proper elevation required for the piping at the location indicated above. Valve boxes and valve stem casings shall be firmly supported and maintained, centered and aligned plumb over the valve or operating stem, with the top of the box or casing installed flush with the finished ground or pavement in existing streets, and installed with the top of the box or casing approximately 6 inches (150 mm) below the standard street subgrade in streets which are excavated for paving construction or where such excavation is scheduled or elsewhere as directed by the Engineer or designated representative.

Drainage branches or air blowoffs shall not be connected to any sanitary sewer or submerged in any stream or be installed in any other manner that will permit back siphonage into the distribution system (see City of Round Rock "Standard Detail Drawings- Series 500/500"). Every drain line and every air release line shall have a full sized independent gate valve flanged directly to the main. Flap-valves, shear gates, etc., will not be accepted.

(B) Setting Fire Hydrants:

Fire hydrants shall be located in a manner to provide accessibility and in such a manner that the possibility of damage from vehicles or conflict with pedestrian travel will be minimized. Unless otherwise directed, the setting of any hydrant shall conform to the following:

Hydrants between curb and sidewalk on public streets, shall be installed as shown on Standard 511-17, with outermost point of large nozzle cap 6" to 18" (150 mm to 450 mm) behind back of curb. Where walk abuts curb, and in other public areas or in commercial areas, dimension from gutter face of curb to

outermost part of any nozzle cap shall be not less than 3 feet (0.9 meters), nor more than 6 feet (1.8 meters), except that no part of a hydrant or its nozzle caps shall be within 6 inches (150 mm) of any sidewalk or pedestrian ramp. Any fire hydrant placed near a street corner shall be no less than 20 feet (6 meters) from the curb line point of tangency. Fire hydrants shall not be installed within nine feet (2.75 meters) vertically or horizontally of any sanitary sewer line regardless of construction.

All hydrants shall stand plumb; those near curbs shall have the 4 inch (102 mm) nozzle facing the curb and perpendicular to it. The hydrant bury mark shall be located at ground or other finish grade; nozzles of all new hydrants shall be approximately 18 inches (450 mm) above grade. Lower barrel length shall not exceed 5 feet (1.5 meters). Barrel extensions are not permitted unless approved by the Engineer or designated representative. Each hydrant shall be connected to the main by 6 inch (152 mm) ductile iron pipe; a 6 inch (152 mm) gate valve shall be installed in the line for individual shutoff of each new hydrant.

Below each hydrant, a drainage pit 2 feet (0.6 meter) in diameter and 2 feet (0.6 meter) deep shall be excavated and filled with compacted coarse gravel or broken stone mixed with coarse sand under and around the bowl of the hydrant, except where thrust blocking is located (City of Round Rock Specification Item 510 and Standard Detail 510-6 and to a level 6 inches (150 mm) above the hydrant drain opening.

The hydrant drainage pit shall not be connected to a sanitary sewer. The drain gravel shall be covered with filter fabric to prevent blockage of voids in the gravel by migration of backfill material. The bowl of each hydrant shall be well braced against unexcavated earth at the end of the trench with concrete thrust blocking (taking care not to obstruct the hydrant drain holes), or the hydrant shall be tied to the pipe with approved metal harness rods and clamps. The fire line shall be provided with joint restraint from the main line to the fire hydrant. Hydrants shall be thoroughly cleaned of dirt or foreign matter before setting.

Fire hydrants on mains under construction shall be securely wrapped with a poly wrap bag or envelope taped into place. When the mains are accepted and placed in service the bag shall be removed.

(C) Pressure Taps: Refer to Section 510.3 (24) of Standard Specification Item Number 510, "Pipe".

(D) Plugging Dead Ends:

Standard plugs shall be inserted into the bells of all dead ends of pipes, tees or crosses and spigot ends shall be capped. All end plugs or caps shall be secured to the pipe conforming to Section 510.3 (22) of Standard Specification Item Number 510, "Pipe".

(E) Protective Covering:

Unless otherwise indicated, all flanges, nuts, bolts, threaded outlets and all other steel component shall be coal tar coated and shall be wrapped with standard minimum 8-mil (0.2 mm) low density polyethylene film or a minimum 4-mil (0.1

mm) cross laminated high-density polyethylene meeting ANSI/AWWA Specification C-105-current, with all edges and laps taped securely to provide a continuous and watertight wrap. Repair all punctures of the polyethylene, including those caused in the placement of bedding aggregates, with duct tape to restore the continuous protective wrap before backfilling.

(F) Valve Box, Casing and Cover:

Stems of all buried valves shall be protected by valve box assemblies. Valve box castings shall conform to ASTM A 48, Class 30B. Testing shall be verified by the manufacturer at the time of shipment. Each casting shall have cast upon it a distinct mark identifying the manufacturer and the country of origin.

(G) Drain Valve Installations:

Refer to City of Round Rock Standards 511-9.

(H) Air Release Assemblies:

Refer to City of Round Rock Standards Details.

(I) Pressure/Flow Control Valves:

Assemblies shall be installed as indicated.

(J) Connections to Existing System:

Refer to Item No. 510, "Pipe" for connections to the existing system.

(K) Shutoffs:

Refer to Item No. 510, "Pipe" for shutoffs.

511.5 Measurement

All types of valves will be measured per each. Fire hydrants and drain valves will be measured per each. Fire Hydrant and Drain Valve barrel extensions will be measured per vertical foot (meter: 1 meter equals 3.28 feet). Pressure/Flow control valve assemblies and both manual and automatic air release assemblies will be measured per each. The blue reflective delineator for identifying the location of newly installed fire hydrants shall be measured per each.

Unless indicated otherwise in the Drawings, bury depths that exceed 5.5 feet (1.68 meters) shall be considered subsidiary to the completed unit.

511.6 Payment

Payment shall include full compensation, in accordance with the pay item established in the bid, for excavation, furnishing, hauling and placing valves and barrel extensions including anchorage and all incidental and subsidiary materials and work; preparing, shaping, dewatering, shoring of trenches, bedding, placing and compacting backfill materials and for all other incidentals necessary to complete the installation, as indicated in the Drawings, complete in place. The blue reflective delineator for identifying the location of newly installed fire hydrants shall be measured per each.

When indicated in the Drawings, bury depths that exceed 5.5 feet (1.68 meters) payment shall be made at the unit bid price for additional bury depth.

Payment for iron fittings and for wet connections are covered in Section 510.6 of Standard Specification Item 510, "Pipe".

- (A) Valves: Valves will be paid for at the unit bid price for the size and type valve installed, including valve stem casing and cover, excavation and backfill, setting, adjusting to grade, anchoring in place, and other appurtenances necessary for proper operation.
- (B) Fire Hydrants: Fire Hydrants installation shall be paid for at the unit bid price, including fittings, between the main line and the fire hydrant, setting, adjusting to grade, anchoring in place, and other appurtenances necessary for proper operation; but shall not include pipe and valve between the main line and fire hydrant.
- (C) Pressure/Flow Control Assemblies: Pressure control and flow control valve assemblies will be paid for at the unit bid price, including box or vault, setting, adjusting to grade, anchoring in place, adjusting the control device to the required conditions, providing other appurtenances necessary for proper operation, and placing in operation.
- (D) Drain Valve Assemblies: Drain valve installation shall be paid for at the unit bid price, including fittings between the main line and the drain valve, setting, adjusting to grade, anchoring in place, and other appurtenances necessary for proper operation; but shall not include pipe and valve between the main line and drain hydrant.
- (E) Manual Air Release: Manual air release installations will be paid for at the unit bid price and shall include valves, fittings, pipe, tapping the main, box and cover, and other appurtenances necessary for proper operation.
- (F) Automatic Air-Vacuum Valves: Automatic air-vacuum release assemblies will be paid for at the unit bid price and will include the main line tap or outlet, all pipe, valves, fittings, box or vault and cover, and other appurtenances necessary for proper operation.

Payment, when included as a contract pay item, will be made under one of the following:

Valves, _____ Type, _____ Diameter	Per Each.
Fire Hydrants	Per Each.
Reflectorized Pavement Markers (Type II-B-B)	Per Each.
Pressure or Flow Control Valve Assemblies	Per Each.
Drain Valve Assemblies	Per Each.
Manual Air Release Assemblies, _____ Diameter	Per Each.
Automatic Combination Air/Vacuum Release Valve Assembly, _____ Diameter	Per Each.
Iron Body Resilient Seated Gate Valve, 16" (406 mm) Diameter	Per Each.
Additional Bury depth	Per Vertical Foot.

END

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification 511, "Water Valves"

City of Round Rock Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 510	Pipe
<u>Section</u> 510.3 (22)	Pipe Anchorage, Support and Protection
<u>Section</u> 510.3(24)	Water System Connections

ANSI/AWWA Standards

<u>Designation</u>	<u>Description</u>
A-21.11	American National Standard for Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings
C-105	American National Standard for Polyethylene Encasement for Ductile-Iron Pipe
C-500	Metal-Seated Gate Valves for Water Supply Service
C-502	Dry-Barrel Fire Hydrants
C-504	Rubber-Seated Butterfly Valves
C509	Resilient Seated Gate Valves for Water and Sewerage Systems

ASTM Standards

<u>Designation</u>	<u>Description</u>
ASTM A48/A48M	Specification for Gray Iron Castings
ASTM A 536	Specification for Ductile Iron Castings

National Fire Protection Association (NFPA)

National (American) Standard Fire Hose Coupling Screw Thread

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 511, "Water Valves"

City of Round Rock Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 501	Jacking or Boring Pipe
Item No. 502	Tunneling
Item No. 503	Frames, Grates, Rings and Covers
Item No. 505	Concrete Encasement and Encasement Pipe
Item No. 506	Manholes
Item No. 507	Bulkheads
Item No. 508	Miscellaneous Structures and Appurtenances
Item No. 509	Trench Safety Systems

ITEM NO. 551

PIPE UNDERDRAINS

551.1 Description

This item shall consist of pipe underdrains embedded in filter material, constructed at such places as indicated and in accordance with lines and grades established by Engineer. This item shall also consist of any pumping, bailing, drainage and Item No. 509, "Trench Safety Systems" for trench walls, when indicated.

551.2 Materials

(1) Pipe

The following materials will be permitted as alternates unless type is indicated. Size indicated shall be inside diameter. Pipe shall meet the following requirements:

Type 1 Vitrified Clay or Concrete Pipe

Pipe may be either thoroughly and perfectly burned or glazed vitrified clay or nonreinforced concrete conforming to ASTM C 14. Vitrified clay pipe shall be of first quality hub and spigot style, sound, without warps or cracks or other imperfections and shall be sufficiently tough so that it may be cut with a chisel and hammer.

Type 2 Clay Drain Tile

Standard clay drain tile shall conform to specifications of AASHTO M 179.

Type 3 Concrete Drain Tile

Butt end concrete drain tile shall conform to ASTM C 412. Tongue and groove concrete drain tile shall conform to ASTM C 118.

Type 4 Porous Concrete Pipe

Porous concrete pipe shall conform to AASHTO M 176.

Type 5 Perforated Clay Pipe

Perforated clay pipe shall conform to specifications for standard strength perforated clay pipe of AASHTO M 65 except that extra strength clay pipe may be substituted for standard strength clay pipe.

Type 6 Perforated Corrugated Metal Pipe

Perforated helically corrugated metal pipe shall be fabricated from corrugated galvanized sheets and shall conform to AASHTO M 36 or corrugated aluminum alloy sheets and shall comply with AASHTO M 196.

Type 7 Perforated Corrugated Metal Pipe (Bituminous Coated)

Pipe shall conform in all particulars to requirements specified above for perforated corrugated metal pipe. Steel pipe shall be uniformly coated inside and out with a bituminous coating to a minimum thickness of 0.05 inch.

Bituminous material used to coat pipe shall meet the following requirements when tested in accordance with TxDOT Test Method Tex-522-C:

Solubility, % by wt. in	
Trichloroethylene	99.5 minimum
Brittleness Test	Pass
Flow, inches	0.25 maximum

Type 8 Perforated Concrete Pipe

Perforated concrete pipe shall conform to ASTM C 444, "Standard Strength Perforated Nonreinforced Concrete Underdrain Pipe", except that "Extra Strength Perforated Nonreinforced Concrete Underdrain Pipe" may be substituted for standard strength pipe.

Type 9 ABS Perforated Pipe

ABS pipe shall be extruded and fittings molded from virgin ABS plastic material conforming to ASTM D 1788, Type 4, except that minimum heat deflection temperature is 180°F. Contractor shall furnish certified test reports as evidence that material used for project meets ASTM requirements. Dimensions of ABS pipe shall be as shown in Table I. Fittings shall conform to manufacturer's standard for particular size of pipe required.

TABLE I		
Nominal Size, Inches	Inside Diameter Inches, Minimum	Thickness of Barrel Inches, Minimum
4	3.82	0.19
6	5.70	0.28

Perforations shall conform to requirements for Type 5 pipe underdrains. Crushing strength of ASB pipe shall meet or exceed minimum values in Table II when tested in accordance with flat-plate loading method as outlined in ASTM Designation: D 2412.

TABLE II	
Nominal Size, Inch	Minimum Strength lb. Inch
4	179
6	604

Pipe shall withstand at least 35 percent vertical deflection without rupture of pipe wall and stiffness shall equal or exceed valves at 5 percent deflection. Vertical deflection shall be computed as follows:

$$\text{Percent Deflection} = \frac{\text{Reduction Vert. I.D.}}{\text{Nominal I.D.}} \times 100$$

Ends of ABS pipe, couplings and fittings shall be perpendicular or square to longitudinal axis of main body within a maximum angle of 3 degrees. Outer and inner surface of pipe shall be free from blisters, voids and discontinuities.

Type 10 Preformed Corrugated Polyethylene Plastic Tubing

Tubing shall comply with AASHTO M 252.

Type 11 Perforated Polyvinyl Chloride Pipe

Pipe shall be Schedule 40 and conform to ASTM D 1785. Unless otherwise specified, the perforated pipe shall have two rows of holes 13 mm (½ in.) in diameter on 125-mm (5 in.) centers, with allowable tolerances of ±1 mm (1/16 in.) on the diameter and + 6, -0 mm (+¼, -0 in.) on the spacing, and the rows shall be parallel to the axis of the pipe and 120 ±5° apart.

(2) Filter Material

(a) Aggregate

Filter material for use in backfilling trenches under, around and over underdrains shall consist of hard, durable, clean, washed gravel or crushed stone, ranging in size from 5/8 to 1 inch and shall be free from organic matter, clay balls or other deleterious matter.

(b) Geotextile

Geotextile shall conform to Item No. 620, "Filter Fabric".

551.3 Construction Methods

Excavation of each trench shall begin at its outlet and proceed toward its upper end. Trench must not be excavated below proposed grade line and shall be located as indicated or as directed by Engineer and true to line and grade. Trench shall be dressed with a tile hoe or shovel in such manner that will facilitate placement of underdrain. Closed joints shall be coupled with bands, solvent weld couplings or integral joints. Perforated ABS pipe shall be jointed by couplers or solvent welding according to manufacturer's recommendation. No tar paper strips shall be used.

Approved plugs shall be placed in upper ends of pipes and exposed ends of underdrains shall be covered with ½ inch galvanized hardware cloth and filter fabric.

When indicated, concrete riprap or headwalls of dimensions indicated shall be constructed at outlet ends of pipe underdrains. Concrete materials and proportions shall conform to requirements specified for Class B Concrete conforming to Item No. 403, "Concrete for Structures".

When perforated metal pipe is used and trench is founded in pervious material, a thin layer of tamped impervious material shall be placed on bottom of trench as indicated or as directed by Engineer. Sections shall be jointed with band couplers.

When clay or concrete pipe is used and trench is founded in pervious material, a bottom course of specified filter material shall be placed and tamped to a uniform depth of 2 inches. Pipe shall then be firmly embedded in filter material, hub upgrade and spigot firmly centered into adjacent hub end or in the case of butt end type drains with an open

joint of approximately 3/8 inch. Open joints shall then be covered with approved 2 ply tar paper strips not less than 6 inches in width and of sufficient length to permit ends being turned outward and laid flat on bottom course of filter material of each side for a distance of 3 inches. When trench is founded in impervious material, the 2 inch bottom course of filter material shall be omitted, pipe laid directly in trench and filter material placed in trench to a depth of 2 inches on each side of pipe. Two ply tar paper strips shall then be placed as specified above.

551.4 Measurement

Work and accepted materials for "Pipe Underdrains" shall be measured by the linear foot of pipe measured along slope and shall include clearing, excavation, filter material, filter fabric, pipe, length of elbows, wyes, tees and other branches and backfill.

551.5 Payment

Work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit price bid per linear foot of "Pipe Underdrains" of type and size specified, which price shall be full compensation for furnishing and placing materials, for underdrain excavation and backfill, for filter materials, for plugs and screens and for labor, tools, equipment and incidentals necessary to complete the work.

Any riprap, headwalls or Trench Safety System indicated will be measured and paid for in accordance with provisions of Item No. 403, "Concrete for Structures", Item No. 410, "Concrete Structures", Item No. 509, "Trench Safety Systems" and Item No. 591, "Riprap for Slope Protection".

Payment will be made under:

Pipe Underdrains, In. - Per Linear Foot.

End

Ref: 403, 410, 509, 591, 620

ITEM NO. 558

STRUCTURAL PLATE STRUCTURES

558.1 Description

This item shall consist of furnishing and installing structural plate pipes, pipe arches, arches and special shapes conforming to these specifications, of the sizes, out dimensions and materials indicated at locations indicated or as directed by the Engineer, in conformity with established lines and grades. Structural plate pipes shall be furnished round or elongated, as indicated.

558.2 Materials and Manufacture

(1) Plates

The plates and fasteners used for construction of structural plate pipes, pipe arches, arches, underpasses, box culverts and special shapes shall conform to AASHTO M 167 for galvanized corrugated steel structures and to AASHTO M 219 for aluminum alloy structures.

Steel fasteners may be mechanically galvanized or hot-dip galvanized.

Steel plates shall consist of structural units of corrugated galvanized metal. Single plates shall be furnished in standard sizes to permit structure length increments of 2 feet. Plates will have approximately a 2 inch lip beyond each end crest, which results in the actual length of a given structure being approximately 4 inches longer than the nominal length, except when skewed or beveled. Footings for arches shall be designed and constructed to accommodate this additional length.

Aluminum plate shall consist of structural units of corrugated aluminum alloy. For aluminum alloy structures, cut plates shall be furnished on structure ends to permit structure length increments of 1 foot.

Plates shall be formed to provide bolted lap joints. The bolt holes shall be so punched that all plates having like dimensions, curvature and the same number of bolts per foot of seam shall be interchangeable. Each plate shall be curved to the proper radius so that the cross sectional dimensions of the finished structure will be as indicated. Joints shall be staggered so that not more than 3 plates are jointed at any one point. Unless otherwise indicated, bolt holes along those edges of the plates that will form longitudinal seams in the finished structure shall be (a) staggered in rows 2 inches apart, with 1 row in the valley and 1 in the crest of the corrugations and not less than 4 bolts per foot for galvanized steel structures or (b) in rows 1 $\frac{3}{4}$ inches apart with 2 bolts in each valley and on each crest and not less than 16 bolts per 3 feet for aluminum alloy structures. Bolt holes along those edges of the plates that will form circumferential seams in the finished structure shall provide for a bolt spacing of not more than 12 inches. The minimum distance from center of hole to edge of the plate shall be not less than 1 $\frac{3}{4}$ times the diameter of the bolt. The diameter of the bolt holes in the longitudinal seams shall not exceed the diameter of the bolt by more than 1/8 inch. Plates for forming skewed or sloped ends shall be cut so as to give the

angle of skew or slope specified. Burned edges shall be free from oxide and burrs, shall present a workmanlike finish and legible identification numerals shall be placed on each plate to designate its proper position in the finished structure.

(2) **Metal Headwalls**

The material for metal headwalls shall comply with details indicated.

When required, aluminum alloy inverts, toe walls, footings and closure plates shall conform to the material requirements for the aluminum structural plate structure. Extruded aluminum transverse stiffeners shall conform to ASTM B 221, Alloy 6061-T6.

(3) **Concrete**

Concrete and reinforcing steel shall conform to Item No. 403, "Concrete for Structures" and Item No. 406, "Reinforcing Steel". Unless otherwise indicated, concrete for footings and headwalls shall be Class A. Riprap for slope protection and for invert paving, when required, shall be Class B concrete, with reinforcement as indicated and shall conform to Item No. 591, "Riprap for Slope Protection".

Material for membrane curing shall conform to Item No. 409, "Membrane Curing".

558.3 Visual Inspection

The Contractor shall furnish an itemized statement of the number and size of plates in each shipment. From this list a visual inspection shall include an examination of the plates for deficiency in size, radius of curvature specified and any evidence of poor workmanship as outlined herein. The inspection may include the taking of samples for chemical analysis and determination of weight of spelter coating. The plates making up the shipment shall fully meet the requirements of these specifications. Any plates failing to do so will be rejected.

558.4 Mill and Factory Inspection

If the Engineer so elects, he may have the material inspected and sampled in the rolling mill or in the shop where fabricated. He may require from the mill the chemical analysis of any plate. The inspection, either in the mill or in the shop, shall be under the direction of the Engineer. The Engineer or his representative shall have free access to the mill or shop for inspection and every facility shall be extended to him for this purpose. Any material which has been previously rejected at the mill or shop and included in a later lot will be cause for rejection unless it has been satisfactorily repaired.

558.5 Workmanship

Structural plates on which the spelter coating has been damaged or which show defective workmanship, shall be rejected, except that damaged areas of spelter coating deemed by the Engineer to be of a minor nature may be repaired by painting with a zinc dust-zinc oxide paint conforming to individual plates but to the shipment as a whole. The following defects are considered to be poor workmanship. The presence of any or all of them in any individual structure plate will be cause for rejection:

- (a) Uneven laps
- (b) Elliptical shaping (unless specified)
- (c) Variation from a straight center line
- (d) Ragged edges
- (e) Loose, uneven lined or spaced bolts
- (f) Illegible brand
- (g) Bruised, scaled or broken spelter coating
- (h) Dents or bends in the metal itself

558.6 Design

(1) Gage or Minimum Thickness and Corrugations for Structural Plate

The gage or minimum thickness and permissible corrugations of metal plates to be furnished for each structure will be as indicated.

(2) Skewed Structures

The end skew shall not exceed 45 degrees. When the skew of arches is more than 15 degrees, the length of the structure shall be such that no portion of the live load will be carried by the cut portion of the arch end. Where right of way or other conditions do not permit the required length, the cut end shall be supported by a rigid headwall designed to meet the conditions. When the skew angle of pipes exceeds 20 degrees and the structure has the ends cut to fit a slope, the ends shall be reinforced with concrete riprap or other suitable end treatment as indicated on the plans or as directed by the Engineer. If headwalls are required, the plates shall be anchored to the headwall with not less than $\frac{3}{4}$ inch diameter by 6 inch minilength bolts, at not over 19 inch centers. If structures are to have skewed ends, bevels, step-bevels or other special end treatment, this information will be indicated.

(3) Multiple Structures Installed in Parallel Lines

Where multiple lines of pipes, pipe arches or box culverts greater than 48 inches in diameter or span are used, they shall be spaced so that adjacent sides of the pipe shall be at least $\frac{1}{2}$ diameter or 3 feet apart, whichever is less, to permit adequate compaction of backfill material. For diameters up to and including 48 inches, the minimum spacing shall be not less than 24 inches.

(4) Substructure for Arches

The substructure for structural plate arches shall be as indicated.

558.7 Designation of Type

The type(s) of structure will be indicated by one of the following descriptions:

- Structural Plate Pipe (Galv. Steel)
- Structural Plate Pipe (Alum.)
- Structural Plate Pipe Arch (Galv. Steel)
- Structural Plate Pipe Arch (Alum.)
- Structural Plate Arch (Galv. Steel)
- Structural Plate Underpass (Galv. Steel)
- Structural Plate Underpass (Alum.)
- Structural Plate Long Span Structures (Galv. Steel)
- Structural Plate Long Span Structures (Alum.)

When designated as one of the above types without the material being shown, Contractor may furnish the structure in either galvanized steel or aluminum.

558.8 Construction Methods

(1) Excavation

All excavation shall conform to Item No. 401, "Structural Excavation". Trenches for pipes, pipe arches, underpasses or box culverts shall be of sufficient width to provide free working space for erection and thorough tamping of the backfill and bedding material under and around the structure. If the quality of the native soil is less than that of the proposed backfill material, the excavation shall extend, to each side of the barrel, a minimum horizontal distance of half the span or 2/3 of the total rise, whichever is greater. The Contractor shall make such temporary provisions as may be necessary to insure adequate drainage of the trench and bedding during the construction operation.

(2) Foundations, Structural Plate Structures with Metal Inverts

These structures shall be bedded in a foundation of sandy earth material carefully and accurately shaped to fit the lower part of the pipe for at least 10 percent of its overall height, except that the length of bedding arc need not exceed the width of the bottom plate. The sandy material shall be at least 3 inches in thickness so as to obtain uniform seating of the corrugations on the pipe bed. For culverts the bedding specified herein shall be the full width of the invert.

Where rock, in either ledge or boulder formation, is encountered, it shall be removed below grade and replaced with a compacted earth cushion having a thickness of not less than ½ inch per foot height of fill over the top of the pipe, with the minimum allowable thickness of 12 inches and a maximum of 24 inches under the pipe. Where the soil encountered at the established grade is a quicksand, muck or similar unstable material, it shall be removed and replaced in conformance with Item No. 401, "Structural Excavation". Special bedding, when required, shall be as indicated.

(3) **Foundations, Structural Plate Structures with Reinforced Concrete Footings**

Footings for these structures shall be formed and finished to true lines and grades as established by the Engineer. Anchors or slots (for box culverts) shall be set to true line and grade when placing concrete for each substructure unit. The work of placing substructure units shall conform to Item No. 403, "Concrete for Structures", Item No. 406, "Reinforcing Steel" and Item No. 410, "Concrete Structures".

Footing shall be placed entirely on (a) rock, shale or similarly hard material or (b) firm soil or compacted soil cushion. When part of the founding area is rock, it shall be undercut and replaced with a minimum 12 inch thick compacted soil cushion. When a thin layer of soil is partially covering rock within the bearing area and when practical to do so, the soil may be removed and the footings placed directly on rock as indicated.

(4) **Erection**

Structural plate structures shall be installed as indicated and in accordance with this item.

Any steel in joints which is not protected by galvanizing shall be coated with suitable asphaltum paint.

Pipes and/or plates shall be handled carefully to avoid damage to any protective coating. Damaged coatings shall be repaired.

Anchor bolts used for anchoring plates to headwalls or other concrete end treatment shall be $\frac{3}{4}$ inch diameter by 6 inch minimum length on not more than 19 inch centers.

No plates for arch structures shall be placed until the substructure has cured for a minimum of 3 days.

When all plates are in position, all bolts not already in place shall be inserted and all nuts tightened progressively and uniformly, beginning at one end of the structure. All nuts shall be tightened a second time to a torque of not less than 150 ft-lbs nor more than 300 ft-lbs for steel bolts and not less than 100 ft-lbs nor more than 150 ft-lbs if using aluminum bolts. It is essential that bolts be well If an impact wrench is used, a sufficient number of bolts should be checked with a long-handled, structural or socket wrench or a torque wrench to insure that they are properly tightened. All service bolts used in drawing the plates together shall be replaced with standard high strength bolts.

(5) **Shape Control**

The Contractor shall furnish acceptable shape control devices for monitoring the horizontal and vertical shape of the structure(s). The shape shall be kept within 2 percent of design measurements (span or rise, whichever is greater) or 5 inches whichever is less during erection and backfilling.

(6) **Backfilling**

Backfilling and/or construction of the embankment around and over the pipe is a critical phase of the construction and strict adherence to these construction methods is required. Backfilling and/or embankment construction around the pipe shall conform to Item No. 401, "Structural Excavation", except as modified herein.

Within vertical planes 2 feet beyond the horizontal limits of the structure and until a minimum of 2 feet of cover has been compacted over the structure, only hand operated, mechanical tamping equipment will be permitted.

Unless otherwise indicated or permitted in writing by the Engineer, no heavy earth moving equipment will be permitted to haul over the structure until a minimum of 4 feet of permanent or temporary, compacted fill has been placed thereon. Plates or structures damaged by the Contractor's equipment during backfilling operation shall be removed and replaced by the Contractor at his expense.

During the backfilling operations, extreme care shall be taken to avoid unequal pressures and to obtain uniformly compacted backfill material of uniform density throughout the length of the structure and to insure proper backfill under the structure.

Prior to adding each new layer of loose backfill material, until a minimum 2 feet of cover is obtained, an inspection will be made of the inside periphery of the structure to determine any local or unequal deformation caused by improper construction methods.

The structure shall be backfilled so that when backfill is complete the inside dimensions shall be within tolerances set forth in shape control above. In the case of arches (does not apply to pipe arches) when backfilling is completed before headwalls are placed, the first material shall be placed midway between the ends of the arch, forming as narrow a ramp as possible until the top of the arch is reached. The ramp shall be constructed evenly from both sides and the backfilling material shall be thoroughly compacted as it is placed. After the 2 ramps have been constructed to the top of the arch, the remainder of the backfill shall be deposited from the top of the arch both ways from the center, to the ends and as evenly as possible on both sides of the arch. If the headwalls are built before the arch is backfilled, the fill material shall be placed first adjacent to one headwall until the top of the arch as been reached, after which the fill shall be dumped from the top of the arch toward the other headwall, with care being taken to deposit the material evenly on both sides of the arch.

For multiple structures the same backfill phases will be performed for all structures more or less simultaneously. Backfilling between the barrels will usually require that the material be placed with a crane and bucket or other suitable equipment. Backfill material shall not be dropped over the top arc so that damage to the flexible structure will result. Compaction of this backfill shall be with hand operated tampers or other acceptable equipment.

558.9 Measurement

Structural plate pipes, pipe arches, arches or special shapes of the gage or minimum thickness and corrugation indicated will be measured by the linear foot of each structure along its flow line between the ends of the structure.

For multiple structures, the measured length will be the sum of the lengths of barrels as prescribed above.

Aluminum alloy inverts, toe walls, footings, closure plates and stiffeners, when required, will be considered a part of the requirements of the structure and will not be measured for payment.

558.10 Payment

Payment for "Structural Plate Pipes, Pipe Arches, Arches or Special Shapes", measured as prescribed above, will be made at the unit price bid for the various sizes, gage or minimum thickness and of the required material, if specified, of the various items required by the plans, complete in place.

This payment shall be full compensation for furnishing, transporting and erecting; for handling and placing of select fill material; for all bolts, nuts, washers, anchor bolts and anchor channels or angles; for furnishing all aluminum alloy inverts, toe walls, footings, closure plates and stiffeners, when required; and for all other items of material, labor, equipment, tools and incidentals necessary to complete the various installations in accordance with these specifications.

Payment will be made under one of the following:

Structural Plate Pipe, _____, _____	- Per Linear Foot.
Structural Plate Pipe Arch, _____, _____	- Per Linear Foot.
Structural Plate Arch, _____, _____	- Per Linear Foot.
Structural Plate Underpass, _____, _____	- Per Linear Foot.
Structural Plate Box Culvert, _____, _____	- Per Linear Foot.

End

ITEM NO. 559

PORTLAND CEMENT CONCRETE BOX CULVERTS

559.1 Description

This item governs the materials used and the constructing, furnishing and placing of Portland cement concrete box culverts and wing walls on a prepared grade at the location shown on the Drawings and in accordance with Standard Detail 559-1, "Fabrication Tolerances for Precast Box Culverts". Unless indicated otherwise on the Drawings, the Contractor shall have the option of furnishing cast-in-place, precast (formed) or precast (machine made) Portland cement concrete box culverts.

When cast-in-place box culverts are used, they shall conform to the details indicated on the Drawings and Standard Detail 559-1, "Fabrication Tolerances for Precast Box Culverts" along with the requirements for Standard Specification Item No. 403, "Concrete for Structures" and Standard Specification Item No. 410, "Concrete Structures". When precast box culverts are used under traffic, the design loads shall consist of the impact load, dead load and live load [HS 20- per AASHTO Standard Specifications for Highway Bridges; design wheel load, 16 Kips (71.2 kN)] and to the requirements of ASTM C 789 and/or ASTM C 850.

This item to also consist of any pumping, bailing, drainage and requirements of Standard Specification Item No. 509, "Trench Safety Systems" for trench walls, when indicated on the Drawings.

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.

559.2 Submittals

The submittal requirements of this specification item include:

- A. The foundation plan and drilling/excavation details;
- B. Class A Portland cement concrete mix design;
- C. Anchor bolt plan and details;
- D. Reinforcing Steel details and placement drawings and
- E. Casing plan and details (if required).

559.3 Materials

- A. Concrete

Class A Concrete shall be used for cast-in-place and precast (formed) box culverts conforming to the requirements of Standard Specification Item No. 403, "Concrete Structures" and Standard Specification Item No. 410, "Concrete for Structures", except that Class S Portland cement Concrete will be required for direct traffic boxes.

Portland cement concrete for precast (machine made) boxes shall conform to ASTM C 789 or C 850 and shall have a minimum 28-day compressive strength of 5,000 psi (34.475 mPa).

B- Reinforcement

Reinforcing steel shall conform to Standard Specification Item No. 406, "Reinforcing Steel".

C. Jointing Material

Materials for jointing precast box culverts shall conform to Standard Specification Item No. 510, "Pipe".

D. Membrane Curing

Materials for membrane curing shall conform to Standard Specification Item No. 409, "Membrane Curing".

E. Admixtures

Admixtures shall conform to Standard Specification Item No. 405, "Concrete Admixtures". Air entraining admixtures shall be added to the mixture to produce concrete with not less than 4 nor more than 7 percent air content by volume.

F- Granular Backfill

Materials for Granular Backfill shall conform to Standard Specification Item No. 210, "Flexible Base".

G. Foundation Rock

Foundation Rock shall be well graded, coarse aggregate ranging in size from 2 to 8 inches (50 to 200-mm) and capped with 5/8 inch (16-mm) rock.

559.4 Fabrication

Forms for precast (machine made) boxes shall be made of steel. Forms for precast (formed) boxes may be either wood or steel. Forms shall be mortar-tight and of sufficient strength to prevent bulging or misalignment of adjacent boxes. They shall be constructed to permit their removal without damage to the concrete. Offsets at form joints shall not exceed 1/8 inch (3.2-mm). Forms shall be clean and free of extraneous matter when Portland cement concrete is placed.

Positive means of supporting steel cages in place throughout forming and Portland cement concrete placement will be required and subject to the approval of the Engineer or designated representative. Welding of reinforcing steel will be permitted only where shown on the Drawings. Welding shall be done by a qualified welder.

Precast (machine made) boxes shall be cast by a process, which will provide for uniform placement of the Portland cement concrete in the forms and compaction by mechanical devices, that will assure dense concrete. Portland cement concrete shall be mixed in a central batch plant or other approved batching facility from which the quality and uniformity of the Portland cement concrete can be assured. Transit-mixed concrete will not be acceptable for use in precast (machine made) boxes.

Curing of precast boxes made in a commercial plant shall be by any one or by a combination of the following methods, which are compatible with the joint materials selected or as directed by the Engineer or designated representative.

A. Steam Curing

Boxes will be placed in a curing chamber, free from outside drafts and cured in a moist atmosphere maintained by the injection of steam for such time and temperature as necessary for proper curing. The curing chamber shall be constructed to allow full circulation of steam around the entire box. Steam outlets shall be positioned so that live steam is not applied directly to the Portland cement concrete.

B. Water Curing

Boxes may be water cured by covering with water saturated cotton mats, polyethylene sheeting or polyethylene burlap blankets, by a system of perforated pipe or mechanical sprinklers, by porous hose or by other methods that will keep the boxes moist during the curing period. Water for curing shall conform to Standard Specification Item No. 403, "Concrete for Structures".

C. Membrane Curing

Type 1 membrane curing compound may be used for interim curing or for complete curing. All surfaces shall be kept moist prior to the application of the curing compound and shall be damp when the compound is applied.

When used for interim curing, the curing compound shall be applied to the outside surface of the box upon removal of forms. It shall also be applied to the inside surface or a suitable covering may be placed over the box opening to protect the inside of the box against rapid drying.

When used for complete curing, curing compound shall be applied to the inside surface of the box when interim curing is applied or when handling strength has been attained, but not later than 24 hours after casting.

Curing shall not be delayed longer than 1 hour after the Portland cement concrete has been placed in the forms or more than 1/2 hour after removal of forms, unless interim curing is applied.

Precast boxes made in a commercial plant shall be continuously cured for a period of 3 days after reaching handling strength or until the design strength has been attained. Curing may be interrupted for no more than 30 minutes for form removal and no more than 4 hours for removal to a storage area and resumption of curing. All precast boxes shall be protected from freezing during the curing period.

A curing day is a calendar day when the air temperature, taken in the shade away from artificial heat, is above 50°F (10°C) for at least 19 hours or for colder days if satisfactory provisions are made to maintain the temperature at all surfaces of the concrete above 50°F (10°C) for the entire 24 hours.

Test cylinders shall be cured at the same time and in the same manner as the boxes.

Not more than 4 lifting holes may be provided in each box to facilitate handling. They may be cast-in, cut into the fresh Portland cement concrete after form

removal or drilled and shall not be more than 2 inches (50-mm) in diameter or 2 inches (50-mm) square. Cutting or displacement of reinforcement will not be permitted. Spalled areas around the holes shall be repaired. Concrete boxes shall be given an ordinary finish conforming to Standard Specification Item No. 410, "Concrete Structures".

Precast boxes of either type, made in a plant, shall bear the following marking:

The name or trademark of the manufacturer;

The date of manufacture;

The box size and height of fill.

When fitting holes are not provided, one end of each box section shall be clearly marked on the inside and outside walls to indicate the top and/or bottom as it will be installed.

Marking shall be indented into the box or may be painted thereon with waterproof paint.

559.5 Testing

Precast box culverts made in a commercial plant, shall have a minimum of 4 test cylinders for design strength made for each day's production run of each size and class of box culverts. Strength tests for each production run will be based on the average strength of 2 cylinders, which may be tested anytime after completion of the specified curing period.

When design strength is attained on the initial test, further tests on that run will not be required. Should the initial test fail to meet the design strength, a subsequent test shall be made at 28 days unless additional test cylinders were made during production of that run. Failure to attain design strength by the 28-day test will result in rejection of the run represented by the test. Tests for handling strength will be based on the average of 2 cylinders. These test cylinders are in addition to those required for design strength. Cylinders for compressive strength tests shall be made in accordance with TxDOT Test Method Tex-704-I. Testing of precast (formed) culvert sections or cast-in-place culverts shall conform to Standard Specification Item No. 403, "Concrete for Structures".

559.6 Fabricating Tolerances

Tolerances for precast boxes of either type shall conform to the following:

- A. The inside vertical and horizontal dimensions shall not vary from plan requirements more than + 1/2 inch (12.5-mm).
- B. The horizontal or vertical plane at each end shall not vary from being perpendicular to the top and bottom by more than 1/2 inch (12.5-mm) when measured diagonally between opposite interior corners of the end section.
- C. The sides of a section at each end shall not vary from being perpendicular to the top and bottom by more than 1/2 inch (12.5-mm) when measured diagonally between opposite interior corners of the end section.
- D. The thickness of walls and slabs shall not be less than that required by the

Drawings, except that an occasional deficiency not greater than 1/4 inch (6.3-mm), will be acceptable. If proper jointing is not affected, thick nesses in excess of Drawing requirements are acceptable.

- E. The straightness of the tongue and groove at the mating surface shall not vary by more than 1/4 inch (6.3-mm).

Deviations from the above tolerances will be acceptable if the box sections can be fitted at the plant or job site and it is determined that an acceptable joint can be made. For this condition, an acceptable joint is:

When 2 box sections are fitted together on a flat surface in proper alignment and in the position they will be installed, the longitudinal opening at any point shall not exceed 1 inch (50-mm). Box sections accepted in this manner shall be match-marked for installation.

559.7 Defects and Repair

Fine cracks or checks on the surface of the member which do not extend to the plane of the nearest reinforcement will not be cause for rejection unless they are numerous and extensive. Cracks, which extend into the plane of the reinforcing steel, but are acceptable otherwise, shall be repaired in an approved manner.

Small damaged or honeycombed areas, which are purely surface in nature, may be repaired. Excessive damage, honeycomb or cracking will be subject to structural review. Repairs shall be sound, properly finished and cured in conformance with the pertinent specifications.

When fine cracks or hairchecks on the surface indicate poor curing practices, further production of precast boxes shall be discontinued until corrections are made and proper curing provided.

559.8 Storage and Shipment

Precast boxes shall be stored on level blocking in a manner acceptable to the Engineer or designated representative. No load shall be placed upon them until design strength is reached and curing completed. Shipment of boxes may be made when the design strength and curing requirements have been met.

559.9 Construction Methods

Excavation and backfill shall conform to Standard Specification Item No. 401, "Structural Excavation and Backfill" and Standard Specification Item No. 510, "Pipe", except where tunneling or jacking methods are required or indicated on the Drawings.

Precast concrete boxes shall be bedded on a foundation of firm stable material accurately shaped to conform to their base. When indicated on the Drawings, special bedding materials shall be provided.

Unless otherwise indicated on the Drawings, the Contractor may use any of the jointing materials, except rubber gaskets, and shall conform to the jointing requirements in Standard Specification Item No. 510, "Pipe".

When precast boxes are used to form multiple barrel structures, they shall be placed in conformance with the details indicated on the Drawings. Materials to be used between barrels shall be as indicated on the Drawings.

Connections of precast boxes to cast-in-place boxes or to any required headwalls, wingwalls, riprap or other structures shall conform to the details indicated on the Drawings.

Lifting holes shall be filled with mortar or concrete and cured to the satisfaction of the Engineer or designated representative.

559.10 Measurement

A. Cast in Place Box Culverts

The quantities of Portland cement concrete of the various classifications, which will constitute the completed and accepted "Box Culverts" in place will be measured by the cubic yard (cubic meter: 1 cubic meter equals 1.308 cubic yards) , based on the dimensions indicated on the Drawings.

B. Precast

Portland cement Concrete box culverts of each size and type shall be measured by the lineal foot (lineal meter: 1 lineal meter equals 3.28 lineal feet). The measurement will be made between the ends of the box along the central axis. For concrete boxes used in multiple barrel structures, the measured length will be the sum of the lengths of all barrels measured as described above.

559.11 Payment

The unit price bid, per lineal foot for the various sizes and types of precast "Concrete Box Culverts" or the unit price bid, per cubic yard for the various sizes and types of cast in place

"Concrete Box Culverts" shall be full compensation for constructing, furnishing and transporting boxes; the preparation and shaping of bed; jointing of boxes; for connections to existing structures; concrete, reinforcing steel and all other items of material, labor, equipment, tools and incidentals necessary to complete the work in accordance with the Drawings and specifications, except excavation and backfill, which shall be in accordance with Standard Specification Item No. 401, "Structural Excavation and Backfill". When precast boxes are laid on a skew, full compensation for cutting the ends when required by the Drawings, shall be included in the unit bid price per lineal foot, measured in accordance with "Measurement" above.

Payment will be made under one of the following:

Concrete Box Culverts, ____Ft. x ____Ft.	Per Lineal Foot.
Concrete Box Culverts	Per Cubic Yard.

End

<u>SPECIFIC</u> Cross Reference Materials

Standard Specification Item No. 559, "Concrete Box Culverts"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 210	Flexible Base
Item No. 403	Concrete for Structures
Item No. 405	Concrete Admixtures
Item No. 406	Reinforcing Steel
Item No. 409	Membrane Curing
Item No. 410	Concrete Structures
Item No. 509	Trench Safety Systems
Item No. 510	Pipe

American Society for Testing and Materials,

<u>ASTM Designation</u>	<u>Description</u>
C 789/789M	Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers
C 850/850M.	Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers with Less Than 0.6 m (2 ft) of Cover Subjected to Highway Loadings

Texas Department of Transportation, Manual of Testing Procedures

<u>Test Method</u>	<u>Description</u>
Tex 704-1	Making, Curing, and Testing Compression Test Specimens in Precast Concrete

<u>RELATED</u> Cross Reference Materials

Standard Specification Item No. 559, "Concrete Box Culverts)

Texas Department of Transportation: Standard Specifications for Construction, Maintenance Of Highways, Streets and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 420	Concrete Structures
Item No. 421	Portland Cement Concrete
Item No. 440	Reinforcing Steel

ITEM NO. 591

RIPRAP FOR SLOPE PROTECTION

591.1 Description

This item shall govern the excavation of all materials encountered for placing riprap, disposal of excess material and backfilling around the completed riprap to the grade indicated on the Drawings. The work shall include all pumping and bailing, furnishing and placing riprap of rock or concrete in accordance with the details and to the dimensions indicated on the Drawings.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

591.2 Submittals

The submittal requirements for this specification item shall include:

- A. The type, size and source of riprap material (rock or broken concrete),
- B. Aggregate types, gradations and physical characteristics for the Portland cement concrete mix,
- C. Proposed proportioning of materials for the mortar mix,
- D. Type, details and installation requirements for reinforcement, joint material, tie backs and anchors,
- E. Description of filter fabric including characteristics, test data and manufacturer's recommendations for installation.

591.3 Materials

- A. Rock

Rock for riprap shall consist of field rock or rough, unhewn quarry rock as nearly uniform in section as is practicable. The rock shall be dense, resistant to the action of air and water and suitable in all respects for the purpose intended.

- B. Broken Concrete

The rock used for mortar riprap may consist of broken concrete removed under the contract or obtained from other approved sources. Broken concrete shall be as nearly uniform in section as practicable and of the sizes indicated in Section 591.5, "Dry Riprap".

- C. Concrete

Cast in place concrete shall be Class A Concrete and shall conform to Standard Specification Item No. 403, "Concrete for Structures".

- D. Grout and Mortar

Grout and mortar shall consist of 1 part Portland Cement and 3 parts sand, thoroughly mixed with water. Mortar shall have a consistency such that it can be easily handled and spread by trowel. Grout shall have a consistency such that it

will flow into and completely fill all joints.

E. Reinforcement

Reinforcement shall conform to Standard Specification Item No. 406, "Reinforcing Steel".

F. Joints

Premolded expansion joint material shall conform to Standard Specification Item No. 408, "Concrete Joint Material".

G. Tie Backs and Anchors

Galvanized tie backs and anchors shall be as indicated on the Drawings.

H. Filter Fabric

Filter Fabric shall conform to Standard Specification Item No. 620, "Filter Fabric".

591.4 Construction Methods

Prior to commencement of this work, all required erosion control and tree protection measures (Standard Specification Item No. 610, "Preservation of Trees and Other Vegetation") shall be in place and utilities located and protected as set forth in the "General Conditions". Construction equipment shall not be operated within the drip line of trees unless indicated on the Drawings. Construction materials shall not be placed under the canopies of trees. No excavation or embankment shall be placed within the drip line of trees until tree wells are constructed. Spalls and small stones used to fill open joints and voids in rock riprap shall be rocked and wedged to provide a tight fit.

Unsuitable excavated materials or excavation in excess of that needed for construction shall be known as "Waste" and shall become the property of the Contractor and it shall become his sole responsibility to dispose of this material in an environmentally sound manner off the limits of the right of way at a permitted disposal site.

All blasting shall conform to 01550, "Public Safety and Convenience". The Contractor shall comply with all laws, ordinances, applicable safety code requirements, uniform Fire Code Articles 77, "Explosive Materials" and 80, "Hazardous Materials" and any other regulations relative to handling, storage and use of explosives. In all cases, a Blasting Permit must be obtained in advance from the appropriate City agency.

591.5 Dry Riprap

Unless otherwise indicated on the Drawings, all rocks used in these types of riprap shall weigh between 50 and 150 pounds (22 and 69 kilograms) each and at least 60 percent of the rocks shall weigh more than 100 pounds (45 kilograms) each. When the riprap will be placed on an erodible soil, as determined by the Engineer or designated representative, a layer of filter fabric shall be placed, prior to placement of the Riprap material.

The rocks shall be placed in a single layer with close joints. The upright axis of the rocks shall make an angle of approximately 90 degrees with the embankment slope. The courses shall be placed from the bottom of the embankment upward, with the larger rocks being placed on the lower courses. Open joints shall be filled with spalls. Rocks

shall be arranged to present a uniform finished top surface such that the variation between tops of adjacent rocks shall not exceed 3 inches (75 mm). Rocks that project more than the allowable amount in the finished work shall be replaced or chipped. Dry Riprap may have a toe wall of concrete with dimensions and reinforcement indicated on the Drawings.

591.6 Mortared Rock Riprap

Rock for this purpose, as far as practicable, shall be selected as to size and shape in order to secure fairly large, flat-surfaced rock which may be laid with a true and even surface and a minimum of voids. Fifty percent of the mass rock shall be broad flat rocks, weighing between 100 and 150 pounds (45 and 69 kilograms) each, placed with the flat surface uppermost and parallel to the slope. The largest rock shall be placed near the base of the slope. The spaces between the larger rocks shall be filled with rocks of suitable size, leaving the surface smooth, reasonably tight and conforming to the contour required on the Drawings. In general, the rocks shall be placed with a degree of care that will insure plane surfaces with variation from the true plane of no more than 3 inches in 4 feet (no more than 60 mm per meter). Warped and curved surfaces shall have the same general degree of accuracy as indicated for plane surfaces.

Before placing mortar, the rocks shall be wetted thoroughly and as each of the larger rocks is placed, it shall be surrounded by fresh mortar and adjacent rocks shall be shoved into contact. After the larger rocks are in place, all of the spaces or opening(s) between them shall be filled with mortar and the smaller rocks then placed by shoving them into position, forcing excess mortar to the surface and insuring that each rock is carefully and firmly embedded laterally. After the work described above has been completed, all excess mortar forced up shall be spread uniformly to completely fill all surface voids. All surface joints then shall be pointed up roughly, either with flush joints or with shallow, smooth raked joints.

591.7 Concrete Riprap

Concrete for riprap shall be placed as indicated on the Drawings or as directed by the Engineer or designated representative. Unless otherwise indicated on the Drawings, concrete riprap shall be reinforced using wire or bar reinforcement.

Concrete shall be Class A or as indicated otherwise on the Drawings and shall conform to Standard Specification Item No. 403, "Concrete for Structures".

When welded wire reinforcement is indicated, it shall be a minimum of 6 x 6 W1.4 x W1.4 (150 x 150 MW9 x MW9) with a minimum lap of 6 inches (150 mm) at all splices. At the edge of the riprap, the wire fabric shall not be less than 1 inch (25 mm) nor more than 3 inches (75 mm) from the edge of the concrete and shall have no wires projecting beyond the last member parallel to the edge of the concrete.

When bar reinforcement is used, the sectional area of steel in each direction shall not be less than the sectional area of the wire fabric described above. The spacing of bar reinforcement shall not exceed 18 inches (450 mm) in each direction and the distance from the edge of concrete to the first parallel bar shall not exceed 6 inches (150 mm).

Reinforcement shall be supported properly throughout the placement to maintain its position approximately equidistant from the top and bottom surface of the slab.

Unless otherwise noted, expansion joints of the size and type indicated on the Drawings shall be provided at intervals not to exceed 40 feet (12.2 meters) and shall extend the full width and depth of the concrete. Marked joints shall be made 3/8 inch (9.5 mm) deep at 10 foot (3 meter) intervals. All joints shall be perpendicular and at right angles to the forms unless otherwise indicated on the Drawings.

Slopes and bottom of the trench for toe walls shall be compacted and the entire area sprinkled before the concrete is placed.

After the concrete has been placed, consolidated and shaped to conform to the dimensions indicated on the Drawings and has set sufficiently to avoid slumping, the surface shall be finished with a wooden float to secure a reasonably smooth surface.

Immediately following the finishing operation, the riprap shall be cured conforming to Standard Specification Item No. 410, "Concrete Structures".

591.8 Pneumatically Placed Concrete Riprap, Type I and Type II

Pneumatically placed concrete for riprap shall be placed as indicated on the Drawings or as established by the Engineer or designated representative. Pneumatically placed concrete shall conform to Standard Specification Item No. 404, "Pneumatically Placed Concrete". Reinforcement shall conform to the details indicated on the Drawings and Standard Specification Item No. 406, "Reinforcing Steel". Reinforcement shall be supported properly throughout placement of concrete. All subgrade surfaces shall be moist when concrete is placed.

The surface shall be given a wood float finish or a gun finish as indicated on the Drawings.

The strength and design of Pneumatically Placed Concrete Riprap shall be either Type I or if indicated, Type II conforming to Standard Specification Item No. 404, "Pneumatically Placed Concrete".

Immediately following the finishing operation, the riprap shall be cured conforming to Standard Specification Item No. 410, "Concrete Structures".

591.9 Measurement

Measurement of acceptable riprap will be made on the basis of the (a) area in square yards (square meters: 1 square meter equals 1.196 square yards) indicated on the Drawings, complete in place or (b) the volume of concrete placed in cubic yards (cubic meters: 1 cubic meters equals 1.308 cubic yards), complete in place as indicated on the Drawings for the thickness specified.

Concrete toe walls will not be measured separately but shall be subsidiary to the riprap of the type with which it is placed.

591.10 Payment

The riprap quantities, measured as provided above, will be paid for at the unit bid prices per square foot or per cubic yard as indicated for riprap of the various classifications.

The Unit Bid Price shall include full compensation for furnishing, hauling and placing all materials, including toe walls, reinforcement and premolded expansion joint material and for all labor, tools, equipment and incidentals necessary to complete the work.

Payment for excavation of toe wall trenches and for all necessary excavation below natural ground or bottom of excavated channel will be included in the unit bid price for riprap.

Payment for excavation required for shaping of slopes for riprap shall be included in the unit bid price for riprap, except for the situation when the header banks upon which the riprap is to be placed are built by prior contract. In this specific case the excavation for shaping of slopes, will be paid for conforming to Standard Specification Item No. 401, "Structural Excavation and Backfill".

Payment will be made under one of the following:

Dry Riprap -	Per Square Yard.
Mortared Rock Riprap -	Per Square Yard.
Concrete Riprap, ___ In. -	Per Square Yard.
Concrete Riprap	Per Cubic Yard.
Pneumatically Placed Concrete Riprap, ___In.	Per Square Yard.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification 591, "Riprap for Slope Protection"

City of Round Rock Specifications

<u>Designation</u>	<u>Description</u>
Item No. 403	Concrete for Structures
Item No. 404	Pneumatically Placed Concrete
Item No. 406	Reinforcing Steel
Item No. 408	Concrete Joint Material
Item No. 410	Concrete Structures
Item No. 610	Preservation of Trees and Other Vegetation
Item No. 620	Filter Fabric

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 591, "Riprap for Slope Protection"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 623	Dry Stack Rock Wall

ITEM NO. 593

P.C. CONCRETE RETARDS

593.1 Description

This item governs Portland Cement concrete retards used to anchor underground pipe. Retards shall be constructed as indicated on the Drawings, presented in City of Round Rock Standard Detail 593-1 or as directed by the Engineer or designated representative in accordance with these specifications. This item shall also govern any pumping, bailing and dewatering or drainage necessary to complete the work, including Standard Specification Item No. 509, "Trench Safety Systems" for trench walls, when Concrete Retards are indicated on the Drawings or required 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 SI units are given preference followed by inch-pound units shown within parentheses.

593.2 Submittals

The submittal requirements of this specification item include:

- A. Class D p.c. concrete mix design,
- B. Construction details (i.e. reinforcing steel, curing membrane).

593.3 Materials

- A. Portland Cement Concrete

The concrete materials used in construction under this item shall conform to Class D, Standard Specification Item No. 403, "Concrete for Structures".

- B. Reinforcement

Reinforcement shall conform to Standard Specification Item No. 406, "Reinforcing Steel".

593.4 Construction Methods

Prior to placement of Portland cement concrete, excavation for retards shall be made to proper section and depth. If considered necessary by Engineer or designated representative, the bottom of the excavation shall be hand tamped and sprinkled. The excavated area for concrete retards shall be moist when the Portland cement concrete is placed.

After the Portland cement concrete has been placed, consolidated and shaped to conform to the dimensions indicated on the Drawings and after sufficiently set, it shall be given a moderately rough finish by floating with a wood float (Standard Specification Item No. 411, "Surface Finishes for Concrete").

No mortar or concrete work shall be undertaken, when the ambient temperature is below 35°F (1°C) and Work shall be protected from freezing. After completion of the concrete retard, exposed surfaces shall be covered with burlap, cotton mats or other approved covering and kept moist for a minimum period of 3 days. White pigmented curing compound conforming to Item No. 409, "Membrane Curing", Type 2, will be permitted when applied to exposed surfaces.

Unless directed otherwise by the Engineer or designated representative, the material excavated during trenching shall be disposed of at a permitted site.

593.5 Measurement

Concrete Retards will be measured either by the cubic yard per Drawing dimensions or on a unit basis complete in place.

593.6 Payment

Work performed and materials furnished as prescribed by this Standard Specification item, measured as provided under the "Measurement" section will be paid for by the cubic yard or the unit price bid for "Concrete Retards", as indicated in the Contract Documents. The bid pay item price shall include full compensation for excavation, reinforcing, furnishing, hauling and placing all materials required in the construction, the disposal of excavated material and any manipulation, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under one of the following:

Portland Cement Concrete Retards	Per Cubic Yard.
Portland Cement Concrete Retards	Per Each.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification Item No. 593, "P.C. Concrete Retards"

City of Round Rock Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 403	Concrete for Structures".
Item No. 406	Reinforcing Steel".
Item No. 409	Membrane Curing",
Item No. 411	Surface Finishes for Concrete
Item No. 507	Trench Safety Systems"

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification Item No. 593, "P.C. Concrete Retards"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 402	Controlled Low Strength Material
Item No. 405	Concrete Admixtures
Item No. 407	Fibrous Concrete
Item No. 501	Jacking or Boring Pipe
Item No. 502	Tunneling
Item No. 504	Adjusting Structures
Item No. 505	Concrete Encasement and Encasement Pipe
Item No. 506	Manholes
Item No. 507	Bulkheads
Item No. 510	Pipe
Item No. 511	Water Valves

TxDOT Specifications

<u>Designation</u>	<u>Description</u>
Item 421	Portland Cement Concrete
Item 440	Reinforcing Steel
Item 526	Membrane Curing
Item 532	Concrete Erosion Retards

ITEM NO. 594

GABIONS AND REVET MATTRESSES

594.1 Description

The work to be performed under this specification shall include furnishing, assembling, filling, and tying rock-filled wire mesh compartmented gabions and revet mattresses in accordance with the lines, grades, and dimensions shown on the Drawings or otherwise established in the field by the Engineer or designated representative. The type of construction (i.e. twisted woven mesh, welded mesh or both) and wire sizes [i.e. 13.5 gage (2.2 mm), 12 gage (2.7 mm) or 10 gage (3.4 mm)] shall be as defined in the Drawings or otherwise established 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.

594.2 Materials

Gabions and revet mattresses shall be constructed of galvanized steel wire with polyvinylchloride (PVC) flexible coating. The gabions and revet mattresses shall be of the construction and sizes specified in the Drawings and shall meet the specifications presented herein. Unless otherwise specified in the Drawings or approved by the Engineer or designated representative, the gabions and revet mattresses may be constructed of either double twist woven mesh or welded wire mesh.

Gabions shall be furnished in the specified dimensions within a tolerance of ± 5 percent. Revet mattresses shall be furnished in the specified dimensions within a tolerance of (5 percent for the length and width and (10 percent for the height. For each individual gabion or revet mattress, the same mesh style shall be used for the base, front, ends, back, diaphragms and lid panels. Each gabion or revet mattress shall be manufactured and divided into cells of equal length, no greater than 3 feet (0.9 meter), by diaphragm panels.

(1) Gabion and Revet Mattress Wire

Gabion wire shall be galvanized steel, Class 3 or A coating, soft temper conforming to ASTM A 641, and shall specifically meet the requirements given below for gabions (12 gage wire) and/or revet mattresses (13.5 wire gage) as called for in the Drawings. PVC coating of the wire may be fusebonded or extruded onto the wire. Galvanization of welded wire shall be performed either before or after welding.

Table 1: Requirements Mesh Wire for Gabions and Revet Mattress Units

Characteristic	Gabions	Revet Mattresses
Wire Gage	12 gage	13.5 gage
Maximum Tensile Strength (ASTM 641)	70,000 psi (483 mPa)	75,000 psi (517 mPa)
Nominal Wire Diameter (ASTM A 641)	0.106 inch (2.7 mm)	0.0866 inch (2.2 mm)
Minimum Diameter (ASTM A 641, Table 3)	0.102 inch (2.6 mm)	0.0826 inch (2.9 mm)
Galvanizing, Zinc (ASTM A 641, Table 1)	0.80 oz/ft ² (245 gr/m ²)	0.70 oz/ft ² (215 gr/m ²)

(2) Gabion Mesh**(A) Woven Mesh**

Woven mesh shall be of a uniform nonraveling, double twist hexagonal pattern nominally of dimensions 3.25 inches by 4.5 inches (83 mm by 114 mm). Selvedge wire shall be 10 gage (nominal diameter of 3.4 mm).

(B) Welded Mesh

Mesh opening shall be nominally 3 inches by 3 inches (75 mm by 75 mm). Strength of welds shall meet the following requirements when tested in accordance with section 13.4 of ASTM A-974:

Table 2: Minimum Weld Strength Requirements

Type of Structure	Wire Size (Diameter)	Minimum Average Weld Shear Strength
	Gage (mm)	English Units (SI Units)
Gabions	12 (2.7)	472 lbf (2.10 kN)
Revet Mattress	13.5 (2.2)	292 lbf (1.30 kN)

(C) Manufacturing

Twisted wire mesh gabions shall be manufactured in conformance with ASTM A-975, while welded wire mesh gabions shall be manufactured in conformance with ASTM A-974.

(3) Revet Mattresses**(A) Woven Mesh**

Woven mesh shall be of a uniform nonraveling, double twist hexagonal

pattern, nominally of dimensions 2.5" x 3.25" (64 mm by 83 mm). Selvage wire shall be 12 gage (nominal diameter of 2.7 mm).

(B) Welded Mesh

Mesh opening shall be nominally 1.5" x 3.0" (38 mm by 76 mm). Strength of welds shall meet the requirements listed in Table 2 for 13.5 gage (2.2 mm) wire, when tested in accordance with section 13.4 of ASTM A-974:

(C) Manufacturing

Twisted wire mesh revet mattresses shall be manufactured in conformance with ASTM A-975, while welded wire mesh revet mattresses shall be manufactured in conformance with ASTM A-974.

(4) **PVC Coating**

All wire used in fabrication of the gabions, revet mattresses and wiring operations during construction shall, after zinc coating, have a fusebonded or extruded coating of PVC. The coating shall be gray in color. The thickness shall be nominally 0.020 inch (0.5 mm), and shall not be less than 0.015 inch (0.38 mm) in thickness. It shall be capable of resisting deleterious effects of natural weather exposure, and immersion in salt water.

For PVC-coated welded wire fabric panel, cutting of the panels shall not be allowed closer than 1/4 inch (1/8 inch (6 mm (3.18 mm) after fabrication in order to prevent exposure near the welds.

(A) Initial Properties:

1) Woven Mesh:

The initial properties of the PVC coating material shall have a demonstrated ability to conform to the following requirements specified in ASTM A-975:

a) Specific Gravity:

The specific gravity as determined in accordance with ASTM D-792 shall be between 1.3 to 1.35.

b) Durometer Hardness:

The hardness as determined in accordance with ASTM D-2240 shall be between 50 to 60, Shore D.

c) Tensile Strength:

The tensile strength when tested in accordance with ASTM D-412 shall not be less than 2985 psi (20.6 mPa).

d) Modulus of Elasticity at 100% Elongation:

The Modulus of Elasticity when determined in accordance with ASTM D-412 shall not be less than 2700 psi (18.6 mPa).

- e) Resistance to Abrasion:
The percentage loss in weight (mass) during abrasion testing in accordance with ASTM D-1242 shall be less than 12%.
- f) Brittleness Temperature:
The brittleness temperature shall not be higher than 15°F (-9.0°C) or a lower temperature specified by the Engineer, when tested in accordance with ASTM D-746. The maximum brittleness temperature should be at least 15°F (8°C) below the minimum temperature at which the gabion will be handled or filled.

2) Welded Mesh:

The initial properties of the PVC coating material shall have a demonstrated ability to conform to the following requirements specified in ASTM A-974:

- a) Specific Gravity:
The specific gravity as determined in accordance with ASTM D-792 shall be between 1.20 and 1.40.
- b) Durometer Hardness:
The hardness as determined in accordance with ASTM D-2240 shall not be less than 75, Shore A.
- c) Tensile Strength:
The tensile strength when tested in accordance with ASTM D-638 shall not be less than 2275 psi (15.7 mPa).
- d) Modulus of Elasticity:
The Modulus of Elasticity when determined in accordance with ASTM D-638 shall not be less than 1980 psi (13.7 mPa).
- e) Resistance to Abrasion:
The percentage loss in weight (mass) shall be less than 12 % during abrasion testing in accordance with ASTM D-1242, Method B, at 200 cycles, CSI-A abrader tape, 80 grit.
- f) Brittleness Temperature:
The brittleness temperature shall not be higher than 15°F (-9.0°C) or a lower temperature specified by the Engineer, when tested in accordance with ASTM D-746. The maximum brittleness temperature should be at least 15°F (8°C) below the minimum temperature at which the gabion will be handled or filled.

g) Adhesion:

The PVC coating on the wire shall adhere to the wire such that the coating breaks rather than separates from the wire, when tested in accordance with the PVC Adhesion Test described in Section 13.3 of ASTM A-974.

h) Mandrel Bend:

The PVC-coated wire, when subjected to a single 360° bend at 0°F (-18°C) around a mandrel ten times the diameter of the wire, shall not exhibit breaks or cracks in the PVC coating.

(B) Performance Tests:

The PVC coating shall have the demonstrated ability to withstand the specified exposure testing.

1) Exposure to Salt Spray: The PVC shall show no effect after 3000 hours of salt spray exposure in accordance with ASTM Test Method B-117.

2) Exposure to Ultraviolet Rays:

The PVC shall show no effect of exposure to ultraviolet light with test exposure of 3000 hours, using apparatus Type E and 145°F (63°C), when tested in accordance with ASTM Practice D-1499 and G-23.

(C) Properties After Exposure Tests:

After conclusion of the salt spray and exposure to ultraviolet light tests, the PVC shall not show cracks, blisters or splits, nor any noticeable change in color. In addition the PVC coating shall not show cracks or breaks after the wires are twisted in the fabrication of the mesh, nor shall there be any moisture intrusion under the PVC coating as a result of the test.

After completion of the exposure tests the following criteria shall also be met:

1) Woven Mesh:

a) The Specific Gravity shall not change more than 6% of its initial value.

b) The Durometer Hardness shall not change more than 10% of its initial value.

c) The Tensile Strength shall not change more than 25% of its initial value.

d) The Resistance to Abrasion shall not change more than 10% of its initial value.

2) Welded Mesh:

- a) The Specific Gravity shall not change more than 6% of its initial value.
- b) The Modulus of Elasticity shall not change more than 25% of its initial value.
- c) The Tensile Strength shall not change more than 25% of its initial value.
- d) The Resistance to Abrasion shall not change more than 10% of its initial value.

(D) Salt Spray Resistance for Fastener:

The fasteners for twisted mesh wire gabions andrevet mattresses shall be subjected to Salt Spray Test of Test Method B-117 for a period of not less than 48 (1 hour cycle length. After testing the fasteners, the selvedge, or mesh wire confined by the fasteners shall show no rusty spots on any part of the surface excluding the cut ends.

(5) **Stone**

(A) Gabion Basket Stones

Stone fill shall be durable and of suitable quality to ensure permanence in the structure. The stone used to fill the gabion baskets shall be a clean, sound, and durable rock meeting the following requirements. It shall have a wearing loss less than 35 percent when the stone is tested with the Los Angeles Abrasion Machine in accordance with ASTM Test Method C535 (TxDOT Test Method Tex-410A). The loss of material experienced during five cycles of magnesium sulfate exposure conducted in accordance with TxDOT Test Method Tex411A for Rock RipRap shall not exceed 18 percent. The stone shall be well graded to produce a dense fill, angular in texture, while meeting the following gradation requirements:

Table 3: Gabion Stone Gradation Requirements

Sieve Size		Percent by Weight (Mass)
US	(SI)	% Passing Each Individual Sieve
8 Inch	(200 mm)	100
4 Inch	(100 mm)	0 - 5
3 Inch	(75 mm)	0

The minimum unit weight (unit mass) of a rockfilled gabion shall be 120 pcf [1.92 megagrams (mg) per cubic meter]. Verification of unit weight (mass) shall be performed when ordered by the Engineer, by constructing a test gabion with materials supplied for construction with the same effort and method intended for production gabions.

(B) Revet Mattress Stone:

The stone used to fill the revet mattresses shall be as specified for gabions except that it shall have a maximum dimension of 5 inches (125mm) and a minimum dimension of 3 inches (75 mm). The majority of the stone shall be in the 3 to 4 inch (75 to 100 mm) range; cubical or rounded in shape. A tolerance of 5% shall be allowed on the upper and lower dimensions of the rock.

(6) **Connections**

(A) Wire

Lacing wire and connecting wire shall be 13.5 gage [0.087 inch (2.20 mm)] PVC coated galvanized steel, Class 3, soft temper, conforming to ASTM A-641. During testing, any separation of 2 inches (50 mm) or more between connecting wires shall be considered as a failure.

(B) Spiral Binder for Welded Wire Mesh

Spiral binders shall consist of 0.106 inch (2.7 mm) PVC coated wire for the gabion and 0.087 inch (2.2 mm) PVC coated wire for the revet mattresses. Spiral binders shall have a 3.0 inch (75 mm) maximum separation between continuous successive loops (3 inch or 75mm pitch).

The binder shall be made of galvanized steel, Class 3, soft temper, conforming to ASTM A-641.

(C) Alternate Fasteners for Twisted Woven Mesh

Alternate fasteners, acceptable for use by the intended gabion basket manufacturer, may be submitted to the Engineer for consideration and approval prior to construction. The fasteners may consist of split ring or interlocking fasteners. Alternate fasteners systems shall produce a joint that meets the requirements of ASTM A-975, Section 7, Table 2.

(7) **Fastener System**

The Contractor shall provide a complete description of the fastener system, including the number of fasteners required for all vertical and horizontal connections for single- and multiple-basket joinings, as well as the number and size wires the fastener is capable of properly joining. The Contractor shall provide a description of a properly installed fastener, including test reports, drawings and/or photographs. Properly formed fasteners shall meet the requirements of ASTM A-974 for welded wire mesh or ASTM A-975 for twisted woven mesh.

(A) Each interlocking fastener shall be locked and closed.

- (B) Each overlapping ring fastener shall be closed and the free ends shall overlap an average of 1 inch (25 mm).
- (C) Spiral binders shall be screwed into position such that they pass through each mesh opening along the joint. In order to prevent unraveling, both ends of the spiral shall be crimped back around itself.
- (D) Wire fasteners shall not be used to join more wires, or larger wires, than tested and approved for the application.

(8) Panel to Panel Joint Strength

The minimum strength of the joined panels shall be as specified in Section 7.3 of ASTM A-974 for Welded wire panels or Section 7.3 of ASTM A-975 for twisted woven mesh.

(9) Miscellaneous

Aggregate bedding, geotextiles or other materials shall conform to the requirements established on the Drawings.

(10) Certificate of Compliance

The Contractor shall submit Certificates of Compliance for all materials proposed for use to the Engineer for review and approval one week prior to construction.

594.3 Construction

Twisted wire mesh Gabon's and revote mattresses shall be supplied in the forms allowed in ASTM A-975, while welded wire mesh Gabon's and revote mattresses shall be supplied in a form allowed in ASTM A-974.

The Gabon/revote mattress manufacturer/supplier will be required to have a qualified representative on site at the start of gabion/revet mattress construction. The Contractor shall submit work experience documentation of the representative for review/approval by the Engineer or designated representative. The representative shall be available for consultation as needed throughout the gabion construction.

Gabions and revet mattresses shall be constructed to the lines and grades shown on the Drawings. Individual or groups of gabions or revet mattresses, which deviate from line and grade, shall, at the direction of the Engineer or designated representative, be removed and replaced at no cost to the owner. Gabions or revet mattresses, which are constructed with bulges, and/or underfilled, loosely filled, or otherwise lacking a neat and compact appearance shall, at the direction of the Engineer or designated representative, be repaired/replaced at no cost to the owner. Underfilling of gabion/revet mattress corners to facilitate insertion of spirals shall not be permitted.

(1) Foundation Preparation

The foundation shall be excavated to the extent shown on the Drawings or as directed by the Engineer or designated representative. All loose or otherwise unsuitable materials shall be removed. All depressions shall be carefully backfilled to grade. The depressions shall be backfilled with suitable materials from adjacent required excavation, or other approved source, and compacted to

a density at least equal to that of the adjacent foundation. If pervious materials are encountered in the foundation depressions, the areas shall be backfilled with free draining materials.

Any buried debris protruding from the foundation that will impede the proper installation and detrimentally impact the final appearance of the gabion, shall also be removed, and the voids carefully backfilled and compacted as specified above. Immediately prior to gabion or revet mattress placement, the prepared foundation surface shall be inspected and approved by the Engineer and no material shall be placed thereon until that area has been approved.

Placement of filter material and/or filter fabric shall be as shown on the Drawings or directed by the Engineer.

(2) **Gabion/Revet Mattress Basket Assembly**

No work shall take place using PVC coated materials unless both the ambient air temperature and the temperature of the PVC materials are at least 15°F (8°C) above the brittleness temperature of the PVC materials.

Assembly of gabions and revet mattresses shall consist of shaping and tying each individual basket. Baskets shall be assembled by connecting all untied edges including diaphragms with lacing wire, spirals or approved fasteners. The connections for the completed assemblies shall conform to the requirements of Section 7 of ASTM specifications A-974 (welded wire) and Section 7.3 and Table 2 of A-975 (double twisted).

Assembly of baskets, connection of baskets together and lid closures shall be accomplished in accordance with one of the following approved procedures:

(A) Lacing Wire:

Using lacing wire of appropriate length, secure one end of the wire onto the basket corner by looping and twisting the lacing wire together. Proceed along the joint by tying with double loops every other mesh opening at intervals not more than 6 inches (150 mm) apart, while pulling the basket elements tightly together. Secure the other end of the lacing wire again by looping and twisting the wire around itself.

(B) Spiral Binders for Welded Wire Mesh:

Spiral binders, meeting the minimum acceptance criteria of article 594.2(6)(c) shall be screwed into position such that they pass through each mesh opening along the joint. To prevent unraveling, each end of the spiral binder shall be crimped back against itself.

(C) Alternate Fasteners for Twisted Woven Mesh:

Interlocking fasteners meeting the minimum acceptance criteria of article 594.2(6)(c), shall be installed with, as a minimum, one interlocking fastener in every other opening.

Ring fasteners meeting the minimum acceptance criteria of 594.2(6)(c), shall be installed with, as a minimum, one split ring fastener in every

opening, having a minimum 1 inch (25 mm) total overlap and securing only the number and diameter of wires for which tested.

Placing of gabions and revet mattresses shall consist of installing baskets to the lines and grades shown on the Drawings. Gabions and revet mattresses shall be securely fastened to each adjoining unit along the vertical and top reinforced edges of all contact surfaces. Overlying rows of baskets shall be staggered appropriately. Empty sections stacked on a filled line of gabions and revet mattresses shall be securely fastened to the bottom unit along the front, back and ends.

Prior to the placement of rock, the baskets used in the front vertical exposed faces of retaining walls shall be aligned. To facilitate alignment, tension may be applied to empty units at the direction of the Engineer or designated representative.

(3) **Filling of Gabions and Revet Mattresses**

The gabions and revet mattresses may be filled by machine, in maximum lifts of 12 inches (300 mm). The machine work shall be supplemented with handwork to avoid bulges and provide a compact mass with a minimum of voids. Care will be exercised so as not to damage the gabion/revet mattress elements or wire coating by limiting height of drop during filling to 3.0 feet (0.9 meter) for Gabions and 1.5 feet (0.5 meter) for revet mattresses. Undue deformation or bulging of the mesh shall be corrected prior to further stone filling. Where specified on the Drawings, select large stone shall be hand placed on vertical outside faces to achieve a desired neat appearance.

During placement, the depth of stone in any cell shall not exceed the depth in an adjoining cell by more than one foot (300 mm). Stone smaller than the mesh opening found against vertical faces shall be removed.

Two connecting wires in each direction for end units and two parallel connecting wires perpendicular to the exposed face for exposed face units shall be installed at every 12 inch (300 mm) lift. The connecting wires shall loop around two mesh openings, and the ends of wires shall be securely twisted with a minimum of three twists after looping. Prefabricated connecting wire may be used in lieu of connecting wire.

Connecting wires associated with 18inch (450 mm) gabions shall be installed when and as specified on the Drawings or as recommended by the gabion/revet mattress manufacturer.

The gabion or revet mattress unit shall be overfilled by 1 1/2 to 2 inches (37.5 to 50 mm) and the lid shall be bent and stretched until it meets the perimeter edges of the front and end panels. The stretching shall be accomplished using an approved lid closing tool in order to prevent damage to the PVC coating. Crow bars or similar single point leverage devices will not be allowed. The lid shall then be securely tied with lacing wire, spirals or approved fasteners to the fronts, ends and diaphragms. Excessive deformation of the lid panel to facilitate closing of a bulging gabion or revet mattress will not be permitted.

All backfill shall be placed and compacted in sequence with the filling of the baskets; however, care shall be exercised in compacting the fill behind a single row of baskets since excessive compaction effort can displace the gabions/revet mattresses from the desired alignment.

Gabion or revet mattress units may be cut or shaped to fit odd length or odd shaped areas. They shall be cut at least 6" to 8" (150 mm to 200 mm) larger than the opening to allow sufficient material for overlap and lacing. All edges or faces formed in this manner shall be adjusted to present a finished and pleasing appearance.

At all times, care shall be taken to turn all loose and projecting ends of wire into the gabion units to prevent injury.

594.4 Workmanship

Wire of proper grade and quality, when fabricated and installed in the manner herein required, shall result in a strong, serviceable mesh-type product having substantially uniform openings. It shall be fabricated and finished in a workmanlike manner, as determined by visual inspection, and shall conform to this specification.

594.5 Measurement

Measurement of acceptable "Gabions and Revet Mattresses", complete in place, will be made on the basis of volume determined by the actual length, width and height.

594.6 Payment

The Gabion and revet mattress quantities, measured as described above, will be paid for at the unit bid prices per cubic yard (cubic meter: 1 cubic meter equals 1.308 cubic yards) of the various types indicated. The price shall include full compensation for furnishing, hauling and placing all materials, including filter fabric, wire containers, connectors, reinforcement stones and backfill; for all labor, tools, equipment and incidentals needed to complete the work.

Excavation and all subgrade preparation required for shaping the foundation for the wire containers shall be included in the unit bid price for "Gabions and Revet Mattresses".

Payment will be made under one of the following:

Gabions, Twisted Woven Wire -	Per Cubic Yard.
Gabions, Welded Wire -	Per Cubic Yard.
Revet Mattresses, Twisted Woven Wire -	Per Cubic Yard.
Revet Mattresses, Welded Wire -	Per Cubic Yard.

End

SPECIFIC CROSS REFERENCE MATERIALS

Specification Item 594, "GABIONS AND REVET MATTRESSES"

American Society for Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
A-974	Standard Specifications for Welded Wire Fabric Gabions and Gabion Mattresses (Metallic-Coated or Polyvinyl Chloride (PVC) Coated)
A-975	Standard Specifications for Double-Twisted Hexagonal Mesh Gabions and Revet Mattresses (Metallic-Coated Steel Wire or Metallic-Coated Steel with Poly Vinyl Chloride (PVC) Coating)

RELATED CROSS REFERENCE MATERIALS

Specification Item 594, "GABIONS AND REVET MATTRESSES"

City of Round Rock Technical Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 110	Street Excavation
Item No. 111	Excavation
Item No. 120	Channel Excavation
Item No. 130	Borrow
Item No. 132	Embankment
Item No. 220	Sprinkling for Dust Control
Item No. 230	Rolling (Flat Wheel)
Item No. 232	Rolling (Pneumatic Tire)
Item No. 234	Rolling (Tamping)
Item No. 236	Proof Rolling
Item No. 510	Pipe
Item No. 601	Salvaging and Placing Topsoil
Item No. 602	Sodding for Erosion Control
Item No. 604	Seeding for Erosion Control
Item No. 605	Soil Retention Blanket
Item No. 606	Fertilizer
Item No. 607	Slope Stabilization
Item No. 608	Planting

<u>RELATED</u> CROSS REFERENCE MATERIALS - Continued

Specification Item 594, "GABIONS AND REVET MATTRESSES"

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
410-A	Abrasion of Coarse Aggregate Using The Los Angeles Machine
411-A	Soundness of Aggregate By Use of Sodium Sulfate or Magnesium Sulfate

American Society for Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
A-313	Standard Specification for Stainless Steel Spring Wire
A-370	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
A-641	Specification for Zinc Coated (Galvanized) Carbon Steel Wire
A-853	Standard Specification for Steel Wire, Carbon, for General Use
B-117	Test Method of Salt Spray (Fog) Testing
C-535	Standard Test Method for Resistance of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
D-412	Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension
D-638	Test Method for Tensile Properties of Plastics
D-746	Test Methods for Brittleness Temperature of Plastic and Elastomers by Impact
D-792	Test Methods for Specific Gravity (Relative Density) and Density of Plastics by Displacement
D-1203	Standard Test Methods for Volative Loss from Plastics Using Activated Carbon Methods
D-1242	Test Methods for Resistance of Plastics Materials to Abrasion
D-1499	Practice for Operating Light and Water Exposure Apparatus (Carbon-Arc Type) for Exposure of Plastics
D-2240	Test Method for Rubber Property-Durometer Hardness
D-2287	Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
G-23	Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Non-metallic Materials

Standard Specifications Manual

SERIES 600 - ENVIRONMENTAL ENHANCEMENT

Item No.

- 601 Salvaging and Placing Topsoil
- 602 Sodding for Erosion Control
- 604 Seeding for Erosion Control
- 605 Soil Retention Blanket
- 606 Fertilizer
- 607 Slope Stabilization Applications for Erosion Control
- 608 Planting
- 609 Native Grasslands for Erosion Control
- 610 Preservation of Trees and Other Vegetation
- 620 Filter Fabric
- 621 Diversion (Temporary)
- 622 Diversion Dike
- 623 Dry Stack Rock Wall
- 624 Earth Outlet Sediment Trap
- 625 Temporary Grade Stabilization Structure
- 627 Grass-Lined Swale and Grass-Lined Swale with Stone Center
- 628 Sediment Containment Dikes
- 629 Brush Berm Barrier for Erosion Control
- 630 Interceptor Dike
- 631 Interceptor Swale
- 632 Storm Inlet Sediment Trap
- 633 Landgrading
- 634 Level Spreader
- 635 Perimeter Dike
- 636 Perimeter Swale
- 637 Pipe Slope Drain
- 638 Pipe Outlet Sediment Trap
- 639 Rock Berm
- 640 Mortared Rock Wall
- 641 Stabilized Construction Entrance
- 642 Silt Fence
- 643 Stone Outlet Structure
- 644 Stone Outlet Sediment Trap
- 646 Tied Precast Concrete Revetment

ITEM NO. 601

SALVAGING AND PLACING TOPSOIL

601.1 Description

This item shall govern the removal, storage and placement of approved topsoil to the depths and area shown on the Drawings 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.

601.2 Submittals

The submittal requirements of this specification item shall include the test results and soil classification necessary for approval of material as suitable topsoil.

601.3 Materials

A. Topsoil

The topsoil shall be a clean, friable, fertile soil with a relatively high erosion resistance, free of objectionable materials including roots and rocks larger than 1 1/2 inches (37.5 millimeters) and readily able to support the growth of planting (Standard Specification Item No. 608), seeding (Standard Specification Item No. 604) and sodding (Standard Specification Item No. 602).

B. Water

Water shall be furnished by the Contractor and shall be clean and free from industrial wastes and other objectionable matter.

601.4 Sources

The topsoil may be obtained from the right-of-way at sites of proposed excavation or embankment when shown on the Drawings or identified by the Engineer or designated representative. The topsoil may also be obtained from approved sources, which are located outside the right-of-way and have been secured by the Contractor.

601.5 Construction Methods

Precautions will be maintained at all times to protect all trees in the area of construction. Where removal of trees is indicated on the Drawings, they shall be marked as directed by the Engineer or designated representative.

Construction equipment shall not be operated nor construction materials stockpiled under the canopies of trees, unless otherwise approved by the City's Forestry Manager. Topsoil materials shall not be placed within the drip line of trees until tree wells are constructed that conform to Item No. 610, "Preservation of Trees and Other Vegetation" and approved by the City's Forestry Manager. The source and stockpile areas shall be kept drained, insofar as practicable, during the period of topsoil removal.

The existing topsoil to be salvaged shall be removed from areas approved by the Engineer or designated representative, stockpiled in a windrow along the right of way or spread over an area that is ready for topsoil application in accordance with the Drawings or as directed by the Engineer or designated representative.

Trash, wood, brush, stumps, rocks over 1 1/2 inches (37.5 mm) in size and other objectionable material encountered shall be removed and disposed of properly prior to beginning of work required by this item. Grass and other herbaceous plant materials may remain. Large clumps shall be broken up.

After the grading has been completed to the required alignment, grades and cross-sections and prior to the spreading of the salvaged topsoil, any clay or tight soil surfaces shall be scarified by plowing furrows approximately 4 inches (100 mm) deep along horizontal slope lines at 2 foot (600 mm) intervals. The spreading of the salvaged topsoil shall be undertaken as soon as the grading has been completed. The topsoil shall be spread so as to form a cover of uniform thickness indicated. After the topsoil has been placed and shaped, it shall be sprinkled and rolled to provide a suitable seed bed.

601.6 Measurement and Payment

Salvaging, removal and/or placing topsoil materials will not be measured for payment, but shall be considered subsidiary to other items of work.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification 601, "SALVAGING AND PLACING TOPSOIL"

City of Round Rock Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 602	Sodding for Erosion Control
Item No. 604	Seeding for Erosion Control
Item No. 608	Planting
Item No. 610	Preservation of Trees and Other Vegetation

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 601, "SALVAGING AND PLACING TOPSOIL"

City of Round Rock Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 102	Clearing and Grubbing
Item No. 104	Removing Concrete
Item No. 110	Street Excavation
Item No. 111	Excavation
Item No. 120	Channel Excavation
Item No. 132	Embankment
Item No. 606	Fertilizer

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 160	Furnishing and Placing Topsoil
Item No. 164	Seeding for Erosion Control
Item No. 204	Sprinkling

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-103-E	Determination of Moisture Content of Soil Materials
Tex-104-E	Determination of Liquid Limit of Soils
Tex-105-E	Determination of Plastic Limit of Soils
Tex-106-E	Method of Calculating the Plasticity Index of Soils

ITEM NO. 602

SODDING FOR EROSION CONTROL

602.1 Description

This item shall govern planting of Bermuda grass; St. Augustine or other acceptable grass sod at locations indicated on the Drawings or as directed by the Engineer or designated representative in accordance with this Standard Specification Item.

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.

602.2 Submittals

The submittal requirements for this specification item shall include the identification of the type and source of sodding, the type of mulch, type of tacking agent and type and rate of application of fertilizer.

602.3 Materials

A. Block and Mulch Sod

The sod shall consist of live, growing Bermuda Grass, St. Augustine grass, when shown on the Drawings, or other acceptable grass sod indicated on the Drawings secured from sources that are approved by the Engineer or designated representative. Bermuda Grass sod, St. Augustine sod or other grass sod as shown on the Drawings shall have a healthy, virile root system of dense, thickly matted roots throughout the soil of the sod for a minimum thickness of 1 inch (25 millimeters). The thickness measure does not include grass. The sod shall be cut in rectangular pieces with its shortest side not less than 12 inches (300 mm). The Contractor shall not use sod from areas where the grass is thinned out nor where the grass roots have been dried out by exposure to the air and sun to such an extent as to damage its ability to grow when transplanted.

The sod shall be substantially free from noxious weeds, Johnson grass or other grasses and shall not contain any matter deleterious to its growth or which might affect its subsistence or hardiness when transplanted. Unless the area has been closely pastured, it shall be closely mowed and raked to remove all weeds and long standing stems. Sources from which sod is to be secured shall be approved by the Engineer or designated representative.

Care shall be taken at all times to retain the native soil of the roots of the sod during the process of excavating, hauling and planting. Sod material shall be kept moist from the time it is dug until it is planted. The sod existing at the source shall be watered to the extent required by the Engineer or designated representative prior to excavating.

B. Fertilizer

Fertilizer and the rate of application shall conform to the requirements of Standard Specification Item No. 606, "Fertilizer".

C. Mulch

Straw mulch shall be oat, wheat or rice straw. Hay mulch may be substituted for straw mulch and shall be Prairie Grass, Bermuda grass or other hay approved by the Engineer or designated representative. The hay or straw mulch shall be free of Johnson grass or other noxious weeds and foreign materials. It shall be kept in a dry condition and shall not be molded or rotted.

D. Water

Water shall be furnished by the Contractor and shall be clean and free of industrial wastes and other substances harmful to the growth of sod or to the area irrigated.

E. Tacking Agents

Tacking agents for straw or hay mulch shall be as shown on the Drawings.

602.4 Planting Season

All planting shall be done between April and November except as specifically authorized in writing by the Engineer or designated representative.

602.5 Construction Methods

A. General

After the designated areas have been completed to the lines, grade and cross sections indicated on the Drawings, the surface shall be worked to a depth of not less than 4 inches (100 mm) with a disc, tiller or other equipment approved by the Engineer or designated representative. Fertilizer nutrients shall be applied and tilled. Areas that become crusted shall be reworked to an acceptable condition before sodding. Sodding of the type specified shall conform to the requirements of this Specification Item. The Contractor shall give continuous care to the sodded area until the sod is accepted.

B. Placement

The sod shall be placed on the prepared surface with the edges in close contact and alternate courses staggered. In ditches the sod shall be placed with the longer dimension perpendicular to the flow of water in the ditch. On slopes, starting at the bottom of the slope, the sod shall be placed with the longer dimension parallel to the contours of the ground. The exposed edges of sod shall be buried flush with the adjacent soil. On slopes exceeding 3:1 or where the sod may be displaced, the sod shall be pegged with not less than 4 stakes or ground staples per square yard (square meter) with at least 1 stake or ground staple for each piece of sod.

Pegs shall be of wood lath or similar material, pointed and driven with the flat side against the slope, 6 inches (150 mm) into the ground, leaving approximately

1/2 inch (12.5 mm) of the top above the ground. Ground staples shall not be less than 13 inches (330 mm) in length and shall be constructed of No. 11 gage (3 mm) wire that is bent to form a "U" approximately 1 inch (25 mm) in width.

C. Watering

Immediately after the area is sodded, it shall be watered with a minimum of 5 gallons of water per square yard (22.5 liters per square meter) and at 10 day intervals as needed and as directed by the Engineer or designated representative. Subsequent to the initial application, water shall be applied at a minimum rate of 3 gallons per square yard (13.5 liters per square meter), as required on the Drawings or as directed by the Engineer or designated representative until final acceptance by the City or until the grass uniformly reaches a height of 2 1/2 inches (62.5 mm).

Watering shall comply with City Ordinances.

D. Finishing

Where applicable, the shoulders, slopes and ditches shall be smoothed after planting has been completed and shaped to conform to the desired cross sections shown on the Drawings. Any excess soil from planting operations shall be spread uniformly over adjacent areas or disposed of as directed by the Engineer or designated representative so that the completed surfaces will present a neat appearance. All sodded areas shall be rolled after the initial watering application, when sufficiently dry.

602.6 Block Sodding

At locations indicated on the Drawings or where directed by the Engineer or designated representative, sod blocks shall be carefully placed on the prepared areas. The fertilizer shall then be applied in accordance with the applicable provisions of Item No. 606, "Fertilizer" and thoroughly watered. When sufficiently dry, the sodded area shall be rolled or tamped to form a thoroughly compacted, solid mat. Any voids left in the block sodding shall be filled with additional sod and tamped. Surfaces of block sod which, in the opinion of the Engineer or designated representative may slide due to the height and slope of the surface or nature of the soil, shall be pegged with wooden pegs driven through the sod blocks into firm earth sufficiently close to hold the block sod firmly in place. Edges along curbs and drives, walkways, etc., shall be carefully trimmed and maintained until the sodding is accepted.

602.7 Mulch Sodding

The sod source shall be disked in 2 directions cutting the sod thoroughly to a depth of not less than 4 inches (100 mm). Sod material shall be excavated to a depth of not more than 2 inches (50 mm) below the existing root system, being careful to avoid having soil containing no grass roots. The disked sod may be windrowed or otherwise handled in a manner satisfactory to the Engineer or designated representative. The material shall be rejected if not kept in a moist condition.

Prior to placement of mulch sod, the cut slopes shall be scarified by plowing furrows 4 inches (100 mm) to 6 inches (150 mm) deep along horizontal slope lines at 2 foot (600

mm) intervals. Excavated material from the furrows shall not protrude more than 3 inches (75 mm) above the original surface of the cut. Fertilizer shall be distributed uniformly over the area in accordance with the applicable provisions of Item No. 606, "Fertilizer". The sod shall then be deposited upon the prepared area and spread uniformly to the thickness indicated on the Drawings.

Any section that is not true to lines and cross sections shall be remedied by the addition of sod material or by reshaping the material to meet the requirements of "Finishing" [Section 602.5 (4)]. After the sod material has been spread and shaped, it shall be thoroughly wetted and compacted with a corrugated roller of the "Cultipacker" type. All rolling of slope areas shall be on the contour.

602.8 Measurement

Work and acceptable material for "Sodding for Erosion Control" will be measured by the square yard (square meter: 1 square meter is equal to 1.196 square yards) complete in place with a minimum of 95 percent growth with a 2 1/2 inch (62.5 mm) stand of grass.

602.9 Payment

The work performed and materials furnished and measured as provided under "Measurement" will be paid for at the unit bid price for Bermuda Block Sodding", "St. Augustine Block Sodding", "Bermuda Mulch Sodding" or "Other Approved Grass Sodding". The prices shall each represent full compensation for completion of the work including all water applications, rolling, pegging and fertilizer as indicated on the Drawings.

Payment will be made under one of the following:

Bermuda Block Sodding – Per Square Yard.

St. Augustine Block Sodding – Per Square Yard.

Bermuda Mulching Sodding – Per Square Yard.

Grass Sodding – Per Square Yard.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification 602, "SODDING FOR EROSION CONTROL"

City of Round Rock Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 606	Fertilizer

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 602, "SODDING FOR EROSION CONTROL"

City of Round Rock Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 110	Street Excavation
Item No. 111	Excavation
Item No. 120	Channel Excavation
Item No. 132	Embankment
Item No. 601	Salvaging and Placing Topsoil
Item No. 604	Seeding for Erosion Control
Item No. 608	Planting
Item No. 610	Preservation of Trees and Other Vegetation

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 160	Furnishing and Placing Topsoil
Item No. 162	Sodding for Erosion Control
Item No. 164	Seeding for Erosion Control
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 204	Sprinkling

ITEM NO. 604

SEEDING FOR EROSION CONTROL

604.1 Description

This item shall govern the preparation of a seed bed to the lines and grades indicated on the Drawings, sowing of seeds, fertilizing, mulching with straw, cellulose fiber wood chips, recycled paper mulch and other management practices along and across such areas as indicated in the Drawings 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, inch-pound units are given preference with SI units shown within parentheses.

604.2 Submittals

The submittal requirements for this specification item shall include:

- A. Identification of the type, source, mixture, PLS and rate of application of the seed.
- B. type of mulch.
- C. type of tacking agent.
- D. type and rate of application of fertilizer.

604.3 Materials

- A. Seed.

All seed must meet the requirements of the Texas Seed Law including the labeling requirements for showing pure live seed (PLS), name and type of seed. The seed furnished shall be of the previous season's crop and the date of analysis shown on each bag shall be within nine months of the time of delivery to the project. Each variety of seed shall be furnished and delivered in separate bags or containers. A sample of each variety of seed shall be furnished for analysis and testing when directed by the Engineer or designated representative.

The amount of seed planted per acre (hectare) shall be of the type specified in sections 604.5 and 604.6.

- B. Water.

Water shall be clean and free of industrial wastes and other substances harmful to the growth of grass or the area irrigated.

- C. Top soil.

Top soil shall conform to Standard Specification Item No. 130, "Borrow".

- D. Fertilizer.

The fertilizer shall conform to Standard Specification Item No. 606, "Fertilizer".

E. Straw Mulch or Hay Mulch.

Straw Mulch shall be oat, wheat or rice straw. Hay mulch shall be prairie grass, Bermuda grass, or other hay approved by the Engineer or designated representative. The straw or hay shall be free of Johnson grass or other noxious weeds and foreign materials. It shall be kept in a dry condition and shall not be molded or rotted.

F. Tacking Agents.

The tacking agent shall be a biodegradable tacking agent, approved by the Engineer or designated representative.

G. Cellulose Fiber Mulch (Natural Wood).

Cellulose Fiber Mulch shall be natural cellulose fiber mulch produced from grinding clean whole wood chips. The mulch shall be designed for use in conventional mechanical planting, hydraulic planting of seed or hydraulic mulching of grass seed, either alone or with fertilizers and other additives. The mulch shall be such, that when applied, the material shall form a strong, moisture-retaining mat without the need of an asphalt binder.

H. Recycled Paper Mulch.

Recycled paper mulch shall be specifically manufactured from post-consumer paper and shall contain a minimum of 85% recycled paper content by weight, shall contain no more than 15% moisture and 1.6% ash, and shall contain no growth inhibiting material or weed seeds. The recycled paper mulch shall be mixed with grass seed and fertilizer for hydro-seeding/mulching, erosion control, and a binder over straw mulch. The mulch, when applied, shall form a strong, moisture-retaining mat of a green color without the need of an asphalt binder.

604.4 Construction Methods

A. Preparing Seed Bed.

After the designated areas have been rough graded to the lines, grades and typical sections indicated in the Drawings or as provided for in other items of this contract and for any other soil area disturbed by the construction, a suitable seedbed shall be prepared. The seedbed shall consist of a minimum of either 4 inches (100 millimeters) of approved topsoil or 4 inches (100 millimeters) of approved salvaged topsoil, cultivated and rolled sufficiently to reduce the soil to a state of good tilth, when the soil particles on the surface are small enough and lie closely enough together to prevent the seed from being covered too deeply for optimum germination. The optimum depth for seeding shall be 1/4 inch (6 millimeters). Water shall be gently applied as required to prepare the seedbed prior to the planting operation either by broadcast seeding or hydraulic planting. Seeding shall be performed in accordance with the requirements hereinafter described.

B. Watering.

All watering shall comply with City Ordinances. Broadcast seeded areas shall immediately be watered with a minimum of 5 gallons of water per square yard (22.5 liters of water per square meter) or as needed and in the manner and quantity as directed by the Engineer or designated representative. Hydraulic seeded areas and native grass seeded areas shall be watered commencing after the tackifier has dried with a minimum of 5 gallons of water per square yard (22.5 liters of water per square meter) or as needed to keep the seedbed in a wet condition favorable for the growth of grass.

Watering applications shall constantly maintain the seedbed in a wet condition favorable for the growth of grass. Watering shall continue until the grass is uniformly 1 1/2 inches (40 mm) in height and accepted by the Engineer or designated representative. Watering can be postponed immediately after a 1/2 inch (12.5 mm) or greater rainfall on the site but shall be resumed before the soil dries out.

604.5 Non-Native Seeding

A. Method A - Broadcast Seeding.

The seed or seed mixture in the quantity specified shall be uniformly distributed over the prepared seed bed areas indicated on the Drawings or where directed by the Engineer or designated representative. If the sowing of seed is by hand, rather than by mechanical methods, the seed shall be sown in two directions at right angles to each other. If mechanical equipment is used, all varieties of seed, as well as fertilizer, may be distributed at the same time, provided that each component is uniformly applied at the specified rate. After planting, the planted area shall be rolled with a corrugated roller of the "Cultipacker" type. All rolling of the slope areas shall be on the contour.

Seed Mixture and Rate of Application for Broadcast Seeding:

From September 15 to March 1, seeding shall be with a combination of unhulled Bermuda Grass at a rate of 2 pounds per 1000 square feet (1.0 kilograms per 100 square meters) and winter rye or cool season cover crop (see Table 4) at a rate of 5 pounds per 1000 square feet (16.6 kilograms per 100 square meters)

From March 1 to September 15, seeding shall be with hulled Bermuda Grass at a rate of 2 pounds per 1000 square feet (1.0 kilograms per 100 square meters) with a PLS = 0.83. Fertilizer shall be applied and shall conform to Item No. 606, "Fertilizer".

B. Method B - Hydraulic Planting. The seedbed shall be prepared as specified above and hydraulic planting equipment, which is capable of placing all materials in a single operation, shall be used.

March 1 to September 15

Hydraulic planting mixture and minimum rate of application pounds per 1000 square feet (kilograms per 100 square meters):

Hulled Bermuda Seed (PLS=0.83)	Fiber Mulch		Soil Tackifier
	Cellulose	Wood	
1 Lbs/1000 ft ² (0.5kgs/100 m ²)	45.9 Lbs/1000 ft ² (22.5kgs/100 m ²)		1.4 Lbs/1000 ft ² (0.7kgs/100 m ²)
		57.4 Lbs/1000 ft ² (28.0kgs/100 m ²)	1.5 Lbs/1000 ft ² (0.75kgs/100 m ²)

September 15 to March 1

Add 5 pounds per 1000 square feet (2.5 kilograms per 100 square meters) of winter rye or cool season cover crop (see Table 4) to above mixture. The fertilizer shall conform to City of Round Rock Standard Specification Item No. 606, "Fertilizer".

604.6 Native Grass Seeding

The seedbed shall be prepared as specified above. The seed mixture and the rate of application shall be as follows:

Table 2: Native Grasses			
Common Name	Botanical Name	Application rates	
		Lbs/1000 feet ²	kg/ 100 meter ²
Indiangrass	Sorghastrum nutans	0.15	0.075
Sideoats grama	Bouteloua curtipendula	0.2	0.10
Green sprangletop	Leptochloa dubia	0.15	0.075
Buffalo Grass	Buchloe dactyloides	0.25	0.125
Little Bluestem	Schizachyrium scoparium	0.2	0.10
Blue Grama Grass	Bouteloua gracilis	0.15	0.075
Canada Wild Rye	Elymus canadensis	0.2	0.10
Eastern gamagrass	Tripsacum dactyloides	0.25	0.125
Purple Three-Awn	Aristida purpurea	0.15	0.075
Switchgrass	Panicum virgatum	0.1	0.05
Bushy Bluestem	Andropogon glomeratus	0.1	0.05
Big Bluestem	Andropogon gerardii	0.1	0.05
Total Grass Seeding Rate		2.0	1.0

Table 3: Native Wildflowers			
Common Name	Botanical Name	Application rates	
		Lbs/1000 feet ²	kg/ 100 meter ²
Black-Eyed Susan	Rudbeckia hirta	0.05	0.025
Bundleflower	Desmanthus illinoensis	0.05	0.025
Scarlet Sage	Salvia coccinea	0.10	0.05
Pink Evening Primrose	Oenothera speciosa	0.05	0.025
Phlox	Phlox Drummondii	0.05	0.025
Coreopsis	Coreopsis tinctoria	0.05	0.025
Greenthread	Thelesperma filifolium	0.05	0.025
Purple Prairie Clover	Petalostemum purpurea	0.05	0.025
Cutleaf Daisy	Engelmannia pinnatifida	0.05	0.025
Partridge Pea	Cassia fasciculata	0.1	0.05
Indian Blanket	Gaillardia pulchella	0.1	0.05
Mexican Hat	Ratibida columnaris	0.05	0.025
Maximilian Sunflower	Helianthus maximiliani	0.1	0.05
Total Wildflower Seeding Rate		1.0	0.5
Total Warm Season Seeding Rate (Grass & Wildflowers)		3.0	1.5

Table 4: Cool Season Cover Crop			
Common Name	Botanical Name	Application rates	
		Lbs/1000 feet ²	kg/ 100 meter ²
Wheat	Triticum aestivum	1	0.5
Oats	Avena sativa	1	0.5
Cereal Rye Grain	Secale cereale	3	1.5
Total Cool Season Cover Crop Seeding Rate		5	2.5
Total Cool Season Seeding Rate (Grass, Wildflowers, & Cover Crop)		8	4

Species substitution as necessary due to availability shall be approved by the Engineer or designated representative. Watering and fertilizer application shall follow procedures outlined above or as otherwise specified on the Drawings.

Seed shall be applied by broadcast or drill method and shall be distributed evenly over the topsoil areas. Mulching shall immediately follow seed application.

September 15 to March 1

Add 5 pounds per 1000 square feet (2.5 kilograms per 100 square meters) of winter rye or cool season cover crop to grass and wildflower mixture. The fertilizer shall conform to City of Round Rock Standard Specification Item No. 606, "Fertilizer".

604.7 Mulch

A. Straw Mulch.

Straw mulch shall be spread uniformly over the area indicated or as designated by the Engineer or designated representative at the rate of 2 to 2 1/2 tons of straw per acre (4.5 to 5.6 megagrams of straw per hectare). The actual rate of application will be designated by the Engineer or designated representative. Straw may be hand or machine placed and adequately secured.

B. Fiber Mulch.

Cellulose and wood fiber mulch shall be spread uniformly over the area indicated or as designated by the Engineer or designated representative at the rate of 45 to 80 lbs. per 1000 square feet (22.5 to 40 kilograms per 100 square meters).

C. Recycled Paper Mulch.

Recycled paper mulch shall be spread over the area indicated on the Drawings or as designated by the Engineer or designated representative at a rate that will provide 100% coverage.

D. Shredded Brush Mulch.

Small brush or tree limbs except Juniper, which have been shredded, may be used for mulching Native Grass seeding.

604.8 Measurement

Work and acceptable material for "Seeding for Erosion Control" will be measured by the square yard (meter: 1 meter equals 1.196 square yards) or by the acre (hectare: 1 hectare equals 2.471 acres), complete in place, with a minimum of 95 percent coverage for the non-native mix, and 75 percent coverage for the native mix. Bare areas shall not exceed 16 square feet (1.5 square meters), and the height of vegetation shall stand at a minimum of 1 1/2 inch (40 millimeters). Bare areas shall be re-prepared and reseeded as required to develop an acceptable stand of grass.

604.9 Payment

The work performed and materials furnished and measured will be paid for at the unit bid price for "Seeding for Erosion Control" of the method specified on the Drawings and type of mulch. The unit bid price shall include full compensation for furnishing all materials, including all topsoil, water, seed, tackifier, fertilizer or mulch and for performing all operations necessary to complete the work.

Payment will be made under one of the following:

Non-Native Seeding for Erosion Control Method, _____ Mulch Per Square Yard.

Non-Native Seeding for Erosion Control Method, _____ Mulch Per Acre.

Native Seeding for Erosion Control Method, _____ Mulch Per Square Yard.

Native Seeding for Erosion Control Method, _____ Mulch Per Acre.

Mulch, _____ Per Square Yard.

Mulch, _____ Per Acre.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification 604, "SEEDING FOR EROSION CONTROL"

City of Round Rock Technical Specifications

<u>Designation</u>	<u>Description</u>
Item No.130	Borrow
Item No. 606	Fertilizer

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 604, "SEEDING FOR EROSION CONTROL"

City of Round Rock Technical Specifications

<u>Designation</u>	<u>Description</u>
Item No. 601	Salvaging and Placing Topsoil
Item No. 602	Sodding for Erosion Control
Item No. 605	Soil Retention Blanket
Item No. 607	Slope Stabilization
Item No. 608	Planting

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 160	Furnishing and Placing Topsoil
Item No. 162	Sodding for Erosion Control
Item No. 164	Seeding for Erosion Control
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 180	Wildflower Seeding
Item No. 192	Roadside Planting and Establishment

ITEM NO. 605
SOIL RETENTION BLANKET

605.1 Description

This item shall govern the provision and placement of wood, straw or coconut fiber mat, synthetic mat, paper mat, jute mesh or other material as a soil retention blanket for erosion control on slopes or ditches or short-term or long-term protection of seeded or sodded areas indicated on the Drawings or as specified by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, inch-pound units are given preference with SI units shown within parentheses.

605.2 Submittals

The submittal requirements for this specification item shall include the soil retention blanket material type and sample, evidence that the material is listed on TxDOT/TTI Approved Products List, one (1) full set of Manufacturer's literature and installation recommendations, and any special details necessary for the proposed application.

605.3 Materials

A. Soil Retention Blankets

All soil retention blankets must be listed on TxDOT Approved Products List or approved by the Engineer or designated representative.

The soil retention blanket shall be one (1) of the following classes and types as shown on the Drawings:

1. Class 1. "Slope Protection"
 - (a) Type A. Slopes 1:3 or flatter - Clay soils
 - (b) Type B. Slopes 1:3 or flatter - Sandy soils
 - (c) Type C Slopes steeper than 1:3 - Clay soils
 - (d) Type D Slopes steeper than 1:3 - Sandy soils
2. Class 1. "Flexible Channel Liner"
 - (a) Type E Short-term duration (Up to 2 years)
Shear Stress (t_d) < 1 pound per square foot [psf] (48 Pa)
 - (b) Type F Short-term duration (Up to 2 years)
Shear Stress (t_d) 1 to 2 psf (48 to 96 Pa)
 - (c) Type G Long-term duration (Longer than 2 years)
Shear Stress (t_d) >2 to <5 psf (>96 to <239 Pa)
 - (d) Type H Long-term duration (Longer than 2 years)
Shear Stress (t_d) 5 psf (239 Pa)

B. Fasteners

The fasteners shall conform to the recommendations of the manufacturer for the selected soil retention blanket.

605.4 Construction Methods

A. General

The soil retention blanket shall conform to the class and type shown on the Drawings. The Contractor has the option of selecting an approved soil retention blanket conforming to the class and type shown on the Drawings which is included on the Approved Products List published by TxDOT/TTI Hydraulics and Erosion Control Laboratory.

B. Site Preparation

Prior to placement of the soil retention blanket, the seedbed area to be covered shall be relatively free of all clods and rocks over 1 1/2 inches (37.5 mm) in maximum dimension and all sticks or other foreign matter that will prevent close contact of the blanket with the soil surface. The area shall be smooth and free of ruts and other depressions. If the prepared seedbed becomes crusted or eroded as a result of rain or if any eroded places, ruts or depressions exist for any reason, the Contractor shall be required to rework the soil until it is smooth and to reseed or resod the area at the Contractor's own expense. After the area has been properly prepared, the blanket shall be laid out flat, even and smooth, without stretching or crimping the material.

C. Installation

The Soil Retention Blanket, whether installed as slope protection or as flexible channel liner in accordance with the TxDOT/TTI Approved Products List, shall be placed within 24 hours after seeding (Standard Specification Item No. 604) or sodding (Standard Specification Item No. 602) erosion control operations have been completed, or as approved by the Engineer or designated representative. The soil retention blanket shall be installed and anchored in accordance with the Manufacturer's recommendations. The Contractor shall contact the Engineer or designated representative three (3) days prior to the installation of the soil retention blanket to allow for inspection of the installation by City of Round Rock personnel.

605.5 Measurement

This work and acceptable material for "Soil Retention Blanket" will be measured by the square yard (square meter: 1 square meter is equal to 1.196 square yards) of surface area covered, complete in place.

605.6 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 bid price for "Soil Retention Blanket" of the class shown on the Drawings or approved by the Engineer or designated representative. The unit price shall include full compensation for furnishing all

materials, labor, tools, equipment and incidentals necessary to complete the work. Anchors, checks, terminal and wire staples will not be paid for directly, but will be considered as subsidiary to this Item.

Payment will be made under the following:

Soil Retention Blanket Class ____; Type ____ - Per Square Yard.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification 605, "SOIL RETENTION BLANKET"

City of Round Rock Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 602	Sodding for Erosion Control
Item No. 604	Seeding for Erosion Control

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 605, "SOIL RETENTION BLANKET"

City of Round Rock Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 111	Excavation
Item No. 120	Channel Excavation
Item No. 132	Embankment
Item No. 606	Fertilizer
Item No. 608	Planting
Item No. 610	Preservation of Trees and Other Vegetation

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 160	Furnishing and Placing Topsoil
Item No. 162	Sodding for Erosion Control
Item No. 164	Seeding for Erosion Control
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

ITEM NO. 606 FERTILIZER

606.1 Description

This item shall govern the provision and distribution of fertilizer over the areas indicated on the Drawings and in accordance with these specifications.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, inch-pound units are given preference with SI units shown within parentheses.

606.2 Submittals

The submittal requirements for this specification item shall include:

- A. Type of soil(s) at the site.
- B. Type(s) of re-vegetation (seeding, sodding, etc).
- C. Type(s) of fertilizer.
- D. Rate(s) of application of fertilizer.
- E. Chemical analysis of the fertilizer(s).

606.3 Materials

All fertilizer used on site shall be delivered in bags or containers, which are clearly labeled and show the analysis. The figures in the analysis shall represent the percent of nitrogen, phosphoric acid and potash nutrients, respectively, as determined by the methods of the Association of Official Agricultural Chemists. The fertilizer may be subject to testing by the State Chemist in accordance with the Texas Fertilizer Law. A pelleted or granulated fertilizer shall be used.. Fifty percent or greater of the Nitrogen required shall be in the form of Nitrate Nitrogen (NO_3). The remaining Nitrogen required may be in the form of Urea Nitrogen [$\text{CO}(\text{NH}_2)_2$].

The total amount of nutrients furnished and applied per acre (hectare: 1 hectare equals 2.471 acres) shall equal or exceed that specified for each nutrient.

606.4 Construction Methods

Unless otherwise specified, the Contractor shall be responsible for determining appropriate fertilizer for any planting/revegetation required under the Contract. Such determination shall be based on recommendations of a reputable nursery or other qualified source and the determination shall be subject to the approval of the Engineer or designated representative.

Pelleted or granulated fertilizer shall be applied uniformly over the area specified on the Drawings to be fertilized and in the manner determined for the particular item of work. The fertilizer shall be dry and in good physical condition. Fertilizer that is powdered or caked will be rejected. Distribution of the fertilizer for the particular item of work shall meet the approval of the Engineer or Designated Representative.

Maintenance fertilizing shall be applied every 6 months after the new sod or grass is placed or until the work is accepted by the City.

The fertilizer may also be applied with the hydromulch.

606.5 Measurement

Work and acceptable material for "Fertilizer" will be measured by the normal ton of 2,000 pounds (megagrams: 1 megagram equals 1.1023 tons) or by the 100 pounds (50 kilograms: 1 kilogram equals 2.205 pounds) as determined by approved scales or guaranteed weight of sacks shown by the manufacturer.

606.6 Payment

The work performed and materials furnished and measured as provided under "Measurement" will be considered subsidiary to other bid items in the contract unless specified as a Pay Item.

When fertilizer is specified as a pay item, the work performed and materials furnished and measured as provided under "Measurement" will be paid for at the unit bid price for "Fertilizer". The unit bid price shall include full compensation for furnishing all materials and performing all operations necessary to complete the work.

Payment, when specified, will be made under one of the following:

Fertilizer - Per Ton.

Fertilizer - Per 100 Pounds.

End

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 606, "FERTILIZER"

City of Round Rock Technical Specifications

<u>Designation</u>	<u>Description</u>
Item No. 601	Salvaging and Placing Topsoil
Item No. 602	Sodding for Erosion Control
Item No. 604	Seeding for Erosion Control
Item No. 605	Soil Retention Blanket
Item No. 607	Slope Stabilization
Item No. 608	Planting
Item No. 610	Preservation of Trees and Other Vegetation

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 160	Furnishing and Placing Topsoil
Item No. 162	Sodding for Erosion Control
Item No. 164	Seeding for Erosion Control
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 180	Wildflower Seeding
Item No. 192	Roadside Planting and Establishment
Item No. 204	Sprinkling

ITEM NO. 607
SLOPE STABILIZATION APPLICATIONS
FOR EROSION CONTROL

607.1 Description

This item shall govern the construction of slope stabilization devices, where plant growth cannot be readily established or sustained without slope stabilization measures, in conformance with this Specification Item and in accordance with locations, lines and grades indicated on the Drawings or as directed by the Engineer or designated representative.

This Standard Specification Item shall apply to erosion control measures only and shall not apply to structural stabilization of slopes.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, inch-pound units are given preference with SI units shown within parentheses.

607.2 Submittals

The submittal requirements for this specification item shall include the soil retention blanket material type and sample, evidence that the material is listed on the current version of TxDOT/TTI's Approved Products List, one (1) full set of manufacturer's literature and installation recommendations, and any necessary special details.

607.3 Materials

A. Precast Concrete Units.

Concrete units shall be precast concrete blocks with a 12 to 16 inch (300 to 400 mm) module and shall be 4 or 6 inches (100 or 150 mm) thick, as indicated on the Drawings. The concrete shall attain a minimum 28-day compressive strength of 4000 psi (27.5 megaPascals) in conformance to Class S of Standard Specification Item No. 403, "Concrete for Structures". Each precast concrete unit will weigh at least 30 pounds per cubic foot (480 kilograms per cubic meter) and the open void area will range from 20 to 25 percent.

The Filter/carrier fabric shall conform to Item No. 620, "Filter Fabric". The fabric shall be of sufficient strength to support not less than 1 1/2 times the weight (mass) of the mat when slung by lifting at both ends.

B. GeoGrid

GeoGrid shall consist of polypropylene base and shall be: 1) resistant to all natural occurring alkaline and acidic soil conditions, 2) resistant to attack by bacteria and fungi, and 3) ultraviolet stable. The plastic grid shall have a thermal stability range from -60° F to 175° F (-50°C to 80°C) and a Melt Index of 0.2 grams/10 minutes.

Geogrid shall have a density between 75 to 106 pounds per cubic feet (1.2 to 1.7 megagrams per cubic meter) and thickness shall be 0.15 to 0.25 inch (4 to 6 mm). Tensile strength shall be 860 to 1230 pounds per square foot (41 to 59 mPa) across the roll.

C. Earth Reinforcement System

A patented earth reinforcement system shall consist of interlocking precast reinforced concrete units of the size, shape and texture indicated on the Drawings, placed on a concrete foundation. All precast concrete shall be Class S, with a minimum 28 day compressive strength of 4000 psi (27.5 mPa), cast-in-place concrete shall be Class A, conforming to Item No. 403, "Concrete for Structures". All joints shall be caulked and protected with a filter fabric as indicated on the Drawings. All reinforcing steel shall conform to Item No. 406, "Reinforcing Steel". All tie back and reinforcing mesh shall be in accordance with manufacturer's recommendations.

Filter fabric to conform to Item No. 620, "Filter Fabric.

D. Gabions and Revet Mattresses.

Gabions shall be assembled and placed as directed on the Drawings in accordance with Standard Specification Item No. 594, " Gabions and Revet Mattresses".

E. Additional Materials and Methods

In addition to those systems described above, the following items may be used in combinations or separately, as indicated on the Drawings:

Standard Specification Subject	Item No
Concrete for Structures	403
Concrete Structures	410
Riprap for Slope Protection	591
Concrete Retards	593
Sodding for Slope Stabilization	602
Seeding for Slope Stabilization	604
Salvaging and Placing Topsoil	601
Soil Retention Blanket	605
Filter Fabric	620
Dry Stack Wall (DS)	623
Rock Berm (RB)	639
Mortared Rock Wall (RW)	640

Additional Products not mentioned herein may be indicated on the Drawings.

607.4 Construction Methods

A. Precast Concrete Units

1. Subgrade Preparation.

The slope on which the units are to be placed shall be constructed according to lines and grades indicated on the Drawings. Fill materials shall be placed in lifts, which do not exceed 8 inch (200 mm) loose measure, and compacted to a minimum of 95 percent of maximum dry density as determined in accordance with TxDOT Test Method Tex-114-E or as approved by the Engineer or designated representative.

2. Placing the Units.

The precast concrete units shall be placed on a concrete foundation in accordance with the manufacturer's recommendations. Filter fabric will be required.

3. Backfill.

Backfill shall consist of fine granular material or topsoil as indicated on the Drawings or as approved by the Engineer or designated representative. Seeding or sodding, when required, shall be placed directly over topsoil and shall conform to Item No. 604, "Seeding for Erosion Control" and Item No. 602, "Sodding for Erosion Control".

B. GeoGrid

1. Subgrade Preparation.

The compacted slope on which the plastic grids are to be placed shall be constructed according to the lines and grades indicated on the Drawings. Prior to placement the grid, pieces of wood, rock, concrete, brick or other objects that might damage the plastic grid shall be removed.

2. Placement of the Geo Grid.

The grid shall be placed directly on the ground surface. Adjacent and adjoining rolls shall be overlapped and tied in accordance with manufacturer's recommendations by a minimum of 1 and 6 feet (0.3 to 1.8 meters) respectively. The grid shall be installed and anchored in accordance with manufacturer's recommendations and details indicated on the Drawings.

Any damage to the fabric as a result of Contractor's vehicles, equipment or operations shall be repaired at Contractor's own expense.

The amount of grid placed shall be limited to that which can be covered with backfill within the succeeding 72 hours.

3. Backfill.

A minimum thickness of 4 inches (100 mm) of fine granular material shall be placed directly over the plastic grid and compacted to a minimum of 95 percent of the maximum dry density as determined in accordance with

TxDOT Test Method Tex-114-E. Seeding or sodding shall be placed on areas backfilled as indicated on the Drawings and shall conform to Item No. 604, "Seeding for Erosion Control" or Item No. 602, "Sodding for Erosion Control".

C. Earth Reinforcement System

1. Excavation.

Excavation shall conform to applicable requirements of Standard Specification Item No. 111, "Excavation" and Standard Specification Item No. 401, "Structural Excavation and Backfill" in accordance with limits and construction stages indicated on the Drawings. Any foundation soils found to be unsuitable shall be removed and replaced with acceptable backfill material.

2. Foundation.

The foundation subbase for the structure, approved by the Engineer or designated representative, shall be graded and then compacted to 95 percent of the maximum dry density as determined in accordance with TxDOT Test Method Tex-114-E. The leveling pad shall be constructed of Class A concrete conforming to Standard Specification Item No. 403, "Concrete for Structures", along the lines and grades indicated on the Drawings.

3. Wall Erection.

The wall modules, joint filler and leveling pads shall be placed as indicated on the Drawings in accordance with the manufacturer's recommendations. Special care shall be taken in setting the bottom course of units to true line and grade.

All modular units above the first course level shall interlock with lower courses. Vertical joints shall be staggered with each successive course. The vertical joints on the front face of the wall shall not exceed 3/4 inch (19 mm) tolerance. Joint filler shall be installed in all joints and filter fabric shall be installed behind the wall as indicated on the Drawings. The overall vertical tolerance of wall plumbness (from top to bottom) shall not exceed 1/2 inch per 10 feet (4 mm per meter) from the dimensions indicated on the Drawings.

4. Drainage. Drainage shall conform to Standard Specification Item No. 551, "Pipe Underdrains" and to the details indicated on the Drawings.

5. Backfill.

The placement of the backfill shall follow closely behind the erection of each lift of panels. The maximum lift thickness shall not exceed 8 inches (200 mm), loose measure. At each reinforcing mesh level, the backfill shall be roughly leveled before placing and attaching mesh. Reinforcing mesh or straps shall be placed normal to the face of the wall. Backfill compaction shall be accomplished without disturbance or distortion of

reinforcing mesh, filter fabric and face panels. All backfill shall be compacted to 95 percent maximum dry density as determined in accordance with TxDOT Test Method Tex-114-E. The Contractor shall decrease the lift thickness, if necessary, to obtain the specified density. During backfill compaction the moisture content may not exceed a value 2 percent greater than maximum dry density (i.e. optimum as determined by TxDOT Test Method Tex-114-E).

Compaction of the backfill shall not be accomplished by sheep foot, grid rollers or any other type of equipment employing a foot, which in the opinion of the Engineer or designated representative could damage the reinforcing mesh. At the end of each day's operation, the Contractor shall shape the backfill to drain away from the face of the wall.

All backfill material used adjacent to the structure shall be crushed stone, that is free from organic or otherwise deleterious materials, and the grading of the backfill material established in accordance with TxDOT Test Method Tex-110-E shall conform to the following gradation limits:

Sieve Size		
US	SI	Percent Passing
6 inches	150 mm	100
3 inches	75 mm	75 -100
No. 200	75µm	0-15

607.5 Measurement

Work and accepted material for "Slope Stabilization" will be measured by the square yard (square meter: 1 square meter is equal to 1.196 square yards), complete in place from the top of the foundation to the top of the slope stabilization erosion control. Foundations will not be measured for payment.

607.6 Payment

Work performed and materials furnished as prescribed by this Specification Item and measured under "Measurement" will be paid for at unit bid price per square yard for "Slope Stabilization for Erosion Control". The unit bid price shall include full compensation for: a) all excavation, foundation installation, subgrade preparation, placement of filter fabric, underdrains, precast blocks and tie backs, and b) all labor, tools, equipment and incidentals necessary to complete the backfilling operations.

Payment will be made under:

Precast Concrete Unit	Per Square Yard.	
GeoGrid, _____	Per Square Yard.	
Earth Reinforcement System	Per Square Yard.	End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification 607, "SLOPE STABILIZATION APPLICATIONS FOR EROSION CONTROL"

City of Round Rock Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 111	Excavation
Item No. 401	Structural Excavation and Backfill
Item No. 403	Concrete for Structures
Item No. 406	Reinforcing Steel
Item No. 410	Concrete Structures
Item No. 551	Pipe Underdrains
Item No. 591	Riprap for Slope Protection
Item No. 593	Concrete Retards
Item No. 594	Gabions and Revet Mattresses
Item No. 601	Salvaging and Placing Topsoil
Item No. 602	Sodding for Erosion Control
Item No. 604	Seeding for Erosion Control
Item No. 605	Soil Retention Blanket
Item No. 620	Filter Fabric
Item No. 623	Dry Stack Wall (DS)
Item No. 639	Rock Berm (RB)
Item No. 640	Mortared Rock Wall (RW)

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Item No. 110-E	Surveying and Sampling Soils for Highways
Item No. 114-E	Laboratory Compaction Characteristics & Moisture-Density Relationship of Subgrade & Embankment Soil

TxDOT/TTI Hydraulics and Erosion Control Laboratory

<u>Designation</u>	<u>Description</u>
<u>Annual Report</u>	<u>Approved Products List</u>

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 607, "SLOPE STABILIZATION APPLICATIONS FOR EROSION CONTROL"

City of Round Rock Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 120	Channel Excavation
Item No. 132	Embankment
Item No. 606	Fertilizer
Item No. 608	Planting
Item No. 610	Preservation of Trees and Other Vegetation

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 607, "SLOPE STABILIZATION APPLICATIONS FOR EROSION CONTROL"

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 160	Furnishing and Placing Topsoil
Item No. 162	Sodding for Erosion Control
Item No. 164	Seeding for Erosion Control
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

ITEM NO. 608

PLANTING

608.1 Description

This item shall govern the provision of the specified plants and other materials, the initial installation of plants and other materials, the maintenance of plantings, transplanting and any replacement of trees, plants and ground cover which are damaged, diseased or otherwise unhealthy during the warranty period 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, the inch-pound units are given preference followed by SI units shown within parentheses.

608.2 Submittals

The submittal requirements for this specification item shall include:

- A. A listing of each type of planting (tree, shrubs, plants, etc.), type of stock (containerized, ball and burlapped, bare root, bag grown, etc.), name (common and botanical) and size of planting (root diameter, height and spread);
- B. A request, if necessary, for use by Contractor of collected stock on the site;
- C. Specific information for each pesticide (including herbicide) associated with the listing including:
 - manufacturer,
 - product name,
 - description of chemical composition,
 - handling, storage and mixing requirements
 - application recommendations
 - documentation of licensed applicator(s), and
 - MSDS Sheets
- D. Type, chemical analysis and rate of application of fertilizer
- E. Proposed tree dressing, trunk wrapping and flagging tape;
- F. Type, chemical analysis and rate of application of proposed transpirants
- G. Documentation of irrigator license, if irrigation is required at the site.

608.3 General

- A. Plant Standards

Unless shown otherwise on the Drawings, the following published standards will apply. Standards for nursery stock will be as stated in the "American Standard for Nursery Stock", as published by the American Association of Nurserymen, Incorporated. Botanical names as shown on the Drawings will be as stated in the "Standardized Plant Names" as identified by the American Joint Committee on Horticultural Nomenclature or other referenced text including the "Manual of the

Vascula Plants of Texas for Native Flora". Pruning standards will be as established by the National Arborist Association in the "Pruning Standards for Shade Trees".

B. License Requirements

1. Pesticide.

The Contractor shall be a licensed pesticide applicator or shall employ a licensed pesticide applicator for the treatment of insects, diseases, and animals as required by the Texas Pesticide Laws and Regulations of the Texas Department of Agriculture. The Engineer or designated representative may require documentation of such certification as necessary for his record.

2. Herbicide.

The Contractor shall possess a permit or employ a person who possesses a permit to apply herbicide as required by the Texas Herbicide Law of the Texas Department of Agriculture. The Engineer or designated representative may require documentation of such certification as necessary for his records.

3. Irrigation.

The Contractor shall possess an irrigator's license issued by the State of Texas and the Texas Board of Irrigators or employ such a licensed irrigator to perform the irrigation system maintenance. The irrigation system shall be maintained under the supervision of the licensed irrigator who shall be available on the site as required by the Engineer or designated representative.

The Engineer may require documentation of such license for his records. The Contractor shall verify and adhere to the requirements and codes of any controlling utility authorities.

608.4 Materials

A. Plant Material

Plant material shall be first class grade, true to name and of the size indicated on the Drawings. All plants shall be healthy nursery grown unless otherwise indicated on the Drawings. When the Engineer or designated representative is furnished sufficient evidence that a specified plant cannot practically be obtained, the Engineer or designated representative may approve in writing the use of collected native material.

Nursery grown stock, either in containers or in the field, shall be nursery grown in accordance with accepted horticultural practices and under climatic conditions similar to those of the work site for at least twelve (12) months, unless specifically authorized otherwise by the Engineer or designated representative.

1. Container plants.

Soil volume for containers shall be three-fourths (3/4) the depth of the container or greater and contain roots of the plants throughout the root ball.

(a) Containerized Stock.

This stock will be defined as nursery plant stock transplanted from a growing site with a ball of soil, containing an intact root system, and placed in a container and grown in that container continuously long enough for the new fibrous roots to have developed so that the root mass retains its shape and holds together after removal from the container. Containerized stock shall have been grown in the delivered containers for at least six (6) months, but not over two (2) years.

(b) Container Grown Stock.

This stock will be defined as nursery plant stock, which has been planted in a container as a liner, seed or by other propagation method, and that:

- (1) has been systematically replanted or stepped up in larger containers as required,
- (2) has developed a root system in a planting medium capable of sustaining acceptable plant growth, and
- (3) has become established in the container and exhibits a well-rooted condition as evidenced by the soil ball remaining intact when removed from its container.

2. Balled and Burlapped Stock.

This stock will be defined as nursery plant stock which has been removed from the growing site with a ball of soil, containing the intact root system, and encased in burlap (or other approved similar material) to hold the soil in place. Ball sizes for balled and burlapped stock shall be as shown on the Drawings.

3. Bare Root Stock.

This stock will be defined as nursery plant stock, which has been removed from the growing site with the root system substantially free of soil. The approved minimum root spread and condition shall be as shown on the Drawings.

4. Collected Stock.

This stock will be defined as nursery plant stock, which has been removed from its original native habitat. All collected stock shall have specific approval of the Engineer or designated representative before it can be removed from its existing habitat. Ball sizes for collected stock shall be as

shown on the Drawings and shall have sufficient diameter and depth to encompass enough fibrous and feeding root system as necessary for the full recovery of the plant. Collection may be by hand or mechanical method. For balled and burlapped or mechanical transplanting of collected plant material refer to article 608.5.

5. Bag Grown Stock.

This stock will be defined as nursery plant stock which has been transplanted into a nonwoven fabric container which has been placed in the ground and the plant grown under nursery field conditions continuously long enough [normally one (1) month for each inch (25 mm) of bag diameter i.e., a plant with a 24 inch (600 mm) diameter bag, grown in its original planted location for 24 months] for the fibrous roots to have developed so that the root mass retains its shape and holds together after removal of the bag. The root ball shall be flat bottomed and straight sided. Ball sizes for bag grown stock shall be as shown on the Drawings. Bag grown stock shall not be pruned before delivery.

6. Other Plant Materials.

Other plant materials shall be as shown on the Drawings.

B. Rejection of Plants.

Plant material having any of the following features will be subject to rejection:

1. Undue or excessive abrasions of the bark.
2. Dried or damaged root system.
3. Dried or damaged top wood of deciduous plants or dried or damaged foliage and top woods of evergreens.
4. Prematurely opened or damaged buds or buds stripped off.
5. Disease or insect infestation, including eggs or larvae.
6. Dry, loose, cracked, broken and/or undersized balls or containers, which do not conform to sizes indicated on the Drawings.
7. Evidence of heating, molding, wind burn, sunscald, freezing, etc.
8. Container plants that are overgrown or root bound.
9. Plants with bench balls (roots repacked with soil).
10. Plant balls encased in non-bio-degradeable plastic or other impervious material.
11. Field grown or collected plants transplanted into containers less than six (6) months or more than two (2) years.
12. Trees that have been damaged, pruned, crooked or multiple leaders, unless multiple leaders are specified or are normal for the species.
13. Plants with disfiguring knots or fresh cuts of limbs over 3/4 inch (20 mm) that have not completely callused.
14. Plants that do not possess a normal balance between height and spread for the species.
15. Plant containers that are not structurally sound (tracked, bent, etc.).
16. Plants in containers less than three-fourths (3/4) planting medium depth;

17. Any endangered or threatened plants; or plants of historical significance that have been collected;]
18. Any other physical damage or adverse conditions that would prevent thriving growth or cause an unacceptable appearance; or
19. Plants that do not meet the standards shown on the Drawings.

C. Delivery And Receipt of Plants

Material shall not be delivered to the project until ordered to do so in writing by the Engineer or designated representative. When the delivery order is issued, the Engineer or designated representative shall be notified of a proposed delivery of plant material at least 48 hours prior to its arrival at the project. The entire plant shall be properly protected from sun and air damage during the time period from initiation of digging until delivery on the project

Each plant material shipment shall be accompanied by an invoice indicating the number, size and name (common and botanical) of each of the kinds of plant material included in the shipment. Each kind of plant in the shipment shall be adequately identified by tags. All plants shall be individually tagged with nursery name tags designating the genus, species and variety of the plant.

No shipment of plant material shall be accepted, planted and/or heeled-in by the Contractor until such material has been inspected and accepted by the Engineer or designated representative. The Contractor shall assist the Engineer or designated representative in the inspection of material. Any plants rejected shall be immediately removed from the project and replaced.

Unless plants are placed in predug holes and planted as specified herein, they shall be heeled-in and inspected again prior to planting. If delivered to predug planting holes, balled and burlapped plants shall be planted within 1 to 6 hours depending upon the drying effect of the wind and sun. No bare rooted plants shall be placed in predug holes from the delivery truck unless actual planting occurs immediately after removal from its moist packing.

D. Plant Size

Plants will be measured when branches are in their normal position. Height and spread dimensions shown on the Drawings refer to the main body of the plant and not branch tip to tip. Plants with a spreading or semi-spreading habit will be measured by the average diameter of the spread. Plant heights will be measured by the mean height from the ground line to the top of the canopy. Caliper measurements will be taken at a point on the trunk six (6) inches [150 mm] above natural ground for trees up to four (4) inches [100 mm] in caliper and at a point twelve (12) inches [300 mm] above natural ground for trees over four (4) inches [100 mm] in caliper. The caliper size for multi-trunked plants will be determined by adding the calipers of the largest cane and one-half (1/2) the caliper(s) of the second and third largest cane(s).

When a range of size is shown on the Drawings, no plant shall be less than the minimum size and at least 40% of the plants shall be as large as the maximum size shown on the Drawings. The required measurements are the minimum

sizes acceptable and are the measurements after pruning, when pruning is required.

Sizes of plants or plant types such as palms, roses, vines, groundcovers, seedlings, bulbs, corms, tubers, young plants, understock, etc., will be measured in accordance with the plant standards or as indicated on the Drawings.

Container-grown plants which are well established in adequate size containers and are of equal quality and size to the specified balled plants may be accepted in lieu of balled plants; likewise, balled plants of equal quality and size may be substituted for container-grown plants when permitted by the Engineer or designated representative. Soil shall be approximately 3/4 depth of container and contain roots of the plant throughout the soil.

The ball size for a balled and burlapped plant shall be firm natural balls equal to or in excess of the ball sizes indicated on the Drawings. Collected plant material substituted for a nursery-grown plant shall have a ball or root system 1/4 greater in both diameter and depth than the nursery-grown plant for which it is substituted. The ball size shall be the average of the diameters measured 90 degrees apart.

E. Mulch

Unless indicated otherwise on the Drawings, mulch material shall consist of loose organic residue derived from plants or other granular material approved by the Engineer or designated representative. It shall be of such nature that adequate protection is provided against sun baking and quick drying out of the soil and shall not impede aeration or water penetration nor deplete the soil nitrogen. Mulch material shall be free of excess amounts of large leaves and sticks that would prevent proper dressing of the mulched surface, free of harmful substances and free of detrimental amounts of soil or other foreign matter that would promote early compaction, matting or deterioration of the mulch.

F. Peat Moss

Peat Moss shall be of sphagnum origin of commercial quality.

G. Planting Soil Mixture

The planting soil mixture shall consist of a soil mixture of 3/4 fine sandy loam, 1/8 peat moss and 1/8 leaf mold. The sandy loam shall be taken from a well drained, arable site. It shall be free of subsoil, stones, clay, roots, weeds, grass or other objectionable debris, matter or toxic wastes.

H. Water

Water shall be furnished by the Contractor and shall be clean and free of industrial wastes and other substances harmful to the growth of plants and the areas irrigated.

I. Fertilizer

Fertilizer shall be applied uniformly conforming to City of Round Rock Standard Specification tem No. 606, "Fertilizer" at the rate indicated.

J. Pesticides including Herbicides

Pesticides including herbicides shall be of the types that are commercially available selected for the species planted or as indicated on the Drawings and shall be applied in accordance with the manufacturer's recommendations upon approval of the Engineer or designated representative.

K. Stakes and Guys

Stakes shall be 2 x 2 x 18 inch (50 x 50 x 450 mm) sound hardwood or treated pine with tapered point and chamfered tops. Guys wires shall be 2 strand 12 ga. (2.7 mm) galvanized steel wire with 1/2 inch (12.5 mm) diameter reinforced plastic or rubber hose trunk bushings and yellow plastic flagging.

L. Bracing

Bracing shall be 2 x 4 inch (50x100 mm) hardwood or metal fence posts, 6 ft. (1.8 meters) in length with guys and bushings.

M. Flagging Tape

Flagging tape shall be highly reflective, visible at night, and approved by the Engineer or designated representative.

N. Trunk Wrapping

Trunk wrapping shall be 4 inch (100 mm) wide commercial trees wrapping paper with asphalt core or the type shown on the Drawings.

O. Anti-transpirants

Anti-transpirants, intended to prevent evaporation, shall be of the types that are commercially available and approved by the Engineer or designated representative.

608.5 Construction Methods

Immediately following delivery and acceptance at the job, all plants shall be planted or heeled-in in properly moistened material. All plants heeled-in shall be properly maintained by the Contractor until planted. The utmost care shall be exercised in handling plants to prevent injuries to the plants. The solidity of the ball or balled and burlapped plants shall be carefully preserved and such plants shall not be handled by the stems.

Plants with exposed roots shall be protected from drying out during the time the plants are removed from the heeling-in bed and until actually planted.

A. Staking of Planting Locations.

All locations of trees, shrubs and beds shall be staked in the field by the Contractor. All locations will be approved by the Engineer or designated representative prior to any excavation of plant beds or bed preparation. Stakes shall be placed and coded to denote the type of plant material.

B. Excavation of Planting Pits

1. General.

The Contractor shall not excavate plant pits more than 24 hours in advance of planting operations. Any plant pits left unattended for any length of time which may present a hazard shall be covered and/or clearly flagged as approved by the Engineer or designated representative. The walls and bottoms of all plant pits shall be scarified immediately prior to the placement of plants.

2. Pit Sizes.

Planting holes may be dug by hand or by mechanical means and shall be circular or square (according to the shape of the root ball) with vertical sides, unless otherwise indicated on the Drawings. Trimming of the sides or bottom of the hole to uniform shape will not be required. Planting pit sizes shall be as follows, unless indicated otherwise on the Drawings:

- (a) A minimum horizontal dimension of twelve (12) inches [300 mm] between the root ball and the sides of the planting pit for the following plant specifications:
 - (1) Containers of fifteen (15) gallons or larger [56 liters or larger],
 - (2) Boxes of fourteen (14) inches or larger [350 mm or larger] and
 - (3) Root ball diameter of Balled and burlapped or bag grown plants larger than fourteen (14) inches [350 mm].
- (b) A minimum horizontal dimension of two (2) times the diameter of the root ball for the following plant specifications:
 - (1) Containers less than fifteen (15) gallons [less than 56 liters]
 - (2) Root ball diameter of Balled and burlapped or bag grown plants fourteen (14) inches or less [350 mm or less]
- (c) A minimum diameter for bare-root plants to permit the roots to spread without crowding or curving around the walls of the pit.
- (d) Planting pits shall be excavated to a depth of at least 4 inches (100 mm) but not more than 8 inches (200 mm) greater than the depth of the root ball of balled and burlapped, containerized, container grown or bag grown plants; or the depth of the root system of bare-root plants. Pits dug to excess depths shall be backfilled and compacted to bring the pits to the specified depth. The depth of pits on slopes shall be measured at the lower side.

- (e) When performing mechanical transplanting, the receiving plant pit shall be excavated with the same type of equipment used to remove the plant material or as approved by the Engineer or designated representative.
- (f) Special sized holes shall be shown on Drawings.
- (g) Where holes are dug with an augur and the sides of the holes become plastered or glazed, this plastered or glazed surface shall be scarified.

C. Planting Season

All planting shall be performed as shown below, indicated on the Drawings or as approved by the Engineer or designated representative.

Planting Stock	Planting dates
Containerized or Container grown	None specified
Balled and burlapped	November 15 to March 15
Bare root	January 15 to March 15
Bag grown	September 15 to April 15
Collected	As shown on the Drawings or as approved by the Engineer or designated representative

D. Backfilling

Topsoil from the planting hole may be used for backfilling provided it is kept separate from subsoil and rendered loose and friable. Additional topsoil required to backfill the holes shall be furnished in the amount directed in Subarticle 608S.4.G, 'Planting Soil Mixture' and from a source approved by the Engineer or designated representative.

E. Pruning Roots

Root pruning shall be limited to the amount necessary to prune away broken and badly damaged roots.

F. Pruning of Tops

Pruning of plants shall conform to the best horticultural practice and shall be appropriate to the various types of plants and the special requirements of each. Deciduous (non-evergreen) shrubs and trees with heavy tops shall have about 1/3 to 1/2 of the top growth removed. Plants otherwise acceptable, but with broken or badly bruised branches, shall have such branches removed with a clean cut. All cut surfaces over 1 inch (25 mm) in diameter shall be painted with an approved tree pruning compound.

G. Planting and Backfilling

In general the top of root ball shall stand after settlement of the backfill approximately level with the finish grade. When shown on the Drawings, fertilizer of the type and quantity specified shall be added on the backfill material prior to backfilling. Unless indicated otherwise on the Drawings or approved otherwise by the Engineer or designated representative, planting and backfilling shall be as follows:

1. Plant Basin

A basin, 8 to 10 inches (200 to 250 mm) deep, shall be formed by constructing a neat levee around the planting pit. The inside measurement of the basin shall be at least the diameter of the growing plant, unless noted otherwise on the Drawings. On slopes the backfill on the lower side shall be graded in such a manner that an adequate basin will be provided.

As shown on the Drawings, either material excavated from the planting pit (excluding any rocks) or Backfill, as specified in Subarticle 608.5.D may be used to form a basin around the plant. Excess excavated material may be scattered thinly and leveled off provided it is of such consistency and character that it can be readily scattered in an acceptable manner. If scattering of the material may interfere with drainage or mowing, all such material shall be removed and disposed of properly.

2. Depth of Transplanting

In general, plants shall be installed and covered with top soil approximately one (1) inch (25 mm) above the top of the root ball or container soil surface.

3. Bare Root Plants

After the backfill in the bottom of the planting pit has been firmed and the plant placed in the proper position, as shown on the Drawings, loose friable backfill (Subarticle 608.5.D) or planting soil mixture (608.4.G) shall be worked about the roots and thoroughly settled with water as the backfill is made. Care shall be taken to avoid bruising or breaking the roots. Sticks, sod, clods or other material which may form large air pockets in the soil or backfill shall not be included in the backfill.

4. Balled and Burlapped Plants

Plants of this type shall not be handled by the stems nor in such manner that the soil of the ball may be loosened. A saddle around the ball should be used for lifting. The burlap shall not be removed from the ball. After the backfill in the bottom of the pit has been firmed and the plant placed in the proper position, as shown on the Drawings, loose friable backfill shall be worked about the ball in 12 inch (300 mm) lifts until the pit is two-thirds ($\frac{2}{3}$ full). The burlap shall then be opened on top of the root ball to expose the top one-third ($\frac{1}{3}$) of the root ball. The pit shall then be filled

with water and the backfilling completed, working the backfill and water well to prevent any air pockets.

For ball supporting devices such as wire baskets, the basket shall not be removed. The plant shall be placed in the prepared planting pit in the proper position and backfill shall be placed around the ball until the pit is about one-third (1/3) full. The basket shall be carefully removed to just above the backfill, leaving the bottom portion intact. Backfilling shall be completed as described above.

5. Containerized or Container Grown Plants

At the time of planting the root ball and plant shall be carefully removed from the container to prevent damage to the plant and root ball. If in the opinion of the Engineer or designated representative a sufficient amount of soil has fallen off or the ball has been broken to such an extent as to reduce the chances of the plant to grow, the plant will be rejected. Container plants shall be acclimated to outside growing conditions. Container plants shall be placed and backfilled in the same manner as balled and burlapped plants.

6. Bag Grown Plants

Prior to planting, the fabric bag shall be removed by using a knife to cut the side of the bag from top to bottom in three or four places of equidistant around the root ball. The bag shall be carefully peeled down and roots that do not easily peel away from the bag shall be pruned. The plastic bag shall then be pulled from under the root ball. Bag grown plants shall be placed and backfilled in the same manner as balled and burlapped plants.

H. Vegetative Watering

During the planting operations, the Contractor shall keep the ground and backfill material moist to at least 12 inches (300 mm) around the root ball. The Contractor shall be required to meet the minimum watering requirements shown on the Drawings for all circumstances by a method approved by the Engineer or designated representative. When an irrigation system is shown on the Drawings, the Contractor shall coordinate his work to insure that the irrigation system is operational as the plants are installed.

I. Anti-transpirants

When shown on the Drawings, the Contractor shall apply anti-transpirants in accordance with the manufacturer's recommendations and as approved by the Engineer or designated representative.

J. Pruning

Plants shall not be pruned immediately before delivery to the work site, unless shown otherwise on the Drawings or as approved by the Engineer or designated representative. Common nursery pruning practices are acceptable. Any necessary pruning shall be done at the time of planting as approved by the Engineer or designated representative and shall be appropriate to the various types of plants and the special requirements of each.

From 20 to 40 percent of all foliage of mechanically transplanted plants shall be removed by pruning interior branching, entangled limbs and small branches. Structural branching shall not be removed prior to planting. Branch tips shall not be removed to attain the above percentage.

K. Plant Supports and Bracing Trees

Plant supports such as staking, guying and bracing shall be as shown on the Drawings or as required by the Engineer or designated representative.

Trees shall be staked, guyed or braced for support during the same day as planted. Unless shown otherwise on the Drawings, the plants shall stand approximately vertical after staking, guying or bracing. The Contractor shall be responsible for material remaining approximately vertical and straight for all given conditions and shall repair plant supports as often as required until final acceptance of the work.

All trees 1 1/4 inches (38 mm) and greater in caliper shall be adequately braced immediately after the plants have settled. Unless otherwise indicated on the Drawings, trees 1 1/4 to 2 inches (38 to 50 mm) in diameter shall be braced with 1 brace of sawed lumber, 2 x 2 inches (50 x 50 mm), nominal size, firmly fastened to the tree at a point 5 to 6 feet (1.5 to 1.8 meters) above ground or as directed by the Engineer or designated representative. Fastening shall not be accomplished by nails, staples, wire or other materials that may damage tree. Braces shall be of sufficient length to provide bracing when firmly driven into the ground. The tree trunk shall be adequately padded with a section of flexible hose at the point of attachment with a figure 8 tie. Trees, that are 2 inches to 4 inches (50 to 100 mm) in diameter, shall be braced with wires at a height of 6 to 8 feet (1.8 to 2.4 meters) above ground. The wires shall be firmly attached to 3 equally spaced concentric stakes that are firmly driven into the ground. The trunk of the tree shall be adequately and securely padded with rubber at the point of attachment of the wire to prevent damage. Wire shall be number 16 gauge (1.5 mm) galvanized.

Trees larger than 4 inches (100 mm) in diameter shall be braced in accordance with notes on Drawings. The Contractor shall repair braces as often as required until acceptance of the project for "Plant Establishment".

L. Safety Flagging Tape

Staking, guying or bracing, which present a hazard shall be clearly flagged as shown on the Drawings or directed by the Engineer or designated representative.

M. Tree Trunk Protection

All trees indicated on the Drawings to be wrapped shall be neatly and securely wrapped with a commercial tree wrapping material approved by the Engineer or designated representative. The tree wrapping shall begin at the base of the trunk and extend upward with a 50 percent overlap to the second whorl of branches. The tree wrapping material shall be secured at the top of wrap with soft twine or weatherproof type tape or any suitable method, approved by the Engineer or designated representative. Wire, metal bands or other material for this purpose that may cause injury or damage to plants shall not be used.

N. Mulching

All plants shall receive mulching to a depth of 2 to 3 inches (50 to 75 mm) within the water basin or across the beds unless indicated otherwise on the Drawings. A small amount of backfill shall be sprinkled on top of organic mulch to hold it in place if directed by the Engineer or designated representative. If hay is used, the depth shall be 4 inches (100 mm) loose measurement.

O. Plant Material Removal and Replacement

A plant shall be removed and replaced as directed by the Engineer or designated representative at any time during execution of the work under this Item including the Establishment Period if, in the judgement of the Engineer or designated representative, a plant is found to be in any of the following conditions:

1. Dead;
2. Dying;
3. Wilted for 48 hours or more; or
4. Any other signs of detrimental consequence.

All replacement plants shall be the same species, size and quality as originally specified. The Contractor shall make every effort to ensure that the replacement material receives any additional care and maintenance required for the replacement plants to become well established. The Engineer will require replacement of plant material until satisfied that all of the plants on the work are in a healthy, vigorous condition.

P. Maintenance and Initial Plant Replacement

The Contractor shall water the plants as often as necessary, cut the weeds and grass around the planted area including the plant basin and bracing, prune the plants, treat the plants in accordance with approved methods of horticultural practice where insects or disease affect the plants after planting and repair or replace the bracing as may be required or as ordered by the Engineer or designated representative until the planting project has been accepted for "Plant Establishment".

If the Contractor completes the initial planting prior to March 1 for balled and burlapped and bare root plants or April 1 for bag grown plants, he will be required to replant all material found to be missing, damaged or dead during this time. This replanting shall be done between March 1 and March 15 for balled and

burlapped and bare root plants, between April 1 and April 15 for bag grown plants or as directed by the Engineer or designated representative.

In the event that the planting project is not completed by March 15 for balled and burlapped and bare root plants, or by April 15 for bag grown plants and no further planting is permitted until the following "Planting Season", the partial planting will be cared for as prescribed under "Plant Establishment".

608.6 Plant Establishment

"Plant Establishment" shall commence with the notice of substantial completion and shall extend to the following November 15 for those plantings that are completed in accordance with Subarticle 608.5.P, ' Maintenance and Initial Plant Replacement'. In those instances where planting 'out of season' is allowed in writing by the Engineer or designated representative, "Plant Establishment" shall commence with notice of substantial completion and shall extend for a minimum of six (6) months or to the following November 15, whichever results in a later date.

For the work of "Plant Establishment", all possible means shall be employed to preserve the plants in a healthy and vigorous growing condition to insure their successful establishment. The Contractor shall perform all of the activities listed below during placement of all the plants. After the completion of the installation, as shown on the Drawings and as approved by the Engineer or designated representative, the Contractor shall perform the following activities for a period of 90 calendar days:

A. Mulching, Plant Basin and Bed Maintenance

The Contractor shall reshape or reform the existing plant basins and beds as necessary to conform to the Drawings, and as approved by the Engineer or designated representative. As a part of the plant basin and bed maintenance, weeds and grass shall be removed prior to the application of mulch. Unless otherwise shown the Drawings, the mulch shall be maintained to a minimum depth of 2 to 3 inches (50 to 75 mm).

The Contractor shall maintain the plant basins, beds and site fixtures generally free of weeds and grass or other materials detrimental to the growth of the plants or the appearance of the site. Herbicides, if approved by the Engineer or designated representative and used by the Contractor, shall be limited to the plant basin and perimeter thereof or around site fixtures as approved by the Engineer or designated representative. Extreme care shall be taken to insure that the herbicide does not come into contact with any part of the desirable plants. Under no circumstances shall the herbicide be used on days where the wind could cause drift hazard to desirable plants. The Contractor shall also follow the manufacturer's instruction for the use and application of any herbicide.

B. Plant Irrigation

The Contractor shall be required to meet the minimum watering requirements for all circumstances by a method approved by the Engineer or designated representative as stated under Subarticle 608.5.H and/or as shown on the Drawings.

Watering equipment other than an existing irrigation system shall have adequate and accurate measuring devices as approved by the Engineer or designated representative.

C. Mowing and Trimming

The Contractor shall mow and trim the areas identified on the Drawings. The work shall be performed at the frequency as shown on the Drawings. The initial cycle shall begin when directed by the Engineer or designated representative. Mowing heights shall be as shown on the Drawings or approved by the Engineer or designated representative.

The Contractor shall use power equipment as approved by the Engineer or designated representative. Nylon cord trimmers shall not be used inside the plant basins or beds around plant material.

D. Restaking, Reguying and Rebracing of Plants.

Any damaged or destroyed stakes, guys or braces shall be replaced by the Contractor in accordance with the details shown on the Drawings. This shall include any adjustment to the staking or guying to prevent girdling of plants.

E. Pruning

When directed by the Engineer or designated representative or shown on the Drawings, plants shall be pruned by the Contractor to the satisfaction of the Engineer or designated representative. Dead or damaged limbs on trees and shrubs, including suckergrowth on trunks of trees, shall be removed. All pruning shall be accomplished with tools specifically designed for this purpose. All pruned material shall become the property of the Contractor and shall be disposed of properly.

F. Insect, Disease and Animal Control

The Contractor shall treat the plants and/or the planted areas in accordance with accepted methods of horticultural practices and the Texas Department of Agriculture guidelines regarding the use of pesticides. The Contractor shall also follow the manufacturer's instructions for the use and application of any pesticides.

G. Litter Pick-Up

Unless shown otherwise on the Drawings, the Contractor shall collect and dispose of all litter within the landscaped areas. The work shall be performed at the frequency shown on the Drawings or as directed by the Engineer or designated representative.

All litter shall become the property of the Contractor and shall be disposed of properly.

H. Fertilization

During the 90-day establishment period, the Contractor shall furnish and apply fertilizer only to those plants as shown on the Drawings. The analysis, times and

rates of application shall be as shown on the Drawings. The type of fertilizer and method of application shall be as shown on the Drawings or as approved by the Engineer or designated representative.

I. Plant Removal

In the judgement of the Engineer or designated representative, any plant that is dead or dying for reasons beyond the control of the Contractor and is not to be replaced shall be removed by the Contractor to the satisfaction of the Engineer or designated representative. This shall include repair of the plant pit and the surrounding area.

608.7 Acceptability of Plants

Between 90 to 100 days following the initial planting and initial plant replacement, the Engineer or designated representative will make an inspection of the project to determine the acceptability of the plant material. At this time, an inventory of missing, dead or rejected plant material will be made and the Contractor notified that the plants on the inventory are to be replanted the following planting season between November 15 and December 15 or as specifically permitted by the Engineer or designated representative.

Plant material for the replacement planting shall meet all the requirements specified for the original plant material and shall be planted in accordance with the planting instructions listed under "Construction Methods", except that no further plant replacement will be required. Working days stated in the Contract shall apply to the initial construction period only and will not include the time necessary for replanting. A final inspection shall be made within 10 days after the replacement planting is completed.

608.8 Measurement

Work and accepted material as prescribed for this item including "Plant Establishment" will be measured as each plant of the type and size complete and in place.

608.9 Payment

Work performed and accepted material as prescribed by this item, measured as provided under "Measurement", will be paid for at the unit bid price bid for each plant of the type and size specified, complete and in place. The unit bid price shall include full compensation for furnishing all labor, pruning, mowing, insect control, disease control, animal control, watering, fertilizing, herbiciding, litter pickup, maintenance, tools, equipment, materials, supplies and incidentals necessary to complete the work.

Payment will be made under:

Planting Type ____, Size in inches____ Per Each.

Irrigation System Lump Sum

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification 608, "PLANTING"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 606	Fertilizer

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification 608, "PLANTING"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 111	Excavation
Item No. 601	Salvaging and Placing Topsoil

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 160	Furnishing and Placing Topsoil
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 170	Irrigation System
Item No. 192	Roadside Planting and Establishment

ITEM NO. 609
NATIVE GRASSLANDS FOR EROSION CONTROL

609.1 Description

This item shall govern the preparation of a seeding and planting area to the lines and grades indicated on the Drawings. This may include seedbed preparation, sowing of seeds, planting of rooted plants, watering, hydromulch, compost and other management practices, as indicated in the Drawings 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, inch-pound units are given preference with SI units shown within parentheses.

609.2 Submittals

The submittal requirements for this specification item shall include:

- A. Identification of the species, source, mixture and rate of application of the seeding.
- B. Type of mulch or compost.
- C. Watering frequency and amount.
- D. Type of management practices.

609.3. Materials

- A. The seed furnished shall be of the previous season's crop and the date of analysis shown on each bag shall be within twelve months of the time of delivery to the project. Each variety of seed shall be furnished and delivered in separate bags or containers. A sample of each variety of seed shall be furnished for analysis and testing when directed by the Engineer or designated representative.

The amount of seed planted per 1000 square feet (93 square meters) shall be of the type specified in section 609.5.

- B. Water shall be clean and free of industrial wastes and other substances harmful to the growth of grass in the area irrigated.
- C. Top soil shall be a blend of 75% sterile silty clay loam and 25% (by volume) compost.
 - 1. The silty clay loam shall be from a native deposit in an area where all native composted topsoil has been removed. The loam shall have a plasticity index (PI) between 9 and 16.
 - 2. The compost shall be Dillo Dirt or an equal approved by the Engineer or designated representative. Dillo dirt is composted sewage sludge as manufactured by the City of Round Rock Water and Wastewater Department.

- D. A least toxic, integrated pest management (IPM) approach shall be used to control weeds. A written request for approval of weed control product(s) and/or materials shall be submitted to the City of Round Rock for approval.
- E. Rooted plants must be healthy and free of pests. The root system should be well established and in proportion to the top growth.

609.4 Construction Methods

- A. General.

The Contractor shall limit preparation to areas that will be immediately seeded. All noxious weeds shall be eliminated by application of a herbicide and/or by physical removal (by the roots) prior to and/or during the seeding operation. The following list of plants are considered noxious weeds:

Table 1: Weed List

Weed Type	Botanical Name	Common Name
Herb	Ambrosia spp.	Ragweed
Grass	Bothriochloa ischaemum	K.R. Bluestem
Grass	Bromus unioloides	Rescue Grass
Herb	Cenchrus spp.	Sandbur
Herb	Cnidoscolus texanus	Bull Nettle
Herb	Convolvulus spp.	Bindweed
Grass	Cynodon dactylon	Bermudagrass*
Herb	Cyperus esculentus	Yellow Nutsedge (Nut-grass)
Herb	Cyperus rotundus	Purple Nutsedge (Nut-grass)
Grass	Digitaria spp.	Crab Grass
Herb	Medicago sp.	Bur-Clover
Grass	Paspalum dilatatum	Dallis Grass
Grass	Sorghum halapense	Johnson Grass
Herb	Torilis arvensis	Beggar's-tick
Vine	Toxicodendron radicans	Poison Ivy
Herb	Urtica spp.	Stinging Nettle

B. Seed Bed Preparation.

After the designated areas have been rough graded, a suitable seedbed shall be prepared. In areas where cut or fill is required, a minimum of 6 inches (150 mm) of topsoil (see Section 609.3.C) shall be placed or existing soil (that is not infested with weeds or weed rootstock) stockpiled over the entire planting area.

In areas with no soil disturbance, the weeds shall be eliminated and a minimum of 2 inches (50 mm) of topsoil, if none currently exists, shall be placed. An even seedbed shall be prepared with limited irregularities, lumps or soil clods and the surface shall be raked to facilitate seed to soil contact.

C. Watering.

All watering shall comply with City of Round Rock ordinances. Seeded areas shall immediately be watered with a minimum of 5 gallons of water per square yard (22.5 liters of water per square meter) or as needed and in the manner and quantity as directed by the Engineer or designated representative.

Watering applications shall insure that the seedbed is maintained in a moist condition favorable for the growth of grass. Watering shall continue until minimum coverage is achieved and accepted by the Engineer or designated representative. Watering may be postponed immediately after a 1/2 inch (12.5 mm) or greater rainfall on the site but shall be resumed before the soil dries out.

609.5 Native Grassland Seeding and Planting

All areas require both seed and rooted plants. Seeding and planting shall be performed in accordance with the requirements hereinafter described. The optimum depth for seeding shall be from 1/16 inch (1 1/2 millimeters) to 1/8 inch (3 millimeters). Seed shall be applied by a method that achieves consistent distribution and proper seed to soil contact (i.e. hand broadcasting, hydromulch, or drill method). Mulching is not required.

Species substitution, when necessary due to availability, shall be approved by the Engineer or designated representative. Only native species adapted for the designated environmental conditions shall be allowed as substitutes. Shorter growing natives such as Buffalograss should be sodded around manholes or other structures requiring higher visibility for access.

If the native grassland is being installed during the cool season (November 1 to February 15), the cool season cover crop species (as listed) shall be included in the mix.

The seed and rooted plant mixtures shall be applied in accordance with appropriate 'growing environments' (Upland Full Sun–Table 2, Upland Shade-Dappled-Table 3 and Facultative Moderate to High Moisture–Table 4).

Table 2. Upland Species, Full Sun Areas

Common Name	Comments	Botanical Name	Seed application rate lbs/1000 sq. ft. (kg/100 sq. m.)	Rooted Plants Size & Spacing
Buffalo Grass	grass	Buchloe dactyloides	0.3 (0.15)	1 - 16" x 24" piece of sod @ 10 FT. (3m) ctrs.
Blue Grama	grass	Bouteloua gracilis	0.2 (0.1)	Not required
Green Srrangletop	grass	Leptochloa dubia	0.4 (0.2)	
Indian Grass	grass	Sorghastrum nutans	0.2 (0.1)	1 gal @ 10 ft. (3m) ctrs.
Little Bluestem	grass	Schizachyrium scoparium	0.2 (0.1)	
Prairie Wild Rye	grass	Elymus canadensis	0.2 (0.1)	Not required
Purple Threeawn	grass	Aristida purpurea	0.2 (0.1)	
Sideoats Grama	grass	Bouteloua curtipendula	0.3 (0.15)	
Bluebonnet	wildflower	Lupinus texensis	0.4 (0.2)	Not required
Clover (Purple Prairie)	wildflower	Petalostemum purpurea	0.1 (0.05)	Not required
Coreopsis (Plains)	wildflower	Coreopsis tinctoria	0.05 (0.025)	Not required
Goldenrod	wildflower	Solidago altissima	0.02 (0.01)	Not required
Greenthread	wildflower	Thelesperma filifolium	0.075 (0.037)	Not required
Indian Blanket	wildflower	Gaillardia pulchella	0.15 (0.075)	Not required
Lemon Mint	wildflower	Monarda citriodora	0.06 (0.03)	Not required

Table 2. Upland Species, Full Sun Areas - continued

Mexican Hat	wildflower	Ratibida columnaris	0.05 (0.025)	Not required
Pink Evening Primrose	wildflower	Oenothera speciosa	0.02 (0.01)	Not required
Sunflower (Common)	wildflower	Helianthus annuus	0.075 (0.037)	Not required
Cereal rye grain*	cool season cover crop	Elymus	0.5 (0.25)	Not required
Oats*	cool season cover crop	Avena sativa	0.2 (0.10)	Not required
Wheat*	cool season cover crop	Triticum aestivum	0.3 (0.15)	Not required
TOTAL**			Winter: 4.0 (2.0) Summer 3.0 (1.5)	Rooted species mixed equally @ 10 ft. (3 m) ctrs.

* Plant only between Oct. 1 and Jan. 31. Non-persistent winter cover crop for erosion control.

** Any unavailable species can be substituted with the same quantity of another species from this list or another species approved by the Engineer or designated representative.

Table 3. Upland Species, Shade-Dappled Light Areas

Common Name	Comments	Botanical Name	Seed Application Rate lbs/1000 sq. ft. (kg/100 sq. m.)	Rooted Plants Size & Spacing
Meadow Sedge*	sedge	Carex perdentata	No seed required	1 gal. @ 10 ft (3m) ctrs.
Inland Seaoats**	grass	Chasmanthium latifolium	0.5 (0.25)	
Prairie Wild Rye	grass	Elymus canadensis	0.75 (0.37)	Not required
Sideoats Grama	grass	Bouteloua curtipendula	0.75 (0.37)	1 gal. @ 10 ft. (3m) ctrs.

Table 3. Upland Species, Shade-Dappled Light Areas - continued

Purple Coneflower	wildflower	Echinacea purpurea	0.1 (0.05)	Not required
Coreopsis (Lanceleaf)	wildflower	Coreopsis lanceolata	0.1 (0.05)	Not required
Sage (Scarlet)	wildflower	Salvia coccinea	0.1 (0.05)	Not required
Drummond Phlox	wildflower	Phlox Drummondii	0.1 (0.05)	Not required
Black-Eyed Susan	wildflower	Rudbeckia hirta	0.03 (0.015)	Not required
Cutleaf Daisy	wildflower	Engelmannia pinnatifida	0.2 (0.10)	Not required
Tall Aster	wildflower	Aster praealtus	0.02 (0.01)	Not required
Illinois bundleflower	wildflower	Desmanthus illinoensis	0.15 (0.075)	Not required
Standing cypress	wildflower	Ipomopsis rubra	0.1 (0.05)	Not required
Winecup	wildflower	Callirhoe involucrata	0.1 (0.05)	Not required
Cereal rye grain***	cool season cover crop	Secale cereale	0.5 (0.25)	Not required
Oats***	cool season cover crop	Avena sativa	0.2 (0.1)	Not required
Wheat***	cool season cover crop	Triticum estivum	0.3 (0.15)	Not required
TOTAL ****			Winter: 4.0 (2.0) Summer: 3.0 (1.5)	Rooted species mixed equally @ 10 (3m) ctrs.

* If unavailable replace with other shade and drought-tolerant sedge species.

** If unavailable replace with Prairie Wild Rye.

*** Plant only between Oct. 1 and Jan. 31. Non-persistent winter cover crop for erosion control.

**** Any unavailable species can be substituted with the same quantity of another species from this list or another species approved by the Engineer or designated representative.

Table 4. Facultative Species, Moderate High Moisture Areas

Common Name	Comments	Botanical Name	Seed application rate lbs/1000 sq. ft. (kg/100 sq. m.)	Rooted Plants Size & Spacing
Big Bluestem	grass	Andropogon gerardii	0.2 (0.1)	1 gal. @ 10 ft (3m) ctrs
Big Muhly (Lindhiemers)	grass	Muhlenbergia lindheimeri	0.2 (0.1)	
Bushy Bluestem	grass	Andropogon glomeratus	0.2 (0.1)	
Eastern Gama Grass	grass	Tripsacum dactyloides	0.3 (0.15)	
Indian Grass	grass	Sorghastrum nutans	0.2 (0.1)	
Inland Seaoats	grass	Chasmanthium latifolium	0.3 (0.15)	
Prairie Wild Rye	grass	Elymus canadensis	0.3 (0.15)	Not required
Sand Lovegrass	grass	Eragrostis trichodes	0.2 (0.1)	
Switchgrass	grass	Panicum virgatum	0.1 (0.05)	1 gal. @ 10 ft (3m) ctrs.
Black-Eyed Susan	wildflower	Rudbeckia hirta	0.06 (0.03)	Not required
Bundleflower (Illinois)	wildflower	Desmanthus illinoensis	0.35 (0.17)	Not required
Clover (Purple Prairie)	wildflower	Petalostemum purpurea	0.1 (0.05)	Not required
Coneflower (Clasping)	wildflower	Rudbeckia amplexicaulis	0.06 (0.03)	Not required
Coreopsis (Plains)	wildflower	Coreopsis tinctoria	0.05 (0.025)	Not required
Goldenrod	wildflower	Solidago altissima	0.03 (0.015)	Not required
Lazy Daisy	wildflower	Aphanostephus sp.	0.03 (0.015)	Not required

Table 4. Facultative Species, Moderate High Moisture Areas - continued

Lemon Mint	wildflower	Monarda citriodora	0.07 (0.035)	Not required
Sunflower (Common)	wildflower	Helianthus annuus	0.15 (0.075)	Not required
Sunflower (Maximilian)	wildflower	Helianthus maximiliani	0.1 (0.05)	Not required
Cereal rye grain*	cool season cover crop	Secale cereale	0.5 (0.25)	Not required
Oats*	cool season cover crop	Avena sativa	0.2 (0.10)	Not required
Wheat*	cool season cover crop	Triticum aestivum	0.3 (0.15)	
TOTAL**			winter: 4.0 (2.0) summer: 3.0 (1.5)	Rooted species mixed equally @ 10 ft (3m) ctrs.

* Plant only between Oct. 1 and Jan. 31. Non-persistent winter cover crop for erosion control.

** Any unavailable species can be substituted with the same quantity of another species from this list or another species approved by the Engineer or designated representative.

609.6 Management Practices

Weeds, as defined in the Weed List (Table 1), shall be controlled in the most efficient manner possible. The timing of weed control may occur prior to soil disturbance, just before the installation of seed, and/or during the period of grassland establishment. Weed control shall be introduced at one or all of these times, so that the greatest control is achieved. The preferred method of control is to remove weeds, either by physical or mechanical means, when the site is conducive (e.g. when the ground is moist) to this approach.

The entire root system of perennial weeds shall be removed to prevent re-sprouting. Weeds may be controlled with an approved contact, systemic herbicide, provided the product is used with appropriate care and is applied in accordance with label instructions and the following guidelines:

1. Herbicide shall not be applied when the wind is greater than 8 mph (12.9 kph),
2. Herbicide shall not be applied when rainfall is expected within 24 hours,
3. Herbicide shall not contact surface water, i.e. creeks, rivers, and lakes,

4. Herbicide shall not contact desirable vegetation (a wicking method shall be used, if necessary, to accurately contact target weed only during application).

The Engineer or designated representative shall be consulted to determine appropriate weed control management when weeds are located in an environmentally sensitive location (e.g. near water or adjacent to a critical environmental feature).

609.7 Measurement

Work and acceptable material for "Native Grasslands for Erosion Control" will be measured by the square yard (square meter: 1 square meter equals 1.196 square yards) or by the acre (hectare: 1 hectare equals 2.471 acres), complete in place, with a minimum of 75 percent coverage with no bare areas exceeding 32 square feet (3 square meters) and a 1 1/2 inch (40 millimeters) stand of grass. Bare areas shall be reprepared and reseeded as required by the Engineer or designated representative in order to develop an acceptable stand of grass.

609.8 Payment

The work performed and materials furnished and measured will be paid for at the unit bid price for "Native Grasslands For Erosion Control" of the method specified on the Drawings.

The unit bid price shall include full compensation for furnishing all materials, including all topsoil, water, seed, or fertilizer or mulch and for performing all operations necessary to complete the work.

Payment will be made under one or more of the following pay items:

Topsoil and Seedbed Preparation	Per Square Yard.
Topsoil and Seedbed Preparation	Per Acre.
Native Grassland Seeding and Planting	Per Square Yard.
Native Grassland Seeding and Planting	Per Acre.
Watering	Per Square Yard.
Watering	Per Acre.
Management Practices	Per Square Yard.
Management Practices	Per Acre.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification Item 609 "NATIVE GRASSLAND FOR EROSION CONTROL"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 130	Borrow
Item No. 606	Fertilizer

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification Item 609 "NATIVE GRASSLAND FOR EROSION CONTROL"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 601	Salvaging and Placing Topsoil
Item No. 602	Sodding for Erosion Control
Item No. 604	Seeding (Non-Native) for Erosion Control
Item No. 605	Soil Retention Blanket
Item No. 607	Slope Stabilization
Item No. 608	Planting

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 160	Furnishing and Placing Topsoil
Item No. 162	Sodding for Erosion Control
Item No. 164	Seeding for Erosion Control
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 180	Wildflower Seeding
Item No. 192	Roadside Planting and Establishment

ITEM NO. 610

PRESERVATION OF TREES AND OTHER VEGETATION

610.1 Description

This item shall govern the proper care and treatment of all trees and other vegetation in the vicinity of any development activity.

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.

610.2 Submittals

The submittal requirements for this specification item shall include:

- A. Identification of the location, type of protective fencing (i.e. A, B or C), materials of construction and installation details;
- B. Proposed tree dressing;
- C. Type, location and construction details for proposed tree wells;
- D. Location, type, materials of construction and installation details for permeable paving;
- E. Type and rate of application of fertilizer;

610.3 Materials

- A. Protective Fencing

Protective fencing is designated as the materials used to protect the root zones of trees. Three basic types of protective fencing materials are allowed. Type A and Type B are typical applications and shall be installed where damage potential to a tree root system is high, while Type C shall be installed where damage potential is minimal. The specific type of protective fencing for the work shall be as indicated on the Drawings. Type C fence materials shall be subject to approval by the City Forestry Manager for Site Permit Projects, or the Engineer or designated representative for City of Round Rock administered projects. Type C fencing shall be replaced by Type A or Type B fencing as directed by the Engineer or designated representative if it fails to perform the necessary function.

- 1. Type A Chain Link fence (Typical Application-high potential damage)

Type A protective fencing shall be installed in accordance with the Drawings and shall consist of a minimum five-foot (1.5 meters) high chain link fencing with tubular steel support poles or "T" posts.

2. Type B Wood Fence (Typical Application-high potential damage)

Type B protective fencing shall be installed in accordance with the Drawings and shall consist of any vertical planking attached to 2x4-inch (50 x 100 mm) horizontal stringers which are supported by 2x4-inch (50 x 100 mm) intermediate vertical supports and a 4x4-inch (100 x 100 mm) at every fourth vertical support.

3. Type C Other Materials (Limited Application-minimal potential damage)

The following materials may be permitted as alternates for limited or temporary applications (3 days or less) where tree damage potential is minimal (as determined by the City Forestry Manager or designated representative for Site Permit Projects, or the Engineer or designated representative on City of Round Rock administered projects):

(a) High visibility plastic construction fencing.

The fabric shall be 4 feet (1.2 meters) in width and made of high density polyethylene resin, extruded and stretched to provide a highly visible international orange, non-fading fence. The fabric shall remain flexible from -60°F to 200°F (-16°C to 93°C) and shall be inert to most chemicals and acid. The fabric pattern may vary from diamond to circular with a minimum unit weight of 0.4 lbs./Ft. (0.6 kilograms per meter).

The fabric shall have a 4 foot (1.2 meters) width minimum tensile yield strength (Horizontal) of 2000 psi [13.9 megaPascals], ultimate tensile strength of 2680 psi [18.5 megaPascals] (Horizontal) and a maximum opening no greater than 2 inches (50 mm).

(b) Fencing Supports.

The fencing materials, identified in (a) and (b) above, shall be supported by steel pipe, tee posts, U posts or 2" x 4" (50 mm x 100 mm) timber posts that are a minimum of 5-1/2 feet (1.68 meters) in height and spaced no more than 8 feet (2.44 meters) on centers. The fabric shall be secured to posts by bands, wire ties, or other suitable methods subject to the approval of the Engineer or designated representative.

B. Trunk Protection (Limited Application)

When indicated on the Drawings or directed by the City Forestry Manager or designated representative for Site Permit Projects or the Engineer or designated representative for City of Round Rock administered projects, tree trunk protection shall be provided. Tree trunk protection shall consist of any 2 x 4-inch (50 x 100 mm) or 2 x 6-inch (50 x 150 mm) planking or plastic strapping.

C. Tree Dressing

Tree dressing of any damaged areas shall be accomplished using any approved asphaltic tree wound paint, immediately after damage occurs.

D. Tree Wells for Raised Grades

When existing grades are raised by more than 6 inches (150 mm), the tree root system shall be protected by the installation of tree wells as approved by the City Forestry Manager. Native stone, railroad ties or equivalent timber shall be used for the separator wall of the well and PVC conforming to ASTM D-2729, SDR-35 shall be used for the aeration systems in fill areas.

E. Permeable Paving.

Permeable segmented pavers in conjunction with PVC pipe aeration system or concrete on gravel base with cored holes shall be used to protect existing tree root zones when indicated on the Drawings as approved by the City Forestry Manager or designated representative for Site Permit Projects or the Engineer or designated representative for City of Round Rock administered projects.

F. Fertilizer

Fertilizer shall conform to City of Round Rock Standard Specification Item No. 606, "Fertilizer".

610.4 Construction Methods

A. Protective Fencing

All trees and shrubs in the proximity of the construction site shall be carefully checked for damage prior to initiation of any development activity.

All individual trees, shrubs, and natural areas scheduled for preservation shall be protected during construction with temporary fencing as indicated on the Drawings or directed by the City Forestry Manager or designated representative for Site Permit Projects or the Engineer or designated representative for City of Round Rock administered projects.

Protective fences (section 610.3.A) shall be installed prior to the start of any site preparation work (clearing, grubbing, or grading), and shall be maintained in functioning condition throughout all phases of the construction project.

Protective fence locations in close proximity to intersecting streets or drives shall adhere to the sight distance and sight triangle required by the City.

1. Protective fences shall be constructed at the locations (typically the outer limits of the Critical Root Zone) and with materials indicated on the Drawings to prevent the following:
 - (a) Soil compaction in the root zone area resulting from vehicular traffic or storage of equipment or materials.
 - (b) Root zone disturbances due to grade changes [greater than 6" (150 mm) cut or fill] or trenching not reviewed and authorized by the City Forestry Manager or designated representative or the Engineer or designated representative.
 - (c) Damage to exposed roots, trunks or limbs by mechanical equipment.
 - (d) Other activities detrimental to trees such as chemical storage, concrete truck cleaning, and fires.
2. Exceptions to the installation of protective fences at the tree drip lines may be permitted in the following cases:
 - (a) Where there is to be an approved grade change, impermeable paving surface, tree well, or other such site development, the fence shall be erected approximately 2 to 4 feet (0.6 to 1.2 meters) beyond the area of disturbance;
 - (b) When permeable paving is to be installed within a tree drip line, the fence shall be erected at the outer limits of the permeable paving area (prior to any site grading so that this enclosed area is graded separately to minimize root damage);
 - (c) When trees are located close to a proposed building or other construction activity, the fence shall be erected to allow 6 to 10 feet (1.8 to 3 meters) of work space between the fence and the structure and apply organic mulch to a depth of four (4) to six (6) inches [100 to 150 mm] in the unprotected root zone area;
 - (d) When there are street-side pedestrian walkways, fences shall be constructed in a manner that does not obstruct safe passage;

- (e) When there are severe space constraints due to tract size or other special requirements, the Contractor shall contact the City Forestry Manager on Site Permit projects or the Engineer or designated representative for City administered projects to discuss alternatives.

When any of the exceptions listed above will result in a fence being located closer than five (5) feet (1.5 meters) to a tree trunk, the Contractor shall also protect the trunk with strapped-on planking to a height of 8 feet [2.4 meters] (or to the limits of lower branching) in addition to the reduced fencing required.

B. Repair of Damage

Tree roots scarred by equipment shall be cut cleanly and covered with topsoil. When tree roots are pruned, a comparable portion of selected branches shall be cut from the tree on the opposite side. Limb pruning shall be made at the branch collar as indicated on the Drawings. All limbs greater than 1 inch (25 mm) in diameter shall be precut in accordance with ANSI 300 pruning methods to prevent splitting. All cut limbs shall be treated with an approved tree dressing. Tools shall be disinfected with alcohol or 5 ppm chlorine solution between repairs to trees to prevent the transmission of diseases from one tree to another.

All trees damaged during construction shall receive an application of fertilizer within the drip line conforming to Standard Specification Item No. 606, "Fertilizer" at the rate of 4 pounds per caliper inch (.07 kilograms per caliper mm).

C. Cutting and Filling Around Trees

When the depth of an excavation or embankment exceeds 6 inches (150 mm) within the drip line of any tree with a diameter greater than 8 inches (200 mm), a tree well shall be constructed to protect the tree as indicated on the Drawings.

D. Paving Around Trees

Where paving within the dripline of any tree greater than a 6 inch (150 mm) diameter is necessary, a permeable pavement and aeration system must be installed as indicated on the Drawings, except for street construction.

E. Tree Removal

When a tree or shrub is scheduled for removal, it shall be cut to a depth of 12 inches (300 mm) below the surrounding ground line. After removal, soil shall be placed in the hole to a depth matching the existing grade. The tree shall be cut into sections that can be managed, removed from the site and disposed of. All work shall be conducted in such a manner as to protect all facilities, improvements and vegetation in the work area.

Removal of any other trees not scheduled for removal shall be subject to the provisions of the City Tree Ordinance.

All damage resulting from tree removal or pruning shall be repaired at the Contractor's own expense.

F. Final Cleanup

All temporary tree and shrub preservation and protection measures shall be removed when the construction has been completed.

610.5 Measurement

Tree and shrub trimming, fencing, drains, fertilization, etc. will not be measured for payment unless included as a contract pay item. Tree wells for tree protection will be measured by the units, complete in place, conforming to the Drawings.

610.6 Payment

The work and materials prescribed herein with the exception of the Tree Wells will not be paid for directly but shall be considered subsidiary to other items unless a payment item is included as a contract pay item.

If included as a pay item, payment will be made under one of the following:

Protective Fencing Type A Chain Link fence	
(Typical Application-high damage potential)	Per Lineal Foot
Protective Fencing Type B Wood Fence	
(Typical Application-high damage potential)	Per Lineal Foot
Protective Fencing Type C Other Materials	
Limited Application-minimal damage potential)	Per Lineal Foot
Tree Well (Tree Protection)	Per Each.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification Item 610 "PRESERVATION OF TREES AND OTHER VEGETATION"

City of Round Rock Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 606	Fertilizer

ASTM, American Society for Testing and Materials

<u>Designation</u>	<u>Description</u>
D-2729	Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 610, "PRESERVATION OF TREES AND OTHER VEGETATION"

City of Round Rock Standard Specification Items

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 111	Excavation
Item No. 120	Channel Excavation
Item No. 132	Embankment
Item No. 606	Fertilizer
Item No. 608	Planting

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 160	Furnishing and Placing Topsoil
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering

ITEM NO. 620 FILTER FABRIC

620.1 Description

This item shall govern the furnishing of materials and for placement of filter fabric as indicated on the Drawings or directed by the Engineer or designated representative. Filter Fabric shall have the capability for allowing the passage of ground water through it without transporting the soil placed around the filter fabric.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

620.2 Submittals

The submittal requirements of this specification item include:

- A. catalog cuts,
- B. samples of material selected,
- C. testing results,
- D. manufacturer's recommended installation procedures, and
- E. manufacturer certification of compliance with this specification.

620.3 Materials

A. General

The fabric shall be constructed exclusively of synthetic thermoplastic fibers and may be either woven or non-woven to form a mat of uniform quality. Fabric fibers may be either continuous or discontinuous and oriented in either a random or an aligned pattern throughout the fabric. The fabric shall be mildew resistant, rot proof and shall be satisfactory for use in a wet soil and aggregate environment. The fabric shall contain ultraviolet stabilizers and shall have non-raveling edges.

B. Physical Requirements

The fabric shall meet the requirements of table 1, when sampled and tested in accordance with the methods indicated in the table below.

All material shall be shipped with suitable wrapping to protect the fabric during shipping and storage at the job site.

620.4 Construction Methods

The submittal requirements shall be completed before any materials are ordered.

The "Filter Fabric" shall be installed in accordance with the manufacturer's recommendations, as indicated on the Drawings or as directed by the Engineer or designated representative. When lapping is required, it shall be in accordance with the manufacturer's recommendations. Backfilling around the Filter Fabric shall be done in such a manner that the Filter Fabric material will not be damaged during the placement.

TABLE 1: FILTER FABRIC REQUIREMENTS

Original Physical Properties	Test Method	Requirements
Fabric weight (mass), on an ambient temperature air-dried tension free sample, expressed in oz/ sq. yd (grams/ square meter)	TxDoT Tex-616-J*	Underdrains/Slope Stabilization 4.0 (135) minimum
		Gabions and Revet Mattresses 6.0 (200) minimum
Water flow rate by falling head method, 7.9 inches (20 cm) to 3.9 inches (10 cm) on 2 inch (50 mm) ID cylinder with 1 inch (25 mm) diameter orifice, with flow rate expressed in gal/sq.ft/minute (liters/square meter/minute).	TxDoT Tex-616-J*	80 (3,260) minimum
Breaking load in either machine or cross-machine direction, expressed in pounds (newtons)	ASTM D-1682 grab method G**	100 (445) minimum
Equivalent opening size for US Standard (SI) sieves.	CW-02215	70 to 100 (212 to 150µm)
"Apparent elongation" at breaking load in either machine or cross-machine direction, expressed as percent	ASTM D-1682 grab method G**	100 maximum

* TxDoT Tex-616-J, "Testing of Construction Fibers"

** ASTM D 1682 grab method G, "Test Methods for Breaking Load and Elongation of Textile Fabrics" as modified by TxDoT Test Method Tex-616-J

*** CW-02215, US Army Corps of Engineers, Civil Works Construction Guide Specification "Plastic Filter Fabric".

620.5 Measurement

Work and acceptable material for "Filter Fabric" will be measured by the square yard (square meter: 1 square meter equals 1.196 square yards), complete in place.

620.6 Payment

The work performed and the materials furnished and measured as provided under "Measurement" will be paid at the unit bid price for "Filter Fabric". The unit bid price, when included in the contract as a pay item, shall include full compensation for all materials, excavation and backfilling and all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

Filter Fabric

Per Square Yard.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification 620, "FILTER FABRIC"

American Society for Testing and Materials (ASTM)

Designation

Description

D 1682

Test Methods for Breaking Load and Elongation of Textile Fabrics

Texas Department of Transportation Manual of Testing Procedures

Designation

Description

Tex-616-J

Testing of Construction Fabrics

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 620, "FILTER FABRIC"

City of Round Rock Standard Specifications

Designation

Description

Item No. 101

Preparing Right of Way

Item No. 102

Clearing and Grubbing

Item No. 111

Excavation

Item No. 120

Channel Excavation

Item No. 401

Structural Excavation and Backfill

Item No. 602

Sodding for Erosion Control

Item No. 604

Seeding for Erosion Control

Item No. 605

Soil Retention Blanket

Item No. 606

Fertilizer

Item No. 608

Planting

Item No. 610

Preservation of Trees and Other Vegetation

<u>RELATED</u> CROSS REFERENCE MATERIALS - continued

Specification 620, "FILTER FABRIC"

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

ITEM NO. 621
DIVERSION (TEMPORARY)

621.1 Description

This item shall govern providing and placing earthen berms, channels or a combination thereof along such areas as indicated on the Drawings in accordance with these specifications. This method shall only be used during construction and its purpose shall be to temporarily control soil loss by intercepting and conveying the runoff to a stable outlet. This item shall also include the subsequent removal of the diversion device and re-vegetation of the area.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

621.2 Submittals

The submittal requirements for this specification item shall include:

- A. Characteristics (LL, PI, maximum density, etc.) of proposed embankment material,
- B. Identification of the type, source, mixture, pure live seed (PLS) and rate of application of the seeding,
- C. Type of mulch,
- D. Type of tacking agent, and
- E. Type, chemical analysis and rate of application of fertilizer.

621.3 Materials

- A. Berm

The berm shall consist of earthen materials conforming to Standard Specification Item No. 130, "Borrow", Class A and shall be free of brush, debris and stones larger than 6 inches (150 mm). The liquid limit (LL) of the borrow material shall not exceed 45 and the plasticity index (PI) shall not exceed 15 (TxDoT Test Methods Tex 103-E, Tex-104-E and Tex-106-E).

- B. Seeding

Seeding shall conform to Standard Specification Item No. 604, "Seeding for Erosion Control".

621.4 Construction Methods

Diversion shall not be used where the slope of existing ground exceeds 15 percent.

All brush, stumps and debris shall be removed from the diversion area before construction. Diversion berms shall be constructed to the height and length indicated or as directed by the Engineer or designated representative. The height shall include a minimum of 1-foot (0.3 meter) freeboard above the design high water elevation. The berms shall have a minimum width of 4 feet (1.2 meters) at the top with maximum side slopes of 3:1 unless otherwise specified by the Engineer or designated representative.

The earthen material shall be placed in successive 6-inch (150 mm) layers and compacted by rolling with construction equipment or other approved methods to provide not less than 95 percent of the maximum dry density as determined in accordance with TxDOT Test Methods Tex-114-E and Tex-115-E. The top 4 inches (100 mm) shall only be compacted to 85 percent of the maximum density to facilitate seeding. Berms, channels and any area disturbed shall be seeded. Seeding shall conform to Item No. 604, "Seeding for Erosion Control", except that topsoil will not be required on the berm.

Berms and channels shall be maintained and silt accumulation removed when necessary or as directed by the Engineer or designated representative. After completion of construction or when directed by the Engineer or designated representative, the berm and channel shall be removed and the site restored either to its natural condition, to the lines and grades indicated on the Drawings or as determined by the Engineer or designated representative.

621.5 Measurement

The work performed and the materials furnished as prescribed by this item will be measured by the lineal foot (lineal meter: 1 meter equals 3.281 feet) of diversion, complete in place.

621.6 Payment

The work performed and materials furnished and measured as provided under "Measurement" will be paid for at the unit bid price per lineal foot for Diversion as indicated on the Drawings. The unit bid price shall include: a) full compensation for furnishing, hauling and placing all materials; b) all labor, tools, seeding, equipment and incidentals needed to complete the work, c) any repair, replacement and seeding of materials to maintain the Diversion d) removal and disposal of all materials at the completion of construction and e) reseeding the areas disturbed by the removal of the temporary Diversion.

Payment will be made under:

Diversion -

Per Lineal Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification Item 621 "DIVERSION (Temporary)"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 130	Borrow
Item No. 604	Seeding for Erosion Control
Item No. 606	Fertilizer

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-104-E	Determination of Liquid Limit of Soils
Tex-105-E	Determination of Plastic Limit of Soils
Tex-106-E	Method of Calculating the Plasticity Index of Soils
Tex-114-E	Laboratory Compaction Characteristics and Moisture-Density Relationship of Subgrade & Embankment Soil
Tex-115-E	Field Method for Determination of In-Place Density of Soils and Base Materials

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification Item 621 "DIVERSION (Temporary)"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 111	Excavation
Item No. 132	Embankment
Item No. 201	Subgrade Preparation
Item No. 601	Salvaging and Placing Topsoil
Item No. 607	Slope Stabilization

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 160	Furnishing and Placing Topsoil
Item No. 164	Seeding for Erosion Control
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket

ITEM NO. 622

DIVERSION DIKE

622.1 Description

This item shall govern furnishing and installing a temporary or permanent ridge of compacted soil that is located immediately above cut or fill slopes. The temporary or permanent ridge shall be constructed with sufficient grade to intercept storm water runoff from small upland areas and to divert the flow from the exposed slopes to an acceptable outlet as indicated on the Drawings 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, the inch-pound units are given preference followed by SI units shown within parentheses.

622.2 Submittals

The submittal requirements for this specification item shall include:

- A. Characteristics (LL, PI, maximum density, etc.) of proposed embankment material;
- B. Identification of the type, source, mixture, pure live seed (PLS) and rate of application of the seeding;
- C. Identification of the type, source, and mixture of the sodding;
- D. Type of mulch;
- E. Type of tacking agent;
- F. Type, chemical analysis and rate of application of fertilizer;
- G. Type, characteristics, gradation, etc. of proposed riprap;
- H. Type, characteristics, and application method of proposed soil retention blanket;
- I. Type, characteristics, and application method of proposed slope stabilization;
- J. The manufacturer, model and description of the proposed dust control equipment,
- K. The sprinkling plan including application rate, pattern of sprinkling and scheduled times of application.

622.3 Materials

- A. Dikes shall be constructed from suitable embankment material approved by the Engineer or designated representative or from a borrow material meeting the requirements of Standard Specification Item No. 130, "Borrow", Type A.
- B. Stone Riprap shall consist of fieldstone, rough unhewn quarry stone or broken concrete conforming to Standard Specification Item No. 591, "Riprap for Slope Protection".
- C. Seeding shall conform to Standard Specification Item No. 604, "Seeding for Erosion Control".
- D. Sodding shall conform to Standard Specification Item No. 602, "Sodding for Erosion Control".

- E. Soil Retention Blanket shall conform to Standard Specification Item No. 605, "Soil Retention Blanket".
- F. Stabilization for Erosion Control shall conform to Standard Specification Item No. 607, " Slope Stabilization Applications For Erosion Control ".
- G. Water for embankment, erosion control and dust control shall conform to Standard Specification Item Nos. 604, "Seeding for Erosion Control" and 220, "Sprinkling for Dust Control".

622.4 Construction Methods

The Contractor shall minimize the area disturbed by the activity defined by this specification item. Prior to placement of the Diversion Dike, all clearing and grubbing operations (Standard Specification Item No. 102) shall have been completed on the areas over which the Diversion Dike is to be placed. The surface of the ground, which is to receive the Diversion Dike, shall be loosened by scarifying or plowing to a minimum depth of 4 inches (100 mm), except for the case of solid rock. The material, that has been loosened, shall be re-compacted simultaneously with the Diversion Dike. The Diversion Dike shall be placed in successive 6-inch (150 mm) layers for the full width of the Diversion Dike. Soils shall be sprinkled as required and compacted to the extent necessary to provide not less than 90 percent of the maximum dry density as determined in accordance with TxDOT Test Methods Tex-114-E and Tex 115-E. The top 4 inches (100 mm) shall be compacted to 85 percent of the maximum dry density to facilitate seeding.

Diverted runoff from a protected or stabilized area shall have its outlet flow directed to an undisturbed stabilized area or into a level spreader (Standard Specification Item No. 6340 or grade stabilization structure (Standard Specification Item No. 625. Diverted runoff from a disturbed or exposed area shall have its outlet flow directed to a sediment basin or to an area protected by any of these practices.

The structure shall be inspected monthly and after every rainfall. Repairs shall be made, as needed the Contractor and as directed by the Engineer or designated representative, throughout the duration of the contract or until the Engineer or designated representative gives written permission to remove a temporary structure.

The temporary Diversion Dike shall be removed, when directed by the Engineer or designated representative, and the area shall be leveled off and protected by erosion control measures appropriate for the terrain as indicated on the Drawings. Permanent Diversion Dikes shall be seeded in conformance to Standard Specification Item No. 604, "Seeding for Erosion Control".

622.5 Measurement

Work performed as prescribed by this item will be measured by the lineal foot (lineal meter: 1 meter equals 3.281 feet) along the centerline of the Diversion Dike.

622.6 Payment

This item will be paid for at the contract unit bid price for "Diversion Dike". The price shall include full compensation for: a) all work specified herein, b) furnishing, hauling

and placing of all materials and c) all water required to perform all operations necessary to complete the work.

Payment will be made under one of the following:

Diversion Dike, Temporary	Per Lineal Foot.
Diversion Dike, Permanent	Per Lineal Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification 622 "DIVERSION DIKE"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 102	Clearing and Grubbing
Item No. 130	Borrow
Item No. 220	Sprinkling for Dust Control
Item No. 591	Riprap for Slope Protection
Item No. 602	Sodding for Erosion Control
Item No. 604	Seeding for Erosion Control
Item No. 605	Soil Retention Blanket
Item No. 606	Fertilizer
Item No. 607	Stabilization for Erosion Control
Item No. 625	Grade Stabilization Structure
Item No. 634	Level Spreader

Texas Department of Transportation:Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-114-E	Laboratory Compaction Characteristics and Moisture-Density Relationship of Subgrade & Embankment Soil
Tex-115-E	Field Method for Determination of In-Place Density of Soils and Base Materials

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 622 "DIVERSION DIKE"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 111	Excavation
Item No. 132	Embankment
Item No. 201	Subgrade Preparation
Item No. 601	Salvaging and Placing Topsoil
Item No. 605	Soil Retention Blanket

<u>RELATED</u> CROSS REFERENCE MATERIALS - continued

Specification 622 "DIVERSION DIKE"

<u>Designation</u>	<u>Description</u>
Item No. 607	Slope Stabilization
Item No. 621	Diversion (Temporary)

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 160	Furnishing and Placing Topsoil
Item No. 164	Seeding for Erosion Control
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket

ITEM NO. 623

DRY STACK ROCK WALL

623.1 Description

This item shall govern furnishing and placing dry stack gravity rock walls in conformance with the Drawings and as herein specified on a prepared subgrade, including the excavation and backfilling for the wall, to the height, lines, grades, details and locations indicated on the Drawings or as established by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

623.2 Submittals

The submittal requirements for this specification item shall include:

- A. Aggregate types, gradations and physical characteristics for the Portland cement concrete mix,
- B. Proposed proportioning of materials for the mortar mix,
- C. Test results for the weathered field limestone,
- D. Aggregate type and gradation scheduled for granular blanket,
- E. Description of filter fabric including characteristics, test data and manufacturer's recommendations for installation

623.3 Materials

- A. Rock

Native Rock shall be durable weathered field limestone of suitable quality to ensure permanence in the structure. The stone shall have a wearing loss less than 35 percent when the stone is tested with the Los Angeles Abrasion Machine in accordance with ASTM Test Method C535 (TxDOT Test Method Tex-410A). The loss of material experienced during five cycles of magnesium sulfate exposure conducted in accordance with TxDOT Test Method Tex-411A for Rock RipRap shall not exceed 18 percent.

- B. Concrete

Concrete for footings shall be Class A Concrete and conform to Standard Specification Item No. 403, "Concrete for Structures".

- C. Granular Blanket

Flexible Base aggregate conforming to Standard Specification Item No. 210, "Flexible Base", shall be used for the granular blanket.

- D. Mortar

Mortar shall consist of 1 part masonry cement to 3 parts sand by volume, based on dry materials. Mortar which has been mixed longer than 30 minutes or which has developed its initial set shall not be used.

E. Filter

Fabric Filter Fabric conforming to Standard Specification Item No. 620, "Filter Fabric", shall be used for dry stack rock walls constructed in erodible soils.

623.4 Construction Methods

Dry Stack Rock Wall shall be constructed in horizontal courses, on the prepared and compacted subgrade, granular blanket or concrete foundation as indicated on the Drawings. The horizontal and vertical joints of the two lower and upper stone layers shall be mortared. The remaining horizontal and vertical joints shall be dry or mortared as indicated on the Drawings.

623.5 Measurement

Acceptable work performed as prescribed by this item will be measured by the square foot (square meter: 1 square meter is equal to 10.764 square feet) of finished sloping face. Separate measurement will not be made for backfill, footing or the removal of existing mortared rock walls, and these items shall be subsidiary to the item bids.

623.6 Payment

Work performed and materials furnished or prescribed by this item and measured as provided under "Measurement" will be paid for at the unit bid price per square foot for "Dry Stack Rock Wall". The unit bid price shall include full compensation for: furnishing all materials, completing all excavation including existing mortared rock walls, constructing the footings, backfilling behind the wall and providing all equipment, tools, labor and incidentals necessary to complete the work.

Payment will be made under:

Dry Stack Rock Wall -

Per Square Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification 623 "DRY STACK ROCK WALL"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 403	Concrete for Structures
Item No. 210	Flexible Base
Item No. 620	Filter Fabric

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
410-A	Abrasion of Coarse Aggregate Using The Los Angeles Machine
411-A	Soundness of Aggregate By Use of Sodium Sulfate or Magnesium Sulfate

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS - continued

Specification 623 "DRY STACK ROCK WALL"

American Society for Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
C-535	Standard Test Method for Resistance of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 623 "DRY STACK ROCK WALL"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 111	Excavation
Item No. 120	Channel Excavation
Item No. 132	Embankment
Item No. 606	Fertilizer
Item No. 608	Planting
Item No. 610	Preservation of Trees and Other Vegetation

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

ITEM NO. 624

EARTH OUTLET SEDIMENT TRAP

624.1 Description

This item shall govern the trap formed by either an excavation and/or embankment. The trap shall have a discharge point over or cut into natural ground. The outlet shall be free of any restriction to flow. The removal of the entire structure, re-grading and re-vegetation of the area shall be included in this Standard Specification Item.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

624.2 Submittals

The submittal requirements for this specification item shall include:

- A. Identification of the type, source, mixture, pure live seed (PLS) and rate of application of the seeding;
- B. Type of mulch;
- C. Type of tacking agent;
- D. Type and rate of application of fertilizer.

624.3 Materials

Seeding shall conform to Item No. 604, "Seeding for Erosion Control".

624.4 Construction Methods

All excavation operations shall be carried out in such a manner that erosion and water pollution shall be minimal. Any excavated portion of the sediment trap shall have 2:1 or flatter slopes.

Area under the embankment and the pool area shall be cleared, grubbed or stripped of all vegetation and root mat in conformance with Standard Specification Item No. 120, "Clearing and Grubbing".

The fill material for the embankment shall be free of roots or other woody vegetation, as well as oversized stones, rocks, organic material or other objectionable material. The embankment shall conform to Standard Specification Item No. 132, "Embankment".

Outlet crest elevation shall be at least 1 foot (300 mm) below the top of the embankment.

Sediment shall be removed and the trap restored to its original dimensions when the sediment has accumulated to 1/2 the design depth of the trap or 1 foot (300 mm), whichever is less. The sediment that is removed from the trap shall be deposited in an approved spoils area and in such a manner that it will not cause additional siltation.

The structure shall be inspected after each rain and repairs made as needed by the Contractor throughout the duration of this contract or until the Engineer or designated representative gives permission in writing to remove the structure.

The structure shall be removed and the area graded and re-seeded in conformance with Standard Specification Item No. 604, "Seeding for Erosion Control", when the drainage area has been properly stabilized.

624.5 Measurement

Acceptable work, that is performed as prescribed by this Standard Specification item, will be measured by the square yards (square meters: 1 square meter is equal to 1.196 square yards) of sediment trap constructed, removed and re-vegetated.

624.6 Payment

Work performed and materials furnished for this item will be paid at the unit bid price per square yard of sediment trap.

Payment will be made under:

Earth Outlet Sediment Trap

Per Square Yard.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification 624, "EARTH OUTLET SEDIMENT TRAP"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 120	Clearing and Grubbing
Item No. 132	Embankment
Item No. 604	Seeding for Erosion Control

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 624, "EARTH OUTLET SEDIMENT TRAP"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 111	Excavation
Item No. 120	Channel Excavation
Item No. 606	Fertilizer
Item No. 608	Planting
Item No. 610	Preservation of Trees and Other Vegetation

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

ITEM NO. 625

TEMPORARY GRADE STABILIZATION STRUCTURE

625.1 Description

This item shall govern the construction of a temporary channel lined with Hot Mix Asphaltic Concrete, Portland Cement concrete or comparable non-erodable material. The lining shall be placed to extend from the top of a slope to the bottom of a slope and to convey surface runoff safely down-slopes without causing erosion. The removal of the entire structure and the revegetation of the area after the permanent facilities are in place shall also be included in this item.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

625.2 Submittals

The submittal requirements for this specification item shall include:

- A. Aggregate types, gradations and physical characteristics for the Portland cement concrete mix,
- B. Aggregate types, gradations and physical characteristics for the Hot Mix Asphaltic Concrete mix,
- C. Submittal items required in Standard Specification Item 591, "Riprap for Slope Protection".

625.3 Materials

- A. Concrete
Portland Cement concrete shall conform to Class A, Item No. 403, "Concrete for Structures".
- B. Hot Mix Asphaltic Concrete
Asphaltic concrete shall conform to Item No. 340, "Hot Mix Asphaltic Concrete Pavement".
- C. Riprap
Rock or broken concrete riprap for energy dissipation shall not exceed 5 pounds each and shall conform to Item No. 591, "Riprap for Slope Protection".
- D. Seeding
Seeding shall conform to Item No. 604, "Seeding for Erosion Control".

625.4 Construction Methods

The Contractor shall minimize the area disturbed during construction. Prior to placement of the Grade Stabilization Structure, all clearing, grubbing and subgrade preparation operations shall be completed conforming to Item No. 111, "Excavation".

Hot Mix Asphaltic Concrete work shall conform to Item No. 340, "Hot Mix Asphaltic Concrete".

Concrete work shall conform to Item No. 403, "Concrete for Structures" and to Item No. 591, "Riprap for Slope Protection".

At such time as the structure is no longer needed and with the approval of the Engineer or designated representative, the Contractor shall remove the entire structure and revegetate the disturbed area.

625.5 Measurement

Acceptable work performed as prescribed by this Standard Specification Item will be measured along the channel in lineal feet (lineal meters: a lineal meter is equal to 3.281 lineal feet).

625.6 Payment

Work performed and materials furnished for this item will be paid at the unit bid price per linear foot of channel. The unit bid price shall include all clearing, excavation, materials, placement, maintenance, removal and revegetation of disturbed areas.

Payment will be made under:

Grade Stabilization Structure

Per Linear Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification 625 "TEMPORARY GRADE STABILIZATION STRUCTURE"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 111	Excavation
Item No. 340	Hot Mix Asphaltic Concrete Pavement
Item No. 403	Concrete for Structures
Item No. 591	Riprap for Slope Protection
Item No. 604	Seeding for Erosion Control

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 625 "TEMPORARY GRADE STABILIZATION STRUCTURE"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 120	Channel Excavation
Item No. 132	Embankment
Item No. 401	Structural Excavation and Backfill
Item No. 404	Pneumatically Placed Concrete
Item No. 406	Reinforcing Steel
Item No. 408	Concrete Joint Material
Item No. 410	Concrete Structures
Item No. 606	Fertilizer
Item No. 608	Planting
Item No. 610	Preservation of Trees and Other Vegetation
Item No. 620	Filter Fabric

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

ITEM NO. 627**GRASS-LINED SWALE AND GRASS-LINED SWALE WITH STONE CENTER****627.1 Description**

This item governs natural or man-made drainageways of parabolic or trapezoidal cross section that are located below adjacent ground level and are stabilized by suitable vegetation. The flow is normally wide and shallow and conveys the runoff down the slope.

A grass-lined swale shall be used when it is necessary to convey runoff only without causing erosion. In cases where there is base flow involved, it shall be handled by the addition of a subsurface drain or a stone or gabion mattress lined low flow channel to the grass-lined swale.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

627.2 Submittals

The submittal requirements for this specification item shall include:

- A. The submittal requirements (if necessary) for Standard Specification Item Numbers 594, "Gabions and Revet Mattresses", 602, "Sodding for Erosion Control", 604, "Seeding for Erosion Control" and 605, "Soil Retention Blanket".
- B. Aggregate types, gradations and physical characteristics for the Portland Cement Concrete mix,

627.3 Materials

- A. Grass-lined Swale
 - 1. Seed and Mulch

Seed and mulch shall conform to Item No. 604, "Seeding for Erosion Control".
 - 2. Sod

Sodding shall conform to Item No. 602, "Sodding for Erosion Control".
 - 3. Soil Retention Blanket

The soil retention blanket shall conform to Standard Specification Item No. 605, "Soil Retention Blanket".
- B. Stone Center
 - 1. Concrete

Concrete shall conform to Class A, Item No. 403, "Concrete for Structures".

2. Stone

Stone shall be locally obtained with a weight (mass) range of 5 to 50 pounds (2.3 to 22.7 kilograms).

3. Revet Mattress

The Revet Mattress shall meet the requirements for a Revet Mattress of Standard Specification Item No. 594, "Gabions and Revet Mattresses".

627.4 Construction Methods

Except as indicated on the Drawings or directed by the Engineer or designated representative, all trees, brush, stumps, obstructions and other objectionable material shall be removed and disposed of so as not to interfere with the proper functioning of the waterway.

The waterway shall be excavated or shaped to line, grade, typical sections and cross-section indicated on the Drawings and shall be free of bank projections or other irregularities, which could impede normal flow.

Fill shall conform to Standard Specification Item No. 132, "Embankment".

All soil and materials not needed to complete the swale shall be removed.

627.5 Measurement

Acceptable work performed as prescribed by this item shall be measured by lineal feet (lineal meters: 1 lineal meter equals 3.281 lineal feet) along the centerline of the channel.

627.6 Payment

Work performed and materials furnished for this item shall be paid at the unit bid price per linear foot.

Payment will be made under:

Grass-Lined Swale	Per Lineal Foot
Grass-Lined Swale with Stone Center	Per Lineal Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification 627 "GRASS-LINED SWALE AND GRASS-LINED SWALE WITH STONE CENTER"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 132	Embankment
Item No. 403	Concrete for Structures
Item No. 594	Gabions and Revet Mattresses
Item No. 602	Sodding for Erosion Control
Item No. 604	Seeding for Erosion Control
Item No. 605	Soil Retention Blanket

<u>RELATAED</u> CROSS REFERENCE MATERIALS

Specification 627 "GRASS-LINED SWALE AND GRASS-LINED SWALE WITH STONE CENTER"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 111	Excavation
Item No. 120	Channel Excavation
Item No. 401	Structural Excavation and Backfill
Item No. 404	Pneumatically Placed Concrete
Item No. 406	Reinforcing Steel
Item No. 408	Concrete Joint Material
Item No. 410	Concrete Structures
Item No. 606	Fertilizer
Item No. 608	Planting
Item No. 610	Preservation of Trees and Other Vegetation
Item No. 620	Filter Fabric

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

ITEM NO. 628

SEDIMENT CONTAINMENT DIKES

628.1 Description

This item shall govern the provision and placement of temporary filtration dikes along or across such areas as indicated on the Drawings. This method shall be used during construction only and its purpose shall be to temporarily control erosion by intercepting and retaining sediment.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

628.2 Submittals

The submittal requirements for this specification item shall include:

- A. Locations and Types of containment dikes (hay Bales, Triangular Sediment Filter Dike or Filter CurbInlet Protection).
- B. Seeding
 - 1. Identification of the type, source, mixture, pure live seed (PLS) and rate of application of the seeding.
 - 2. Type of mulch.
 - 3. Type of tacking agent.
 - 4. Type and rate of application of fertilizer.

628.3 Materials

A. Hay Bales

"Hay Bales" shall be free of Johnson Grass or other noxious weeds. The bales shall consist of either hay or straw in good condition and be securely tied with wire. Stakes for anchoring bales shall be #4 (10M) reinforcing bars, 1/2 inch (12.5 mm) steel pickets or 2 x 2 inch (50 x 50 mm) wooden stakes. Hay bales shall be limited to drainage areas less than 1/2 acre (0.2 hectares).

B. Filter Dike

"Filter Dike" shall be prefabricated from 6x6-D2.9xD2.9 (150x150-MW19xMW19) WWF and 4.5 oz. (127 grams) non-woven polyester filter fabric securely fastened to WWF with galvanized shoat rings or j-clips. A 12-inch (300-mm) skirt shall be a continuous extension of the filter fabric on the upstream face.

The filter fabric shall extend beyond the dike joints to provide a 3-inch (75-mm) overlap. Ends of dike not lapped with filter fabric shall be plugged with filter fabric.

C. Filter Curb Inlet Protection

"Filter Curb Inlet Protection" shall be prefabricated from 4x4-W1.4xW1.4 (200x200-MW9xMW9) WWF and 4.5 oz. (127 grams) non-woven polyester filter fabric securely fastened to WWF with galvanized shoat rings or j-clips.

628.4 Construction Methods

The Contractor may select the material for the dikes, unless otherwise indicated, conforming to the details on the Drawings.

Bales shall be placed with ends tightly abutting adjacent bales. Each bale shall be embedded in the soil a minimum of 4 inches (100 mm) and a maximum of 6 inches (150 mm). Bales shall be securely anchored in place by a minimum of 2 stakes per bale. The first stake in each bale shall be angled toward the previously placed bale to force the bales together. Stakes shall be embedded in the soil a minimum of 1 1/2 feet (0.45 meters). Bales shall be replaced every 3 months or more often during wet periods.

For filter dikes the filters shall be placed with ends tightly abutting the adjacent filter. Each filter and skirt shall be securely anchored in place using 6 inch (150 mm) staples at a maximum spacing of 12 inches (300 mm) on center. Anchoring on impervious areas shall be accomplished with sand/gravel bags placed at 18 inches (450 mm) on center or with a nominal 1 inch by 4 inch (25 mm by 100 mm) board nailed at 18 inches (450 mm) on center.

For curb inlet protection a 12-inch (300-mm) skirt shall provide a continuous extension of the filter fabric beyond the front face of inlet opening and the filter fabric shall be continuously extended a minimum of 24-inch (600 mm) beyond each end of the inlet opening. A portion of the filter fabric shall be removed as shown on the Drawings or as directed by the Engineer or designated representative. The skirt and filter fabric extensions areas shall be anchored in place with sand/gravel bags placed at a maximum spacing of 36 inches (900 mm) on center.

Silt accumulation behind hay bales and triangular sediment filter dikes shall be removed at a maximum depth of 6 inches (150 mm) or when, in the opinion of the Engineer or designated representative, the structure ceases to function as intended. Silt accumulation behind filter dikes for curb inlet protection shall be removed at a maximum depth of 2 inches (50 mm).

All dikes shall be inspected by the Contractor at least monthly and after each rainfall. Dikes shall be repaired or replaced when necessary or as directed by the Engineer or designated representative.

After completion of construction or when directed by the Engineer or designated representative the dike shall be removed and the site re-graded to the final grades. Any depression shall be filled and any accumulations of silt shall be spread or removed to a permitted disposal area. After removal of the dike the area shall be graded and seeded conforming to Item No. 604, "Seeding for Erosion Control".

628.5 Measurement

The work performed and the materials furnished as prescribed by this item will be measured by the lineal foot (lineal meter: 1 lineal meter equals 3.281 lineal feet) of "Sediment Containment Dikes", complete in place.

Curb Inlet protection shall be considered subsidiary to a newly completed inlet unit, unless a Pay Item is included and identified in Contract Bid Form.

628.6 Payment

The work performed and materials furnished and measured as provided under "Measurement" will be paid for at the unit bid price per lineal foot of "Sediment Containment Dikes" indicated on the Drawings. The Unit bid price shall include full compensation for: (a) furnishing, hauling and placing all materials including all labor, tools, equipment and incidentals needed to complete the work, (b) the repair and/or replacement of materials, (c) the removal and disposal of all silt and debris and (d) the removal of all dikes, silt and debris after completion of construction or when directed by the Engineer or designated representative.

When indicated, payment for sediment containment will be made under:

Sediment Containment Dikes with hay bales	Per Lineal Foot.
Sediment Containment Dikes with filter fabric	Per Lineal Foot.
Filter Curb Inlet Protection (New Inlet)	Per each.
Filter Curb Inlet Protection (Existing Inlet)	Per each.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification 628 "SEDIMENT CONTAINMENT DIKE"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 604	Seeding for Erosion Control

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 628 "SEDIMENT CONTAINMENT DIKE"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 111	Excavation
Item No. 120	Channel Excavation
Item No. 401	Structural Excavation and Backfill
Item No. 406	Reinforcing Steel
Item No. 602	Sodding for Erosion Control
Item No. 605	Soil Retention Blanket
Item No. 606	Fertilizer
Item No. 608	Planting
Item No. 610	Preservation of Trees and Other Vegetation
Item No. 620	Filter Fabric

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

ITEM NO. 629**BRUSH BERM BARRIER FOR EROSION CONTROL****629.1 Description**

This item shall govern the provision and placement of brush along or across such areas as indicated on the Drawings. This method shall be used during construction only and its purpose shall be to temporarily control erosion by intercepting and retaining sediment. Included in this item is the maintenance, silt removal and removal of the entire structure and re-vegetation of the area.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

629.2 Submittals

The submittal requirements for this specification item shall include:

- A. Identification of the type, source, mixture, pure live seed (PLS) and rate of application of the seeding,
- B. Type of mulch,
- C. Type of tacking agent, and
- D. Type and rate of application of fertilizer.

629.3 Materials

- A. Berm

The brush berm shall consist of freshly cut tree and shrub materials. Freshly cut tree branches, fully leaved are preferred. Dried materials or logs greater than 4 inches (100 mm) in diameter are not acceptable.

- B. Anchorage

Reinforcement Bars: No. 5 (15M) conforming to Item No. 406, "Reinforcing Steel".

Stakes: wooden stakes or railroad spikes

Rope: 1/4 inch (6.25 mm) jute

- C. Re-vegetation

Seeding shall conform to Item No. 604, "Seeding for Erosion Control".

629.4 Construction Methods

The brush shall be placed in lifts not exceeding 5 feet (1.5 meters) in height with the longitudinal axis of the brush placed perpendicular to the flow of water. The material shall be placed so that the brush overlaps to provide a uniform section for the entire length of the berm. Each lift shall be compacted by rolling with construction equipment or other approved methods until reduced to approximately 1/3 its original height or as directed by the Engineer or designated representative.

Brush berms will be securely anchored using 36 inch (0.9 meter) long reinforcement bars driven into the ground and rope tied across the berm on soft material or material with stones. When in rock, railroad spikes will be driven into the rock on 4 foot (1.2 meter) centers and rope tied across the berm. In stiff clay soil, 18 inch (450 mm) wooden stakes shall be driven into the ground on 4 foot (1.2 meter) centers and rope tied across the berm to anchor the brush berm. When directed by the Engineer or designated representative, the brush shall be placed in a trench, a minimum of 6 inches (150 mm) deep and/or reinforcing bars placed 5 feet (1.5 meter) on centers embedded a minimum of 18 inches (450 mm) in the ground to secure the berm from movement.

Inspections will be made by Contractor following each rainfall and necessary repairs will be made to assure the berm will function as intended. When silt reaches a depth equal to 1/3 the height of the berm or 1 foot (300 mm) whichever is less, the silt shall be removed and disposed of on an approved site and in such a manner as to not create a siltation problem.

When the site is completely stabilized, the brush will be removed and disposed of in a manner approved by the Engineer or designated representative and the disturbed areas seeded.

629.5 Measurement

The work performed and the materials furnished as prescribed in this item will be measured by the lineal foot (lineal meter: 1 lineal meter equals 3.281 lineal feet) of "Brush Berm Barrier for Erosion Control", complete in place.

629.6 Payment

The work performed and materials furnished and measured as provided under "Measurement" will be paid for at the unit bid price per lineal foot of brush berm barrier as indicated on the Drawings. The Unit Bid Price shall include full compensation for: (a) furnishing, hauling and placing all materials including all labor, tools, equipment and incidentals needed to complete the work, (b) maintaining the berm, (c) removing silt accumulations, (d) removing and disposing of all materials when the berm is no longer required and (e) re-vegetating the site upon removal of the berm.

Payment will be made under:

Brush Berm Barrier for Erosion Control

Per Lineal Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification 629, "BRUSH BERM BARRIER FOR EROSION CONTROL"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 406	Reinforcing Steel
Item No. 604	Seeding for Erosion Control

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 629, "BRUSH BERM BARRIER FOR EROSION CONTROL"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 111	Excavation
Item No. 120	Channel Excavation
Item No. 401	Structural Excavation and Backfill
Item No. 602	Sodding for Erosion Control
Item No. 605	Soil Retention Blanket
Item No. 606	Fertilizer
Item No. 608	Planting
Item No. 610	Preservation of Trees and Other Vegetation
Item No. 620	Filter Fabric

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

ITEM NO. 630

INTERCEPTOR DIKE

630.1 Description

This item shall consist of a temporary ridge of compacted soil, located across disturbed areas or rights of way. The purpose of an interceptor dike is to shorten the length of exposed slopes, thereby reducing the potential for erosion, by intercepting storm runoff and diverting it to a stabilized outlet or sediment trapping device. The removal of the entire structure and re-vegetation of the area are also included in this item.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

630.2 Submittals

The submittal requirements for this specification item shall include:

- A. Characteristics (LL, PI, maximum density, etc.) of proposed embankment material;
- B. Identification of the type, source, mixture, pure live seed (PLS) and rate of application of the seeding;
- C. Type, chemical analysis and rate of application of fertilizer;
- D. The sprinkling plan including application rate, pattern of sprinkling and scheduled times of application.

630.3 Materials

Seeding for re-vegetation shall conform to Item No. 604, "Seeding for Erosion Control".

630.4 Construction Methods

Interceptor dikes are constructed across disturbed rights of way such as for utility lines and streets or disturbed areas such as graded parking lots or landfills. The dikes shall remain in place until the disturbed areas are permanently stabilized.

All trees, brush, stumps, obstructions and other objectionable material shall be removed and disposed in such a manner that will not interfere with the excavation and construction of the dike as indicated on the Drawings. The dike shall not drain onto public right of way.

Interceptor Dikes will be constructed in the following method:

- A. Dikes shall be machine compacted.
- B. Diversion dikes shall have positive drainage to an outlet.
- C. Top width may be wider and side slopes may be flatter than the slopes indicated on the Drawings to facilitate crossing by construction traffic.
- D. Field location may be adjusted as needed to utilize a stabilized safe outlet.

Interceptor Dikes shall have an outlet that functions with a minimum of erosion. Runoff shall be conveyed to a sediment-trapping device, such as a sediment trap or a sediment

basin, when either the Interceptor Dike channel or the drainage area above the dike are not adequately stabilized.

Unless otherwise indicated on the Drawings, stabilization shall conform to Item No. 591, "Riprap for Slope Protection" and/or Item No. 627, "Grass-Lined Swales and Grass-Lined Swales with Stone Center". Riprap, when used, shall be placed in a 3-inch (75 mm) thick layer and embedded into the soil as indicated on the Drawings.

The structure shall be inspected monthly and after every rainfall. Repairs shall be made by the Contractor as needed throughout the duration of this contract or until the Engineer or designated representative issues written permission to remove the structure.

630.5 Measurement

Acceptable work performed as prescribed by this item will be measured by the lineal foot along the 2-foot (0.6 meter) minimum top width, complete in place.

630.6 Payment

The work performed and material furnished for this item as provided under "Measurement" will be paid for at the unit bid price per lineal foot. The Unit Bid Price shall include full compensation for (a) furnishing, hauling and placing all materials including all labor, tools, equipment and incidentals needed to complete the work, (b) maintaining the dike, removing any silt accumulations; (c) removing, regrading and disposing of all materials when the dike is no longer required and (d) re-vegetating the site upon removal of the dike.

Payment will be made under:

Interceptor Dike

Per Lineal Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification 630 "INTERCEPTOR DIKE"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 606	Fertilizer
Item No. 627	Grass-Lined Swales and Grass-Lined Swales with Stone Center

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 630 "INTERCEPTOR DIKE"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 111	Excavation
Item No. 132	Embankment
Item No. 201	Subgrade Preparation
Item No. 601	Salvaging and Placing Topsoil
Item No. 605	Soil Retention Blanket
Item No. 607	Slope Stabilization
Item No. 621	Diversion (Temporary)

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 160	Furnishing and Placing Topsoil
Item No. 164	Seeding for Erosion Control
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering

ITEM NO. 631

INTERCEPTOR SWALE

631.1 Description

This Standard Specification Item governs a temporary excavated drainage way that is located across disturbed areas or rights of way. The purpose of an interceptor swale is to shorten the length of exposed slopes, thereby reducing the potential for erosion, by intercepting storm runoff and diverting it to a stabilized outlet or sediment-trapping device. This item shall also include removal of the "Interceptor Swale" and re-vegetation of the area.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

631.2 Submittals

The submittal requirements for this specification item shall include:

- A. The dry riprap submittal shall include:
 - 1. Type, size and source of rock,
 - 2. Filter fabric, and
 - 3. Construction details.
- B. The seeding submittal shall include:
 - 1. Identification of the type, source, mixture, pure live seed (PLS) and rate of application of the seeding,
 - 2. Type of mulch,
 - 3. Type of tacking agent, and
 - 4. Type and rate of application of fertilizer.

631.3 Materials

- A. Stabilization

Dry riprap shall conform to the requirements for Dry Riprap (Section 591S.5) of Standard Specification Item No. 591, "Riprap for Slope Protection".
- B. Seeding

Seeding shall conform to Item No. 604, "Seeding for Erosion Control".

631.4 Construction Methods

All trees, brush, stumps, obstructions and other objectionable material shall be removed and disposed of so as not to interfere with the proper functioning of the swale, as indicated on the Drawings.

The swale shall be excavated or shaped to line, grade and cross section as required to meet the criteria specified herein and on the Drawings, and shall be free of bank projections or other irregularities which could impede normal flow.

All earth, that is removed and not needed in construction, shall be disposed of at an approved spoils site so that it will not interfere with the function of the swale.

"Interceptor Swale" shall have a level bottom and shall have an outlet that functions with a minimum of erosion.

Runoff shall be conveyed to a sediment-trapping device, as indicated on the Drawings.

Stabilization, when required, shall conform to Standard Specification Item No. 591, "Riprap for Slope Protection" and/or Standard Specification Item No. 627, "Grass-Lined Swale and Grass-Lined Swale with Stone Center".

The structure shall be inspected monthly and after each rainfall. Repairs shall be made by the Contractor, as needed throughout the duration of this Contract or until the Engineer or designated representative issues written permission to remove the structure.

631.5 Measurement

Acceptable work performed as prescribed by this Standard Specification item will be measured by the lineal foot (lineal meter: 1 lineal meter equals 3.281 lineal feet) along the 2-foot (0.6 meter) minimum top width, complete in place.

631.6 Payment

Work performed and materials furnished for this item as provided under "Measurement" will be paid for at the unit bid price per lineal foot. The Unit Bid Price shall include full compensation for: (a) furnishing, hauling and placing all materials including all labor, tools, equipment and the incidentals needed to complete the work, (b) maintaining the dike, (c) removing any silt accumulations; (d) removing, regrading and disposing of all materials when the dike is no longer required and (e) re-vegetating the area upon removal of the dike.

Payment will be made under:

Interceptor Swale -

Per Lineal Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification 631, "INTERCEPTOR SWALE"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 591	Riprap for Slope Protection
Item No. 604	Seeding for Erosion Control

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 631, "INTERCEPTOR SWALE"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 111	Excavation
Item No. 120	Channel Excavation
Item No. 401	Structural Excavation and Backfill
Item No. 602	Sodding for Erosion Control
Item No. 605	Soil Retention Blanket
Item No. 606	Fertilizer
Item No. 608	Planting
Item No. 610	Preservation of Trees and Other Vegetation
Item No. 620	Filter Fabric
Item No. 621	Diversion
Item No. 627	Grass-Lined Swale and Grass-Lined Swale With Stone Center
Item No. 636	Perimeter Swale

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

TEM NO. 632

STORM INLET SEDIMENT TRAP

632.1 Description

This item governs the construction of a temporary silt basin around a drainage structure, the maintenance of the trap, the removal of silt accumulations until the trap is no longer required, the restoration of the area to the final grade and the re-vegetation of the disturbed area.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

632.2 Submittals

The submittal requirements for this specification item shall include:

- A. Locations and Types of inlet traps (yard or curb drain).
- B. Seeding
 - 1. Identification of the type, source, mixture, pure Live Seed (PLS) and rate of application,
 - 2. Type of mulch,
 - 3. Type of tacking agent, and
 - 4. Type and rate of application of fertilizer.

632.3 Materials

- A. Seeding

Seeding for re-vegetation shall conform to Standard Specification Item No. 604, "Seeding for Erosion Control".
- B. Embankment

Embankment shall conform to Standard Specification Item No. 132, "Embankment".

632.4 Construction Methods

The area under the embankment shall be cleared, grubbed and stripped of any vegetation and root material in conformance with Standard Specification Item 102, "Clearing and Grubbing".

Construction operations shall be carried out in such a manner that erosion and water pollution shall be minimized.

Sediment shall be removed and the trap shall be restored to its original dimensions when the sediment has accumulated to 1/2 the design depth of the trap. The sediment, that is removed, shall be deposited in an approved area and in such a manner that it will not erode.

The structure shall be inspected monthly and after each rain and repairs made as needed by the Contractor throughout the duration of this contract or until the Engineer or designated representative provides written permission to remove the structure.

When the trap is no longer required, the Contractor shall remove the silt accumulation and backfill the trap in accordance with Standard Specification Item No. 130, "Borrow" or Standard Specification Item No. 132, "Embankment". Any material placed shall be compacted in 8-inch (200 mm) lifts, loose measure and compacted to the required density by mechanical means.

The temporary Storm Inlet Sediment Trap shall be removed, when directed by the Engineer or designated representative, and the area leveled off and protected by erosion control measures appropriate for the terrain as indicated on the Drawings. Permanent Storm Inlet Sediment Traps shall be seeded and comply with all the requirements for Item No. 604, "Seeding for Erosion Control".

632.5 Measurement

Acceptable work performed as prescribed by this item will be measured by the cubic foot (cubic meter: 1 cubic meter equals 35.31 cubic feet) of sediment trap complete in place.

632.6 Payment

The Work performed and the materials furnished for this item as provided under "Measurement" will be paid for at the unit bid price per cubic foot of sediment trap constructed. The Unit Bid Price shall include full compensation for: (a) furnishing, hauling and placing all materials including all labor, tools, equipment and the incidentals needed to complete the work, (b) maintaining the trap, (c) removing any silt accumulations, (d) removing, regrading and disposing of all silt and debris, (e) regrading and placing embankment and (f) re-vegetation of area upon removal of the trap.

Payment will be made under:

Storm Inlet Sediment Trap -

Per Cubic Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification 632, "STORM INLET SEDIMENT TRAP"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 102	Clearing and Grubbing
Item No. 130	Borrow
Item No. 132	Embankment
Item No. 604	Seeding for Erosion Control

<u>RELATED</u> CROSS REFERENCE MATERIALS
Specification 632, "STORM INLET SEDIMENT TRAP"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 111	Excavation
Item No. 120	Channel Excavation
Item No. 401	Structural Excavation and Backfill
Item No. 602	Sodding for Erosion Control
Item No. 605	Soil Retention Blanket
Item No. 606	Fertilizer
Item No. 608	Planting
Item No. 610	Preservation of Trees and Other Vegetation

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

ITEM NO. 633 LANDGRADING

633.1 Description

This item shall govern reshaping the existing topography in accordance with the Drawings. The purpose of landgrading is to provide for erosion control and vegetation establishment on those areas where the existing topography is to be reshaped by grading.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

633.2 Submittals

The submittal requirements for this specification item shall include:

- A. Sediment control plan
- B. Seeding plan including:
 - 1. Identification of the type, source, mixture, pure live seed (PLS) and rate of application of the seeding,
 - 2. Type of mulch,
 - 3. Type of tacking agent, and
 - 4. Type and rate of application of fertilizer.

633.3 Materials

- A. Seeding

Seeding shall conform to Item No. 604, "Seeding for Erosion Control".
- B. Pipe Underdrains

Pipe underdrains shall conform to Item No. 551, "Pipe Underdrains".

633.4 Construction Methods

Il sediment control practices and measures shall be constructed and in place before proceeding with the construction of "Landgrading". The sediment control practices and measures shall be maintained in accordance with the sediment control plan. Topsoil and fill materials, which are stripped for the establishment of vegetation, shall be stockpiled in amounts necessary to complete finished grading of all exposed areas. Temporary stockpiles, borrow areas and permitted spoil areas shall be shown on the Drawings and no other areas shall be used for these purposes. Cleared areas, that are to receive fill materials, shall be grubbed to remove trees (except for trees shown to remain), vegetation, roots and other objectionable material as required by Standard Specification Item No. 102, "Clearing and Grubbing". Seeps or springs encountered during construction shall be intercepted and diverted to a pipe underdrain conforming to Standard Specification Item No. 551, "Pipe Underdrains".

Except for approved landfills, fill material shall be free of brush, rubbish, rocks, logs, stumps, building debris and other objectionable materials that would interfere with or

prevent construction of satisfactory fills. All fills shall be compacted as required by the Drawings to reduce erosion, slippage, settlement, subsidence or other related problems. Fill intended to support buildings, structures and conduits, etc., shall be compacted in accordance with Standard Specification Item No. 132, "Embankment". All graded areas shall be permanently stabilized and seeded immediately following finished grading.

633.5 Measurement

Acceptable work performed as prescribed by this item will be measured by either square feet (square meters: 1 square meter equals 1.196 square feet) or acres (hectares; 1 hectare equals 2.471 acres) of the area to be graded, which will include stabilization and groundcover re-establishment.

633.6 Payment

Work performed and material furnished for this item will be paid for at the unit bid price per square foot or acre of the area graded. Pipe Underdrains, when required, will be paid for in accordance with Item No. 551, "Pipe Underdrains".

Payment will be made under one of the following:

Landgrading -	Per Square Foot.
Landgrading -	Per Acre.

End

SPECIFIC CROSS REFERENCE MATERIALS

Specification 633, "LANDGRADING (LG) "

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>

Item No. 102	Clearing and Grubbing
Item No. 132	Embankment
Item No. 551	Pipe Underdrains
Item No. 604	Seeding for Erosion Control

RELATED CROSS REFERENCE MATERIALS

Specification 633, "LANDGRADING (LG) "

City of Round Rock Standard Details

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 111	Excavation
Item No. 120	Channel Excavation
Item No. 602	Sodding for Erosion Control
Item No. 605	Soil Retention Blanket

<u>RELATED</u> CROSS REFERENCE MATERIALS - continued

Specification 633, "LANDGRADING (LG) "

<u>Designation</u>	<u>Description</u>
Item No. 606	Fertilizer
Item No. 608	Planting
Item No. 610	Preservation of Trees and Other Vegetation
Item No. 620	Filter Fabric

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

ITEM NO. 634

LEVEL SPREADER

634.1 Description

This item governs furnishing and installing an entrance channel conversion to sheet flow without causing erosion to existing vegetation.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

634.2 Submittals

The submittal requirements for this specification item shall include:

- A. The source, material type and classification, density and moisture requirements of the embankment materials
- B. The soil retention blanket material type and sample, evidence that the material is listed on TxDoT/TTI's Approved Products List, one (1) full set of Manufacturer's literature and installation recommendations, and any special details necessary for the proposed application.

634.3 Materials

- A. Filter Fabric
Filter Fabric shall conform to Item No. 620S, "Filter Fabric".
- B. Backfill
Fill shall conform to Item No. 132, "Embankment".

634.4 Construction Methods

Level Spreader shall be constructed level to insure uniform spreading of sediment-free runoff. The Level Spreader shall be constructed on undisturbed soil. A filter fabric erosion stop shall be placed vertically at least 6 inches (150 mm) deep in a silt trench 1 foot (300 mm) back from the level lip and parallel to the lip. The entire level lip area shall be protected by 2 strips of "Soil Retention Blanket" (Standard Specification Item 605). The entrance channel shall not exceed a 1 percent grade before extending the spreader. All groundcover shall be re-established and construction areas stabilized.

The structure shall be inspected monthly and after each rainfall. Repairs shall be made by the Contractor, as needed, throughout the duration of the contract or until the Engineer or designated representative provides written permission to remove the structure.

634.5 Measurement

Measurement of the Level Spreader as prescribed by this item will be by the square foot (square meters: 1 square meter equals 10.764 square feet) of the bottom channel.

634.6 Payment

Work performed and material furnished or prescribed by this item and measured as provided under "Measurement" will be paid for at the unit bid price per square foot of the bottom channel.

Payment will be made under:

Level Spreader

Per Square Foot of Bottom Channel.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification 634, "LEVEL SPREADER "

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 132	Embankment
Item No. 605	Soil Retention Blanket
Item No. 620	Filter Fabric

<u>RELATED</u> CROSS REFERENCE MATERIALS
Specification 633, "LANDGRADING (LG) "

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 111	Excavation
Item No. 120	Channel Excavation
Item No. 602	Sodding for Erosion Control
Item No. 604	Seeding for Erosion Control
Item No. 606	Fertilizer
Item No. 608	Planting
Item No. 610	Preservation of Trees and Other Vegetation

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

ITEM NO. 635

PERIMETER DIKE

635.1 Description

This item shall govern construction of a temporary ridge of compacted soil located along the perimeter of the site or disturbed area. The purpose of a perimeter dike is to prevent offsite storm runoff from entering the disturbed area and to prevent sediment-laden storm runoff from leaving the construction site or disturbed area.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

635.2 Submittals

The submittal requirements for this specification item shall include:

- A. The Dry Riprap submittal shall include:
 - 1. Type, size and source of rock,
 - 2. Filter fabric, and
 - 3. Construction details.
- B. The seeding submittal shall include:
 - 1. Identification of the type, source, mixture, pure live seed (PLS) and rate of application of the seeding,
 - 2. Type of mulch,
 - 3. Type of tacking agent, and
 - 4. Type and rate of application of fertilizer.

635.3 Materials

- A. Riprap

Riprap for stabilization shall conform to Dry Riprap, Item No. 591, "Riprap for Slope Protection".
- B. Seeding

Seeding shall conform to Item No. 604, "Seeding for Erosion Control".

635.4 Construction Methods

All trees, brush, stumps, obstructions and other objectionable material shall be removed and disposed of in a manner that will not interfere with the excavation and construction of the dike as indicated on the Drawings. The dike shall not drain onto public right of way.

All perimeter dikes shall be machine compacted to the extent necessary to provide not less than 95 percent density conforming to TxDOT Test Method Tex-114-E and shall have positive drainage to an outlet. Diverted runoff from a protected or stabilized upland area shall flow directly onto an undisturbed stabilized area or into a level

spreader (Standard Specification Item No. 634) or grade stabilization structure (Standard Specification Item No. 625).

Diverted runoff from a disturbed or exposed upland area shall be conveyed to a sediment-trapping device such as sediment trap, a sediment basin or to an area protected by any of these practices. Unless otherwise indicated on the Drawings, stabilization shall conform to Item No. 591, "Riprap for Slope Protection" and/or Item No. 627, "Grass-Lined Swale and Grass-Lined Swale with Stone Center". Riprap, when used, shall be placed in a uniform layer embedded in the soil.

The structure shall be inspected monthly and after each rainfall. Repairs shall be made by the Contractor, as needed, throughout the duration of the contract or until the Engineer or designated representative provides written permission to remove the structure.

635.5 Measurement

Acceptable work performed as prescribed by this item will be measured by the lineal foot (lineal meter: 1 lineal meter equals 3.281 lineal feet) along the centerline of the 2-foot (0.6 meter) minimum top width.

635.6 Payment

Work performed and material furnished for this item will be paid for at the unit bid price per lineal foot.

Payment will be made under:

Perimeter Dike -

Per Lineal Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification 635, "PERIMETER DIKE"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 591	Riprap for Slope Protection
Item No. 604	Seeding for Erosion Control
Item No. 625	Grade Stabilization Structure
Item No. 627	Grass-Lined Swale and Grass-Lined Swale with Stone Center
Item No. 634	Level Spreader

Texas Department of Transportation: Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Test Method Tex-114-E	Laboratory Compaction Characteristics And Moisture-Density Relationship of Subgrade and Embankment Soils

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 635, "PERIMETER DIKE"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 111	Excavation
Item No. 120	Channel Excavation
Item No. 602	Sodding for Erosion Control
Item No. 606	Fertilizer
Item No. 608	Planting
Item No. 610	Preservation of Trees and Other Vegetation
Item No. 622	Diversion Dike (DD)
Item No. 630	Interceptor Dike (ID)
Item No. 636	Perimeter Swale (PS)

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

ITEM NO. 636

PERIMETER SWALE

636.1 Description

This item shall govern construction of a temporary excavated drainageway located along the perimeter of the site or disturbed area. The purpose of a perimeter swale is to prevent offsite runoff from entering the disturbed area and to prevent sediment-laden runoff from leaving the construction site or disturbed area. This item shall also include removal of the "Perimeter Swale" and re-vegetation of the area.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

636.2 Submittals

The submittal requirements for this specification item shall include:

- A. Coarse Aggregate, Grade 1 shall include source, gradation and characteristics of the proposed aggregate [Section 403.2 (3) of Standard Specification Item 403].
- B. The Dry Riprap submittal shall include:
 - 1. Type, size and source of rock,
 - 2. Filter fabric, and
 - 3. Construction details.
- C. The seeding submittal shall include:
 - 1. Identification of the type, source, mixture, pure live seed (PLS) and rate of application of the seeding.
 - 2. Type of mulch.
 - 3. Type of tacking agent.
 - 4. Type and rate of application of fertilizer.

636.3 Materials

- A. Stabilization

Stabilization shall conform to Coarse Aggregate, Grade 1, under Standard Specification Item No. 403, "Concrete for Structures". Riprap for vehicle crossings shall conform to the requirements for Dry Riprap (Section 591.5) of Standard Specification Item No. 591, "Riprap for Slope Protection".

- B. Seeding

Seeding shall conform to Item No. 604, "Seeding for Erosion Control".

636.4 Construction Methods

All trees, brush, stumps, obstructions and other objectionable material shall be removed and disposed of so as not to interfere with the proper functioning of the swale.

The swale shall be excavated or shaped to lines, grades and cross sections indicated on the Drawings and shall be free of bank projections or other irregularities which will impede normal flow.

All earth that is removed and not needed in construction shall be disposed of at an approved spoils site so that it will not interfere with the functioning of the swale.

Stabilization shall conform to Coarse Aggregates, Grade 1, (Standard Specification Item No. 403, "Concrete for Structures") in a layer at least 3 inches (75 mm) in thickness and embedded into the soil. The lining shall extend across the bottom and up both sides of the channel to a height of at least 8 inches (200 mm) vertically above the bottom.

At all points where several vehicle crossings will be made per day, the swale shall be stabilized in accordance with Standard Specification Item No. 591, "Dry Riprap", except the stone lining shall be at least 6 inches (150 mm) in thickness for the full width of the traffic crossing roadway.

The structure shall be inspected monthly and after each rainfall. Repairs shall be made by the Contractor, as needed, throughout the duration of the contract or until the Engineer or designated representative provides written permission to remove the structure.

636.5 Measurement

Acceptable work performed as prescribed in this item shall be measured by the lineal foot (lineal meter: 1 lineal meter equals 3.281 lineal feet) along the 4-foot (1.2 meter) minimum bottom width.

636.6 Payment

Work performed and material furnished for this item will be paid for at the unit bid price per lineal foot. The Unit Bid Price shall include full compensation for: (a) furnishing, hauling and placing all materials including all labor, tools, equipment and the incidentals needed to complete the work, (b) maintaining the dike, (c) removing any silt accumulations; (d) removing, re-grading and disposing of all materials when the dike is no longer required and (e) re-vegetating the area upon removal of the dike.

Payment will be made under:

Perimeter Swale -

Per Lineal Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification 636, "PERIMTER SWALE"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 403	Concrete for Structures
Item No. 591	Riprap for Slope Protection
Item No. 604	Seeding for Erosion Control

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 636, "PERIMTER SWALE"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 111	Excavation
Item No. 120	Channel Excavation
Item No. 401	Structural Excavation and Backfill
Item No. 602	Sodding for Erosion Control
Item No. 605	Soil Retention Blanket
Item No. 606	Fertilizer
Item No. 608	Planting
Item No. 610	Preservation of Trees and Other Vegetation
Item No. 620	Filter Fabric
Item No. 621	Diversion
Item No. 627	Grass-Lined Swale and Grass-Lined Swale With Stone Center
Item No. 631	Interceptor Swale

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

ITEM NO. 637

PIPE SLOPE DRAIN

637.1 Description

This item governs the installation of a flexible tubing and/or rigid pipe with a prefabricated entrance section that is temporarily placed to extend from the top to the bottom of a slope. The purpose of the pipe slope drain is to convey surface runoff safely down slopes without causing erosion.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

637.2 Submittals

The submittal requirements for this specification item shall include:

- A. The Dry Riprap submittal shall include:
 - 1. Type, size and source of rock,
 - 2. Filter fabric, and
 - 3. Construction details.
- B. The pipe and inlet pipe submittal shall include:
 - 1. Size, properties, banding, etc for the Corrugated Metal Pipe.
 - 2. Size, properties, and installation details and instructions.

637.3 Materials

- A. Pipe and Inlet Pipe

The pipe and inlet pipe shall be corrugated metal pipe (Standard Specification Item 510, "Pipe") with watertight connecting bands of the size indicated on the Drawings.
- B. Flexible Tubing

The flexible tubing shall be the same diameter as the inlet pipe and shall be constructed of a durable material with hold-down grommets spaced 10 feet (3 meters) on centers.
- C. Riprap

Riprap area shall consist of 6 inch (150 mm) stone and shall meet the requirements for Dry Riprap (Section 591.5) of Standard Specification Item No. 591, "Riprap for Slope Protection" .

637.4 Construction Methods - Flexible

All trees, brush, stumps, obstructions and other objectionable material shall be removed and disposed in a manner that will not interfere with the excavation and construction of the drain as indicated on the Drawings. The drain shall not drain onto the public right of way.

The top of the earth dike over the inlet pipe and those dikes carrying water to the pipe shall be at least 1 foot higher at all points than the top of the inlet pipe.

The pipe slope drain shall be of the type indicated on the Drawings and constructed to the details indicated on the Drawings.

The flexible tubing shall be securely fastened to the corrugated metal pipe with metal strapping or watertight connecting collars. The flexible tubing shall be securely anchored to the slope by staking at the grommets provided.

A riprap apron shall be provided at the outlet, as indicated on the Drawings and/or Standard Details.

The structure shall be inspected monthly and after each rainfall. Sediment buildup shall be removed and repairs shall be made by the Contractor, as needed, throughout the duration of the contract or until the Engineer or designated representative provides written permission to remove the structure.

637.5 Measurement

Acceptable work performed as prescribed by this item will be measured per each.

637.6 Payment

Work performed and materials furnished for this item will be paid for at the unit price per each.

Payment will be made under:

Pipe Slope Drain	Per Each.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS	
Specification 637, "PIPE SLOPE DRAIN"	

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 591	Riprap for Slope Protection
Item No. 510	Pipe
Item No. 604	Seeding for Erosion Control

<u>RELATED</u> CROSS REFERENCE MATERIALS	
Specification 637, "PIPE SLOPE DRAIN"	

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 111	Excavation
Item No. 120	Channel Excavation
Item No. 401	Structural Excavation and Backfill
Item No. 602	Sodding for Erosion Control

<u>RELATED</u> CROSS REFERENCE MATERIALS - continued

Specification 637, "PIPE SLOPE DRAIN"

<u>Designation</u>	<u>Description</u>
Item No. 605	Soil Retention Blanket
Item No. 606	Planting
Item No. 610	Preservation of Trees and Other Vegetation
Item No. 620	Filter Fabric

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

ITEM NO. 638
PIPE OUTLET SEDIMENT TRAP

638.1 Description

This item shall govern construction of a basin formed by an embankment or excavation along with an embankment at the point of discharge of the pipe. The outlet for the trap shall be through a perforated riser and a pipe through the embankment.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

638.2 Submittals

The submittal requirements for this specification item shall include the Size, properties, banding, installation details and instructions for the corrugated metal pipe for the pipe and pipe riser.

638.3 Materials

Corrugated metal pipe shall be used with diameter selected from the following table:

Minimum Pipe Diameter		Maximum Drainage Area	
Inches	millimeters	Acres	Hectares
12	300	1	0.4
18	450	2	0.8
21	525	3	1.2
24	600	4	1.6
30	750	5	2.0

638.4 Construction Methods

All trees, brush, stumps, obstructions and other objectionable material shall be removed and disposed of in a manner that will not interfere with the excavation and construction of the trap as indicated on the Drawings. The trap shall not drain onto public right of way.

All excavation operations shall be carried out in such a manner that erosion and water pollution shall be minimal. Any excavated portion of sediment trap shall have 2:1 or flatter slopes.

All pipe connections shall be watertight.

At least the top 2/3 of the riser shall be perforated with 1/2 inch (12.5 mm) diameter holes spaced 8 inches (200 mm) vertically and 10 to 12 inches (250 to 300 mm) horizontally.

Fill material around the pipe spillway shall be compacted in 4 inch (100 mm) layers. A minimum of 2 feet (0.6 meter) of compacted backfill shall be placed over the pipe spillway before crossing it with construction equipment.

The fill material for the embankment shall be free of roots or other woody vegetation, as well as oversized stones, rocks, organic material or other objectionable material. The embankment shall be compacted by traversing with mechanical equipment while it is being constructed.

The structure shall be inspected monthly and after each rainfall. Repairs shall be made by the Contractor, as needed, throughout the duration of the contract or until the Engineer or designated representative provides written permission to remove the structure.

Sediment shall be removed and trap restored to its original dimensions when the sediment has accumulated to 1/2 the design depth of the trap or 1 foot (300 mm), whichever is less. The sediment that is removed shall be deposited in an approved area and in such a manner that it will not erode.

The structure shall be removed and area restored and vegetated when the drainage area has been properly stabilized.

638.5 Measurement

Acceptable work performed as prescribed by this item will be measured by the square yard (square meter: 1 square meter equals 1.196 square yards) of sediment trap constructed.

638.6 Payment

Work performed and materials furnished for this structure will be paid for at the unit bid price per square yard of sediment trap constructed.

Payment will be made under:

Pipe Outlet Sediment Trap -

Per Square Yard.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification 638, "PIPE OUTLET SEDIMENT TRAP"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 510	Pipe

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 638, "PIPE OUTLET SEDIMENT TRAP"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 111	Excavation
Item No. 120	Channel Excavation
Item No. 401	Structural Excavation and Backfill
Item No. 602	Sodding for Erosion Control
Item No. 605	Soil Retention Blanket
Item No. 606	Fertilizer
Item No. 608	Planting
Item No. 610	Preservation of Trees and Other Vegetation
Item No. 620	Filter Fabric

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<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

ITEM NO. 639

ROCK BERM

639.1 Description

This item shall govern the construction of a temporary berm of open graded rock that is installed at the toe of a slope on the perimeter of a developing area. The purpose of a rock berm is to intercept sediment-laden water from unprotected areas, to retain the sediment and to release the water in sheet flow. This item shall also govern the removal of the "Rock Berm" and re-vegetation of the area.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

639.2 Submittals

The submittal requirements for this specification item shall include:

- A. Function (stream flow or other) and dimensions of the rock berm
- B. Source, type and gradation of rock
- C. Re-vegetation program, including:
 - 1. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding.
 - 2. Type of mulch.
 - 3. Type of tacking agent.
 - 4. Type and rate of application of fertilizer.

639.3 Design Criteria

A rock berm shall be constructed near the perimeter of a disturbed site within the development area. It is not to be constructed outside the property lines without obtaining an easement or written permission from the affected adjacent property owners.

A detailed design is not required for the installation of a rock berm; however, the following criteria shall be observed:

Drainage area	- less than 5 acres (2 hectares).
Height	- 18 inches (450 mm) minimum height, measured vertically from the top of the existing ground at the upslope toe to the top of the berm.
Top width	- 2 feet (0.6 meter) minimum.
Side slopes	- 2:1 or flatter.
Grade	- Berms will be built along a contour as near possible to a 0 percent grade.

639.4 Materials

Surplus rock excavated from utility trenches or from other excavations may be used in

construction of these berms. In general, the rocks shall be sound with a minimum of 3 inches (75 mm) in smallest dimension and shall weigh between 10 and 30 pounds (4.5 to 13.6 kilograms) each. Seeding for re-vegetation shall conform to Item No. 604, "Seeding for Erosion Control".

Use only open-graded rock of the size indicated on the Drawings, with most of the fines removed.

639.5 Construction Methods

All trees, brush, stumps and objectionable material shall be removed and disposed in a manner that will not interfere with the construction of the berm.

A trench shall be excavated to a minimum depth of 4 inches (100 mm) below existing grade for placement of the rock as indicated the Drawings. The rocks shall be placed in interlocking layers with close joints starting at the base. Open joints shall be filled with rock-spalled materials as required to stabilize the berm.

The area upstream from the rock berm shall be maintained in a condition which will allow sediment to be removed following the runoff from a rainfall event. After each rainfall event of 1 inch (25 mm) or more, an inspection of the rock berm will be made by the Contractor and the stone shall be replaced when the structure ceases to function as intended because of silt accumulation among the rocks, washout, construction traffic damage, etc.

When the silt reaches a depth equal to 1/3 the height of the berm or 6 inches (150 mm), whichever is less, the Contractor will remove the accumulated silt and dispose of it at an approved disposal site in a manner that will not contribute to additional siltation. The berm will be reshaped as needed during construction.

When the site is completely stabilized, the berm will be removed and disposed of in a manner approved by the Engineer or designated representative.

The area will be re-vegetated as required by Item No. 604, "Seeding for Erosion Control".

639.6 Measurement

Acceptable work performed and prescribed in this item will be measured by the linear foot (lineal meter: 1 lineal meter equals 3.281 lineal feet) along the centerline of top of berm.

639.7 Payment

The work performed and material furnished and measured as provided under "Measurement" to construct this item will be paid for at the unit bid price per linear foot of rock berm barrier as indicated on the Drawings. The Unit Bid Price shall include full compensation for: (a) furnishing, hauling and placing all materials including all labor, tools, equipment and incidentals needed to complete the work, (b) maintaining the berm, (c) removing silt accumulations, (d) rock replacement, (e) removing and disposing of all materials when the berm is no longer required and (f) re-vegetating the site upon removal of the berm.

Payment will be made under:

Rock Berm Per Lineal Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification 639, "ROCK BERM"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 604	Seeding for Erosion Control

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 639, "ROCK BERM"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 111	Excavation
Item No. 120	Channel Excavation
Item No. 401	Structural Excavation and Backfill
Item No. 602	Sodding for Erosion Control
Item No. 605	Soil Retention Blanket
Item No. 606	Fertilizer
Item No. 608	Planting
Item No. 610	Preservation of Trees and Other Vegetation
Item No. 620	Filter Fabric

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<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

ITEM NO. 640

MOTARED ROCK WALL

640.1 Description

This item shall govern the construction of mortared rock walls, as herein specified, on a prepared subgrade, including furnishing the stone, mortar and other related materials to construct walls, the excavation and backfilling the wall, removal of any old structure or portions thereof encountered, disposal of surplus excavated material and the completion of Mortared Rock Walls as indicated on the Drawings 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, the inch-pound units are given preference followed by SI units shown within parentheses.

640.2 Submittals

The submittal requirements for this specification item shall include:

- A. Details concerning the p.c. concrete footing including dimensions of the footing, the p.c. concrete mix design, steel reinforcement, etc.
- B. Source, type and gradation of rock
- C. Mortar mix design.

640.3 Materials

- A. Rock:

All types used shall be native limestone suitable for horizontal course type construction. The size of rock to be used for construction shall be as indicated on the Drawings, but may vary as approved by the Engineer or designated representative.

- B. Portland Cement: ASTM C 150, Type I
- C. Masonry Cement: ASTM C 91
- D. Sand: ASTM C 144, Natural
- E. Water: Free from matter that could impair suitability for use in mortar
- F. Hydrated Lime: ASTM C 207, Type S
- G. Mortar:

Mortar shall be composed of 1 part Portland Cement, 1 part hydrated lime and 6 parts sand (by volume) and water. Mortar shall have a consistency that insures that it can be easily spread by a trowel. An alternate mix composed of 1 part masonry cement and 3 parts sand may be used. The sand shall be measured damp and loose.

640.4 Construction Methods

Stone shall be laid plumb, level or true to a line. All stone shall be laid in a full bed of mortar with head joints and edge joints completely filled. The face shall be aligned or exposed as indicated on the Drawings. Exterior joints that will remain exposed shall be finished in a manner approved by the Engineer or designated representative.

In hot weather, stone work shall be kept moist until the mortar has set. No mortar work will be done when the temperature is below 40°F (4°C) in the shade and all work may be suspended during freezing or undesirable weather. The mortar materials shall be mixed mechanically for not less than 5 minutes after all ingredients are in the mixer. Mortar that has begun to set or that has been mixed for more than 2 hours shall not be used.

Spalls may be used in partially filling the large voids, provided they are keyed in properly and are well coated with mortar. All finished rockwork shall be protected from damage. Chipped rockwork, that will remain exposed, shall be satisfactorily repaired or replaced.

Mortared rock walls shall consist of courses or layers of rock with the spaces between them filled with mortar and shall be constructed at such places as indicated on the Drawings or as directed by the Engineer or designated representative, in accordance with these specifications and in conformity with the lines, grades, height, depth and other details shown on the pertinent typical sections.

Excavation and concrete footings for mortared rock walls shall not be paid for directly, but shall be considered subsidiary to mortared rock wall construction.

Prior to placing any material, the footings shall have been placed by the Contractor as part of this contract to the approved line and grade and allowed at least 36 hours curing time. The rock shall then be thoroughly wet and bedded in 1 inch (25 mm) of mortar placed on the footings, one against the other, with the resulting voids being completely filled with mortar. The finished surface shall be even and level.

640.5 Measurement

Mortared rock wall will be measured by the square foot (square meter: 1 square meter equals 10.76 square feet) of the exposed face of wall. No measurement will be made for concrete footing and shall be considered subsidiary to the rock wall construction.

640.6 Payment

Mortared rock wall acceptably completed will be paid for at the contract unit bid price per square foot. The unit bid price shall include full compensation for furnishing all materials, for excavation, and backfill, for all forming, transporting, placing, finishing and for all equipment, tools, labor and incidentals necessary to place mortared rock wall on concrete footing as specified and indicated on the Drawings.

Payment will be made under:

Mortared Rock Wall	Per Square Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification 640, "MORTARED ROCK WALL"

American Society for Testing and Materials, ASTM

<u>Designation</u>	<u>Description</u>
C 91	Specification for Masonry Cement
C 144	Specification for Aggregate for Masonry
C 150	Specification for Portland Cement
C 207	Specification for Hydrated Lime for Masonry

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 640, "MORTARED ROCK WALL"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 111	Excavation
Item No. 401	Structural Excavation and Backfill
Item No. 403	Concrete for Structures
Item No. 405	Concrete Admixtures
Item No. 406	Reinforcing Steel
Item No. 606	Fertilizer
Item No. 608	Planting
Item No. 610	Preservation of Trees and Other Vegetation
Item No. 620	Filter Fabric

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work

ITEM NO. 641

STABILIZED CONSTRUCTION ENTRANCE

641.1 Description

This item governs the construction of a stabilized pad of crushed stone located at any point where traffic will be entering or leaving a construction site to or from a public right of way, street, alley, sidewalk or parking area. The purpose of a stabilized construction entrance is to reduce or eliminate the tracking or deposition of sediment onto public right of way or paved areas.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

641.2 Submittals

The submittal requirements for this specification item shall include:

- A. Source, type and gradation of rock
- B. Drainage technique (i.e. drainage swale or entrance grading) proposed to prevent runoff from exiting the construction site.

641.3 Materials

Aggregate for construction shall conform to the following gradation:

Table 1: Aggregate Gradation Chart (TEX 401-A, % Retained per sieve)	
US 5 inch (SI 125 mm)	US 2 inch (SI 50 mm)
0	100

641.4 Construction Methods

All trees, brush, stumps, obstructions and other objectionable material shall be removed and disposed of in a manner that will not interfere with the excavation and construction of the entrance as indicated on the Drawings. The entrance shall not drain onto public right of way or shall not allow surface water runoff to exit the construction site.

When necessary, vehicle wheels shall be cleaned to remove sediment prior to entrance onto paved areas or public right of way. When vehicle washing is required, it shall be done on an area stabilized with crushed stone, which drains into an approved sediment trap or sediment basin. All sediment shall be prevented from entering any storm drain, ditch or watercourse through use of sand bags, gravel, boards, silt fence (Standard Specification Item No 642) or other methods approved by the Engineer or designated representative.

The entrance shall be maintained in a condition that will prevent tracking or disposition of sediment onto paved areas or public right of way. This restriction may require

periodic top dressing with additional stone as conditions demand, as well as the repair and/or cleanout of any measures used to trap sediment. All sediment that is spilled, dropped, washed or tracked onto paved areas or public right of way must be removed immediately.

641.5 Measurement

Acceptable work performed as prescribed in this item will be measured by unit of each stabilized construction entrance installed.

641.6 Payment

Work performed and materials furnished under this item shall be paid for at the unit bid price per each.

Payment, when included as a contract pay item, will be made under:

Stabilized Construction Entrance	Per Each.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS
Specification 641, "STABILIZATION CONTRUCTION ENTRANCE (SCE)"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 642	Silt Fence (SF)

<u>RELATED</u> CROSS REFERENCE MATERIALS
Specification 641, "STABILIZATION CONTRUCTION ENTRANCE (SCE)"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 111	Excavation
Item No. 120	Channel Excavation
Item No. 401	Structural Excavation and Backfill
Item No. 610	Preservation of Trees and Other Vegetation

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 168	Vegetative Watering

ITEM NO. 642

SILT FENCE

642.1 Description

This item shall govern the provision and placement of a filter fabric fence including maintenance of the fence, removal of accumulated silt and removal of the silt fence upon completion of the project.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

642.2 Submittals

The submittal requirements for this specification item shall include:

- A. Source, manufacturer, characteristics and test data for the filter fabric,
- B. Manufacturer, characteristics and test data for the posts and wire fence.

642.3 Materials

A. Fabric

1. General:

The filter fabric shall be of nonwoven polypropylene, polyethylene or polyamide thermoplastic fibers with non-raveling edges. The fabric shall be non-biodegradable, inert to most soil chemicals, ultraviolet resistant, unaffected by moisture or other weather conditions, and permeable to water while retaining sediment. The filter fabric shall be supplied in rolls a minimum of 36 inches (0.9 meter) wide.

2. Physical Requirements:

The fabric shall meet the requirements presented in Table 1, when sampled and tested in accordance with the methods indicated herein, and/or on the Drawings.

B. Posts:

Posts shall be painted or galvanized steel Tee or Y-posts with anchor plates, not less than 5 feet (1.5 meters) in length with a minimum weight of 1.3 pounds per foot (1.9 kilograms per meter) with a minimum Brinell Hardness of 143. Hangers shall be adequate to secure fence and fabric to posts. Posts and anchor plates shall conform to ASTM A-702.

C. Wire Fence:

Wire fence shall be welded wire fabric 2 x 4 - W1.0 x W1.0 (50 x 100 - MW7 x MW7) and shall conform to Standard Specification Item No. 406, "Reinforcing Steel".

TABLE 1. Filter Fabric Requirements		
Physical Properties	Method	Requirements
Fabric Weight in ounces per square yard (grams/square meter)	TEX-616-J ¹	4.5 minimum (150 minimum)
Water Flow Rate in gallons/sq. foot/ minute (liters/square meter/minute)	TEX-616-J ¹	40 maximum (1630 maximum)
Equivalent Sieve Opening Size: US Standard (SI Standard sieve size)	CW-02215 ²	40 to 100 (425 to 150 mm)
Mullen Burst Strength: lbs. per sq. inch (psi) megaPascal (mPa)	ASTM D-3786 ³	300 minimum (2 minimum)
Ultraviolet Resistance; % Strength Retention	ASTM D-1682 ⁴	70 minimum

¹ TxDoT Test Method Tex-616-J, "Testing of Construction Fabrics".

² US Army Corps of Engineers Civil Works Construction Guide Specification CW-02215, "Plastic Filter Fabric".

³ ASTM D-3786, "Test Method for Hydraulic Bursting Strength of Knitting Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method".

⁴ ASTM D-1682, "Test Methods for Breaking Load and Elongation of Textile Fabrics".

642.4 Construction Methods

The silt fence fabric shall be securely attached to the posts and the wire support fence with the bottom 12 inches (300 mm) of the filter material buried in a trench a minimum of 6 inches (150 mm) deep and 6 inches (150 mm) wide to prevent sediment from passing under the fence. When the silt fence is constructed on impervious material, a 12-inch (300-mm) flap of fabric shall be extended upstream from the bottom of the silt fence and weighted to limit particulate loss. No horizontal joints will be allowed in the filter fabric. Vertical joints shall be overlapped a minimum of 12 inches (300 mm) with the ends sewn or otherwise securely tied.

The silt fence shall be a minimum of 24 inches (0.6 meter) high. Posts shall be embedded a minimum of 12 inches (300 mm) in the ground, placed a maximum of 8 feet (2.4 meters) apart and set on a slight angle toward the anticipated runoff source. When directed by the Engineer or designated representative, posts shall be set at specified intervals to support concentrated loads.

The silt fence shall be repaired, replaced, and/or relocated when necessary or as directed by the Engineer or designated representative. Accumulated silt shall be

removed when it reaches a depth of 6 inches (150 mm), or lesser depth if the integrity of the silt fence has been jeopardized.

642. 5 Measurement

The work performed and the materials furnished under this item will be measured by the lineal foot of "Silt Fence", complete in place.

642.6 Payment

The work performed and materials furnished and measured as provided under "Measurement" will be paid for at the unit bid price per lineal foot of "Silt Fence". The price shall include full compensation for furnishing, hauling and placing all materials, labor, tools, equipment and incidentals necessary to complete the work including inspecting, repairing, replacing and relocating the fence, removal of silt and removal and disposal of all materials at the completion of construction and re-vegetation of disturbed areas.

Payment will be made under:

Silt Fence for Erosion Control

Per Lineal Foot.

END

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification 642 "SILT FENCE"

City of Round Rock Technical Specifications

<u>Designation</u>	<u>Description</u>
Item No. 406	Reinforcing Steel

American Society For Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
A-702	Specification for Steel Fence Posts and Assemblies, Hot Wrought
D-1682	Test Methods for Breaking Load and Elongation of Textile Fabrics
D-3786	Test Method for Hydraulic Bursting Strength of Knitting Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method

Texas Department of Transportation Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-616-J	Testing of Construction Fabrics

U.S. Army Corps of Engineers

<u>Designation</u>	<u>Description</u>
CW-02215	Civil Works Construction Guide Specification "Plastic Filter Fabric"

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 642 "SILT FENCE"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 111	Excavation
Item No. 120	Channel Excavation
Item No. 40	Structural Excavation and Backfill
Item No. 610	Preservation of Trees and Other Vegetation

ITEM NO. 643

STONE OUTLET STRUCTURE

643.1 Description

This item shall consist of a temporary crushed stone dike installed in conjunction with and as part of a diversion dike, interceptor dike or perimeter swale. The purpose of this stone outlet structure is to provide a protected outlet for a diversion dike, interceptor dike or perimeter dike, to provide for diffusion of concentrated flow and to allow the area behind the dike to de-water. This item shall include removal of the "Stone Outlet Structure" and re-vegetation of the area.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

643.2 Submittals

The submittal requirements for this specification item shall include:

- A. Source, manufacturer, characteristics and test data for the filter fabric,
- B. Source, type and gradation of stone,
- C. Re-vegetation program, including:
 - 1. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding.
 - 2. Type of mulch.
 - 3. Type of tacking agent.
 - 4. Type and rate of application of fertilizer.

643.3 Materials

- A. Stone

The stone used in construction of this stone outlet dike shall be crushed stone at least 3 inches (75 mm) in diameter but not over 6 inches (150 mm) in diameter or 1/2 cubic foot (.014 cubic meter) in volume.

- B. Seeding

Seeding for re-vegetation shall conform to Standard Specification Item No. 604, "Seeding for Erosion Control".

- C. Fabric Core

- 1. General:

The filter fabric shall be of non-woven polypropylene, polyethylene or polyamide geo-textile with non-raveling edges. The fabric shall be non-biodegradable, inert to most soil chemicals, ultraviolet resistant, unaffected by moisture or other weather conditions, and permeable to

water while retaining sediment. The filter fabric shall be supplied in rolls a minimum of 36 inches (0.9 meter) wide.

2. Physical Requirements:

The fabric shall meet the requirements presented in TABLE 1, when sampled and tested in accordance with the methods indicated herein and/or on the Drawings.

TABLE 1. Filter Fabric Requirements		
Physical Properties	Method	Requirements
Fabric Weight in ounces per square yard (grams/square meter)	TEX-616-J ¹	4.5 minimum (150 minimum)
Water Flow Rate in gallons/sq. foot/minute (liters/square meter/minute)	TEX-616-J ¹	40 maximum (1630 maximum)
Equivalent Sieve Opening Size: US Standard (SI Standard sieve size)	CW-02215 ²	40 minimum (425 mm minimum)
Mullen Burst Strength: lbs. per sq. inch (psi) megaPascal (mPa)	ASTM D-3786 ³	250 minimum (1.7 minimum)
Ultraviolet Resistance; % Strength Retention	ASTM D-1682 ⁴	70 minimum

¹ TxDoT Test Method Tex-616-J, "Testing of Construction Fabrics".

² US Army Corps of Engineers Civil Works Construction Guide Specification CW-02215, "Plastic Filter Fabric".

³ ASTM D-3786, "Test Method for Hydraulic Bursting Strength of Knitting Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method".

⁴ ASTM D-1682, "Test Methods for Breaking Load and Elongation of Textile Fabrics".

643.4 Construction Methods

On the area over which the Stone Outlet Structure is to be placed, all clearing, grubbing and excavation operations shall be completed before placing the Stone Outlet Structure. The Stone Outlet Structure foundation soil shall be compacted to the extent necessary to provide an in-place density (TxDoT Test Method Tex-115E) not less than 90 percent of the laboratory density as determined in accordance with TxDoT Test Method Tex-114-E. The stone shall be placed, spread and shaped to the grades indicated on the Drawings. All disturbed areas shall be graded and compacted to an in-place density (TxDoT Test Method Tex-115E) not less than 85 percent of the maximum laboratory density (TxDoT Test Method Tex-114-E) and then seeded in accordance with Standard Specification Item 604.

The stone outlet structure shall be inspected by the Contractor monthly and after each rainfall event of 1 inch (25 mm) or more. Stone shall be replaced when the structure ceases to function as intended due to silt accumulation among the stone, washout, construction traffic damage, etc. When the silt reaches a depth equal to 1/3 the height of the structure or six inches (150 mm), whichever is less, the Contractor will remove the accumulated silt and dispose of it at a disposal site, approved by the Engineer or designated representative, in a manner that will insure that additional siltation will not occur.

When indicated on the Drawings, the Stone Outlet Structure shall be removed when directed by the Engineer or designated representative and the area leveled off and protected by erosion control measures appropriate for the terrain. Stabilization shall consist of complete vegetation cover, sufficiently established to be erosion resistant.

643.5 Measurement

Acceptable work performed as prescribed by this item shall be measured by the cubic foot (cubic meter: 1 cubic meter equals 35.315 cubic feet) of the outlet.

643.6 Payment

Work performed and material furnished for this item will be paid for at the unit bid price per cubic foot. Aggregate will not be a separate pay item, but will be included in this cost.

Payment will be made under:

Stone Outlet Structure

Per Cubic Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification 643, "STONE OUTLET STRUCTURE"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>

Item No. 604	Seeding for Erosion Control

American Society For Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>

D-1682	Test Methods for Breaking Load and Elongation of Textile Fabrics
D-3786	Test Method for Hydraulic Bursting Strength of Knitting Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method

Texas Department of Transportation Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>

Tex-114-E	Laboratory Compaction Characteristics and Moisture-Density Relationship of Subgrade & Embankment Soils
Tex-115-E	Field Method For Determination of In-Place Density of Soils and Base Materials

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS - continued

Specification 643, "STONE OUTLET STRUCTURE"

<u>Designation</u>	<u>Description</u>
Tex-616-J	Testing of Construction Fabrics

U.S. Army Corps of Engineers

<u>Designation</u>	<u>Description</u>
CW-02215	Civil Works Construction Guide Specification, "Plastic Filter Fabric".

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 643, "STONE OUTLET STRUCTURE"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 111	Excavation
Item No. 120	Channel Excavation
Item No. 401	Structural Excavation and Backfill
Item No. 610	Preservation of Trees and Other Vegetation

ITEM NO. 644

STONE OUTLET SEDIMENT TRAP

644.1 Description

This item governs the construction of a temporary Stone Outlet Sediment Trap consisting of a basin formed by an embankment or excavation and an embankment. The outlet for the trap is over a level stone section. The stone outlet for a sediment trap differs from that for a stone outlet structure because of the intentional ponding of water behind the stone. To provide for a ponding area, a relatively impervious core (e.g., timber, concrete block or straw bales wrapped in three layers of geo-textile fabric) with a nominal diameter of 12 inches (300 mm) is placed in the stone enclosure. The core shall be covered by a minimum of 6 inches (150 mm) of stone.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

644.2 Submittals

The submittal requirements for this specification item shall include:

- A. Source, manufacturer, characteristics and test data for the filter fabric,
- B. Source, type and gradation of stone,
- C. Sediment Plan Details including type of trap, size of outlet, trap dimensions, embankment height and excavation depth, along with the drainage area.

644.3 Materials

- A. Core
The impervious inner core shall be constructed of timber, concrete block or straw bales.
- B. Rock
The rock shall be at least 3 inches (75 mm) in diameter and not exceed 6 inches (150 mm) or 1/2 cubic foot (.012 cubic meter) in volume.
- C. Embankment Fill
Fill material for the embankment shall be free of roots or other woody vegetation, as well as oversized stones, rocks, organic material or other objectionable material.
- D. Fabric Core
 - 1. General:
The filter fabric shall be of non-woven polypropylene, polyethylene or polyamide geo-textile with non-raveling edges. The fabric shall be non-biodegradable, inert to most soil chemicals, ultraviolet resistant, unaffected by moisture or other weather conditions, and permeable to

water while retaining sediment. The filter fabric shall be supplied in rolls a minimum of 36 inches (0.9 meter) wide.

2. Physical Requirements:

The fabric shall meet the requirements presented in TABLE 1, when sampled and tested in accordance with the methods indicated herein, and/or on the Drawings.

TABLE 1. Filter Fabric Requirements		
Physical Properties	Method	Requirements
Fabric Weight in ounces per square yard (grams/square meter)	TEX-616-J ¹	4.5 minimum (150 minimum)
Water Flow Rate in gallons/sq. foot/minute (liters/square meter/minute)	TEX-616-J ¹	40 maximum (1630 maximum)
Equivalent Sieve Opening Size: US Standard (SI Standard sieve size)	CW-02215 ²	40 minimum (425 mm minimum)
Mullen Burst Strength: lbs. per sq. inch (psi) megaPascal (mPa)	ASTM D-3786 ³	250 minimum (1.7 minimum)
Ultraviolet Resistance; % Strength Retention	ASTM D-1682 ⁴	70 minimum

¹ TxDoT Test Method Tex-616-J, "Testing of Construction Fabrics".

² US Army Corps of Engineers Civil Works Construction Guide Specification CW-02215, "Plastic Filter Fabric".

³ ASTM D-3786, "Test Method for Hydraulic Bursting Strength of Knitting Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method".

⁴ ASTM D-1682, "Test Methods for Breaking Load and Elongation of Textile Fabrics".

644.4 Construction Methods

Area under embankment shall be cleared, grubbed and stripped of any vegetation and root mat. The pool area shall be cleared.

All excavation operations shall be carried out in such a manner that erosion and water pollution shall be minimal. Any excavated portion of sediment trap shall have 2:1 or flatter slopes.

The embankment shall be mechanically compacted while it is being constructed. All fill slopes shall have a 2:1 slope or flatter.

The structure shall be inspected monthly and after each rainfall event of 1 inch (25 mm) or more. Repairs shall be made by the Contractor, as needed, throughout the duration of this contract or until the Engineer or designated representative issues written permission to remove the structure.

Sediment shall be removed and trap restored to its original dimensions when the sediment has accumulated to 1/2 the design depth of the trap or six inches (150 mm), whichever is less. The sediment that is removed shall be deposited in an area approved by the Engineer or designated representative in a manner that will insure that it will not erode.

The structure shall be removed and the area stabilized when the drainage area has been properly stabilized.

644.5 Measurement

Acceptable work performed as prescribed by this item will be measured by cubic feet (cubic meter: 1 cubic meter equals 10.764 cubic feet) of sediment trap constructed.

644.6 Payment

Work performed and materials furnished for this item will be paid for at the unit bid price per cubic foot of sediment trap constructed.

Payment will be made under:

Stone Outlet Sediment Trap

Per Cubic Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification 644, "STONE OUTLET SEDIMENT TRAP (SST)"

American Society For Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
D-1682	Test Methods for Breaking Load and Elongation of Textile Fabrics
D-3786	Test Method for Hydraulic Bursting Strength of Knitting Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method

Texas Department of Transportation Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-616-J	Testing of Construction Fabrics

U.S. Army Corps of Engineers

<u>Designation</u>	<u>Description</u>
CW-02215	Civil Works Construction Guide Specification, "Plastic Filter Fabric"

City of Round Rock Technical Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS - continued

Specification 644, "STONE OUTLET SEDIMENT TRAP (SST)"

<u>Designation</u>	<u>Description</u>
Item No. 111	Excavation
Item No. 120	Channel Excavation
Item No. 401	Structural Excavation and Backfill
Item No. 610	Preservation of Trees and Other Vegetation

ITEM NO. 646

TIED PRECAST CONCRETE REVETMENT

646.1 Description

This item shall govern the materials and construction of an Erosion Control System in accordance with these specifications and with the lines, grades, design and dimension indicated on the Drawings 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, the inch-pound units are given preference followed by SI units shown within parentheses.

646.2 Submittals

The submittal requirements for this specification item shall include:

- A. Source, manufacturer, characteristics and test data for the revetment rope,
- B. PC Concrete mix design information, including mix composition, source, type and gradation of aggregates, sand etc. and proposed admixtures,
- C. Source, manufacturer, characteristics and test data for the filter fabric

646.3 Materials

- A. Portland Cement (p.c.) Concrete

The Portland cement concrete shall be Class B and shall conform to Standard Specification Item No. 403, "Concrete for Structures".

Air entrainment admixtures shall be used in the p.c. concrete mix and shall conform to Standard Specification Item No. 405, "Concrete Admixtures". With prior approval of the Engineer or designated representative, retarding admixtures may be used. Concrete sand and crushed stone or gravel passing 3/8 inch US Standard (SI sieve designation of 9.5 mm) sieve shall be used for the concrete mix design.

- B. Revetment Rope

Revetment Rope shall be constructed of high tenacity, low elongation, continuous filament polyester fibers, consisting of parallel core fibers, which are contained within an outer braid jacket or cover.

The outer cover shall consist of an 8, 10, 12 or 16 strand braid covering the core fibers.

The weight (mass) of the core shall be between 65 percent and 75 percent of the total weight (mass) of the rope.

Construction of the rope shall be such that the cover braid is non-load bearing and the rope is torque free.

Minimum average breaking strengths for new, dry rope and the minimum and maximum weights (mass) for the rope are as follows:

Rope Diameter			Circumference		Minimum		Minimum	
Nominal		Actual			Weight, lbs. Per 100 ft.	Mass, kgs. per 100 m	Breaking Strength	
inches	Ins.	mm	Ins.	mm			lbs.	kNs.
3/16			.589	15	1.3	1.9	1,600	7.1
1/4		6.1	.754	19	2.1	4.1	2,750	12.2
1/4	.255	6.5	.801	20	2.6	5.0	3,300	14.7
1/4	.280	7.1	.880	22	2.9	5.6	4,000	17.8
1/4	.295	7.5	.927	24	3.1	6.0	4,500	20.0
5/16	.32	8.1	1.005	27	4.2	8.1	6,000	26.7
3/8	.380	9.6	1.194	30	5.0	9.7	8,800	39.1
1/2	.5	12.7	1.571	40	9.4	18.2	14,000	62.3

Elongation requirements specified below are based upon stabilized new, dry rope. Stabilization refers to a process in which the rope is cycled 50 times between a load corresponding to 200D square and a load equal to 10 percent, 20 percent or 30 percent of the rope's approximate average breaking strength. Relevant elongation values are as shown in the table below. The tolerance on these values is plus or minus 5 percent.

	Percent Breaking Strength		
	10%	20%	30%
Permanent Elongation While Working	0.7%	1.8%	2.6%
Elastic Elongation	0.6%	1.4%	2.2%
Total Stretch	1.3%	3.2%	4.8%

The critical temperature, defined as the point at which degradation of the rope occurs due to temperature alone, shall be a minimum of 350°F (177°C). The melting point of the rope materials shall be a minimum of 480°F(249°C).

C. Anchors and Miscellaneous Hardware

Anchors shall be screw type helix anchors and shall conform to ASTM A-36. Anchor size, length and spacing shall produce a direct pull equivalent to the dead weight (mass) of the mats. The anchors shall be galvanized in accordance with ASTM A-123. Clips, sleeves and other miscellaneous hardware shall be aluminum.

Filter fabric shall be placed below the revetment conforming to Item No. 620, "Filter Fabric".

D. Blocks and Mats

Cellular concrete blocks shall be cast to the dimensions of 4 inches (100 mm) by 11 7/8 (300 mm) inches by 23 7/8 inches (600 mm) nominal, with a minimum weight of 35 to 40 pounds per square foot (170 to 195 kilograms per square meter). (OPTIONAL: Each mattress shall contain a nonabrasive plastic tubing incorporated into the system continuously longitudinally and laterally.) The blocks shall have cells and outer recesses in the vertical direction. (OPTIONAL: Vertical cells may be eliminated in certain specified projects.)

The blocks shall be assembled into mats of length and width to fit the proposed work. The blocks shall be bound into mats by the use of the revetment rope. Two strands of rope shall extend through each block in a longitudinal direction and 1 strand of rope shall extend through each block in a lateral direction.

Each longitudinal rope will be looped at one end of each row of blocks and the ends bound together at the opposite end of each row. The binding of the rope ends shall be by sleeves. Lateral rope shall extend approximately 6 inches (150 mm) past the outer recesses of the mat and shall be held in place by buttons or similar devices.

Longitudinal ropes shall be a minimum 1/4 inch (6.3 mm) diameter for mats up to 50 feet (15 meters) in length and 5/16 inch (7.8 mm) for mat lengths in excess of 50 feet (15 meters). Rope used in the transverse direction shall be 1/4 inch (6.3 mm) in diameter.

646.4 Construction Methods

The slope on which the mats are to be placed shall be constructed according to the lines and grades indicated on the Drawings. Fills shall be placed by pushing embankment material into place with a bulldozer or similar equipment. When the material is high enough above water level to support compaction equipment, the fill shall be compacted by this equipment to an in-place density (TxDoT Test Method Tex-115-E) not less than 95 percent of the maximum density conforming to TxDoT Test Method Tex-114-E.

Additional height of fill will be obtained by adding thin layers of embankment material and walking it down with compaction equipment. The depth of layers and amount of compaction shall be varied to obtain a density equal to or greater than the adjoining natural soil.

An anchor trench shall be constructed at the top of the mat system according to the lines, grades and dimensions indicated on the Drawings. Toe trenches and side trenches, if indicated on the Drawings, will also be constructed.

Woven and/or non-woven filter fabric shall be placed on the slope and in the anchor and trench as indicated on the Drawings.

Prior to placement of the fabric, pieces of wood, rock, concrete, brick or other objects that might puncture the fabric shall be removed.

Fabric shall be placed directly on the ground surface. Longitudinal and transverse joints shall be overlapped at least 3 feet (0.9 meter). Workmen placing the fabric may walk on the fabric. However, equipment shall be prohibited from operating on it.

The fabric shall be kept in its protective wrapping until ready for use. Any fabric that has been out of its protective cover for over 72 hours without being covered shall be considered unsatisfactory and shall be removed and replaced with satisfactory fabric.

Torn, punctured or separated sections of fabric shall be repaired by placing a fabric patch over the hole prior to placing the mats. The patch shall be large enough to overlap a minimum of 3 feet (0.9 meter) in all directions.

The mats shall then be attached to a spreader bar or other type device and placed in their proper positions by the use of a crane or other equipment approved by the Engineer or designated representative.

Mats shall be anchored at the top by fastening the rope loop to anchors driven into the anchor trench as indicated on the Drawings. Enough anchors shall be used to support the entire weight (mass) of the mat.

As adjacent mats are placed, they shall be secured to each other from the top down to the water line by fastening the protruding transverse ropes together along each side of the mats. The fastening shall be done with sleeves or clips.

Anchor trenches and side trenches shall be backfilled and compacted flush with the top of the mats from the water line up.

Mats shall be custom fabricated at the plant or cut on the job site to fit irregular configurations.

The entire surface specified for erosion control shall be covered by mats without any vacancies, gaps or holes.

646.5 Measurement

Work and accepted material as prescribed for this item will be measured by the square foot (square meter: 1 square meter equals 10.764 square feet) of surface area and toe trenches covered by mats.

646.6 Payment

Work performed and materials furnished as prescribed by this specification item and measured under "Measurement" will be paid for at the unit bid price per square foot for "Tied Precast Concrete Revetment". This unit bid price shall include full compensation for all surface preparation, furnishing and placing all filter fabric, for furnishing and placing all blocks, rope, anchors, sleeves, clips and buttons and for all manipulation, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

Tied Precast Concrete Revetment

Per Square Foot.

End

<u>SPECIFIC</u> CROSS REFERENCE MATERIALS

Specification 646, "TIED PRECAST CONCRETE REVETMENT"

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 403	Concrete For Structures
Item No. 406	Concrete Admixtures
Item No. 620	Filter Fabric

American Society For Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
A-36	Specifications for Structural Steel
A-123	Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

Texas Department of Transportation Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-114-E	Laboratory Compaction Characteristics and Moisture-Density Relationship of Subgrade & Embankment Soils
Tex-115-E	Field Method For Determination of In-Place Density of Soils and Base Materials
Tex-616-J	Testing of Construction Fabrics

<u>RELATED</u> CROSS REFERENCE MATERIALS

Specification 646, "TIED PRECAST CONCRETE REVETMENT"

Texas Department of Transportation Manual of Testing Procedures

<u>Designation</u>	<u>Description</u>
Tex-616-J	Testing of Construction Fabrics

American Society For Testing and Materials (ASTM)

<u>Designation</u>	<u>Description</u>
D-1682	Test Methods for Breaking Load and Elongation of Textile Fabrics
D-3786	Test Method for Hydraulic Bursting Strength of Knitting Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method

City of Round Rock Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 101	Preparing Right of Way
Item No. 102	Clearing and Grubbing
Item No. 111	Excavation
Item No. 120	Channel Excavation
Item No. 401	Structural Excavation and Backfill
Item No. 610	Preservation of Trees and Other Vegetation

ATTACHMENT D

PRE-TEST

LABORATORY

Report #: T 217050-7
Boring #: B-1
Location:

DEPTH FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT.	UNIT DRY WT LB/CU FT	WATER CONTENT %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	% PASSING NO. 200 SIEVE.	COMP. TONS/SQ.F T	R.Q.D.
2.0	X		Gray Tan Clay w/ Imbedded Base Material			8.5	33	17	16	47.4	PP 2.0	
4.0			Greenish Gray Clay Base Material Imbedded								PP 2.0	
6.0			Tan Brown Clay								PP 2.5	
8.0	X		Tan Clay		101.1	23.6	70	25	45	92.0	PP 3.5	
13.0			Tan Shaley Clay with Red Orange Clay Imbedded Quartz Imbedded								PP 4.5+	
18.0	X		Gray Brown Shaley Clay Quartz Imbedded		105.8	21.4	69	25	44	99.2	PP 4.5+	
20.0	X		Brown Clay Imbedded Gray Shaley Clay, Gray Streaks		109.5	15.7	67	20	47	97.1	PP 4.5+	
COMPLETION DEPTH: 20.0' DATE: 4-4-17				DEPTH TO WATER IN BORING:								

02000 PLANS, DETAILS AND NOTES

If applicable, insert reference(s) to project plans; details; and notes

Construction Drawings for West WWTP Force Main Relocation in separate document.