



LAKE HAVASU CITY

FINAL CONTRACT DOCUMENTS

AND

TECHNICAL SPECIFICATIONS

VADOSE WELL DESIGN AND

EXPANSION

B24-PW-107015-500403

June, 2023

LAKE HAVASU CITY
CONTRACT DOCUMENTS
VOLUME 1

TABLE OF CONTENTS

DIVISION I – BID AND CONTRACT DOCUMENTS

LHC 00020	-	NOTICE INVITING BIDS
LHC 00040	-	INTENT TO BID NOTIFICATION
LHC 00100	-	INFORMATION FOR BIDDERS
LHC 00300	-	BID PROPOSAL
LHC 00310	-	BID SCHEDULE
LHC 00400	-	ARIZONA STATUTORY BID BOND
LHC 00420	-	BIDDER'S STATEMENT OF QUALIFICATIONS
LHC 00430	-	AFFIDAVIT OF CONTRACTOR CERTIFYING NO COLLUSION IN BIDDING
LHC 00450	-	HAZARD COMMUNICATION PROGRAM
LHC 00460	-	EMPLOYMENT ELIGIBILITY VERIFICATION FORM
LHC 00500	-	CONTRACT
LHC 00500A	-	INDEMNIFICATION & INSURANCE REQUIREMENTS
LHC 00500B	-	CONTRACTOR CLAIM HANDLING PROCEDURE
LHC 00510	-	ARIZONA STATUTORY PERFORMANCE BOND
LHC 00520	-	ARIZONA STATUTORY PAYMENT BOND
LHC 00670	-	NOTICE OF AWARD
LHC 00680	-	NOTICE TO PROCEED
LHC 00685	-	CERTIFICATE OF SUBSTANTIAL COMPLETION
LHC 00690	-	CERTIFICATION OF COMPLETION
LHC 00700	-	GENERAL CONDITIONS
LHC 00800	-	SPECIAL PROVISIONS

DIVISION 2 – GENERAL REQUIREMENTS

LHC 01110	-	SUMMARY OF WORK
LHC 01200	-	MOBILIZATION/DEMobilIZATION
LHC 01210	-	MEASUREMENT AND PAYMENT
LHC 01300	-	FORCE ACCOUNT
LHC 01320	-	PROJECT MEETINGS, SCHEDULES, AND REPORTS

LHC 01325	–	CONSTRUCTION PHOTOGRAPHS
LHC 01330	–	SUBMITTALS
LHC 01420	–	DEFINITIONS AND STANDARDS
LHC 01520	–	FIELD OFFICES AND SHEDS
LHC 01530	–	TEMPORARY BARRIERS AND CONTROLS
LHC 01560	–	TEMPORARY UTILITIES AND FACILITIES
LHC 01580	–	PROJECT IDENTIFICATION AND SIGNS
LHC 01600	–	EQUIPMENT AND MATERIALS
LHC 01631	–	SUBSTITUTIONS
LHC 01780	–	CONTRACT CLOSEOUT

DIVISION 3 – TECHNICAL SPECIFICATIONS

33 21 13.03	–	VADOSE WELL CONSTRUCTION
LHC 02100	–	CLEARING AND GRUBBING
LHC 02000	–	EARTHWORK
LHC 02254	–	SHEETING AND SHORED EXCAVATIONS
LHC 02300	–	TRENCH EXCAVATION AND BACKFILL
LHC 02510	–	ROCK RIP-RAP CONSTRUCTION
LHC 02515	–	UTILITY VALVES AND ACCESSORIES
LHC 02535	–	PIPE INSTALLATION
LHC 02550	–	WATER PIPING SYSTEMS
LHC 02551	–	REUSE LINE CONSTRUCTION
LHC 09900	–	PROTECTIVE COATINGS
LHC 16000	–	GENERAL ELECTRICAL REQUIREMENTS
LHC 16111	–	CONDUIT, FITTINGS AND ACCESSORIES
LHC 16120	–	WIRE, CABLE, AND ACCESSORIES
LHC 16450	–	GROUNDING
LHC 16900	–	GENERAL REQUIREMENTS INSTRUMENTATION AND CONTROLS
LHC 16902	–	MEASURING AND CONTROLLING INSTRUMENTS AND LOOPS
LHC 16924	–	PROGRAMMABLE LOGIC CONTROLLER (PLC) AND ACCESSORIES
LHC 16950	–	FIELD TESTING

**LAKE HAVASU CITY
VADOSE WELL DESIGN AND EXPANSION
PROJECT 107015
SECTION 001 SEALS PAGE**

SPECIFICATIONS

DIVISION 2 – GENERAL REQUIREMENTS

- LHC 01110 – SUMMARY OF WORK
- LHC 01200 – MOBILIZATION/DEMobilIZATION
- LHC 01210 – MEASUREMENT AND PAYMENT
- LHC 01300 -- FORCE ACCOUNT
- LHC 01320 – PROJECT MEETINGS, SCHEDULES, AND REPORTS
- LHC 01325 – CONSTRUCTION PHOTOGRAPHS
- LHC 01330 – SUBMITTALS
- LHC 01420 – DEFINITIONS AND STANDARDS
- LHC 01520 – FIELD OFFICES AND SHEDS
- LHC 01530 – TEMPORARY BARRIERS AND CONTROLS
- LHC 01560 – TEMPORARY UTILITIES AND FACILITIES
- LHC 01580 – PROJECT IDENTIFICATION AND SIGNS
- LHC 01600 – EQUIPMENT AND MATERIALS
- LHC 01631 – SUBSTITUTIONS
- LHC 01780 – CONTRACT CLOSEOUT

DIVISION 3 – TECHNICAL SPECIFICATIONS

- 33 21 13.03 – VADOSE WELL CONSTRUCTION
- LHC 02515 – UTILITY VALVES AND ACCESSORIES
- LHC 02550 – WATER PIPING SYSTEMS
- LHC 09900 – PROTECTIVE COATINGS



Expires 06/30/2025

Kevin M. Bral, P.E

**LAKE HAVASU CITY
VADOSE WELL DESIGN AND EXPANSION
PROJECT 107015
SECTION 001 SEALS PAGE**

SPECIFICATIONS

- DIVISION 3 – TECHNICAL SPECIFICATIONS
- LHC 02100 -- CLEARING AND GRUBBING
- LHC 02200 - EARTHWORK
- LHC 02254 – SHEETING AND SHORED EXCAVATIONS
- LHC 02300 – TRENCH EXCAVATION AND BACKFILLING
- LHC 02510 – ROCK RIP-RAP CONSTRUCTION
- LHC 02535 – PIPE INSTALLATION
- LHC 02550 – WATER PIPING SYSTEMS
- LHC 02600 – SUBGRADE PREPARATION
- LHC 02610 – AGGREGATE BASE COURSE
- LHC 02650 – TRAFFIC CONTROL
- LHC 02535 – PIPE INSTALLATION
- LHC 02551 – REUSE LINE CONSTRUCTION



EXPIRES 12-31-2025

Sean Perrotto

**LAKE HAVASU CITY
VADOSE WELL DESIGN AND EXPANSION
PROJECT 107015
SECTION 001 SEALS PAGE**

SPECIFICATIONS

DIVISION 3 – TECHNICAL SPECIFICATIONS

- LHC 16000 - GENERAL ELECTRICAL REQUIREMENTS
- LHC 16111 - CONDUIT, FITTINGS AND ACCESSORIES
- LHC 16120 - WIRE, CABLE AND ACCESSORIES
- LHC 16450 - GROUNDING
- LHC 16900 - GENERAL REQUIREMENTS – INSTRUMENTS AND CONTROLS
- LHC 16901 - CONTROL PANELS – INSTRUMENTS AND CONTROLS
- LHC 16902 - MEASURING AND CONTROLLING INSTRUMENTS AND LOOPS
- LHC 16924 - PROGRAMMABLE LOGIC CONTROLLER (PLC) AND ACCESSORIES
- LHC 16950 - FIELD TESTING



Joel Kath, P.E

SECTION 00020
NOTICE INVITING BIDS
Lake Havasu City

PROJECT NO.: B24-PW-107015-500403

PROJECT NAME: Vadose Well Design & Expansion

PRE-BID MEETING: NONE

BID DUE DATE: August 23, 2023

BID DUE TIME: 3:00 p.m., ARIZONA TIME

PROJECT DESCRIPTION:

The work involves constructing one (1) vadose zone injection well; wastewater conveyance from the existing forcemain to the vadose zone injection well; an access road and associated civil improvements; wellhead piping and appurtenances; and associated electrical and instrumentation and controls improvements.

QUESTIONS: All questions that arise relating to this solicitation shall be directed in writing to purchasing@lhcaz.gov with a copy to engineeringinfo@lhcaz.gov. To be considered, written inquiries shall be received at the above-referenced email address by August 11, 2023, 3:00 p.m. Arizona Time. Inquiries received will then be answered in an Addendum.

Sealed bids for the project specified will be received by the **City Clerk's Office, 2330 N. McCulloch Boulevard, Lake Havasu City, Arizona, 86403** until the time and date stated. **Bids received by the correct time and date will be opened and read aloud immediately thereafter in Room 109 of Lake Havasu City Hall.** Public openings may be attended virtually by accessing the following video conferencing system:

To join the meeting on a computer or mobile phone:
<https://bluejeans.com/2330864044?src=calendarLink>
Meeting ID: 233 086 4044
Phone Dial-in
+1.408.740.7256 (US (San Jose))
+1.888.240.2560 (US Toll Free)

Bids must be clearly addressed to the City Clerk's Office, 2330 McCulloch Blvd. N, Lake Havasu City, Arizona, 86403, and received no later than the exact time and date indicated above. Late bids will not be considered under any circumstances.

Bids must be submitted in a sealed envelope with the Project Number and the bidder's name and

address clearly indicated on the envelope. All bids must be completed in ink or typewritten on a form to be obtained from the specifications and a complete Invitation for Bid returned along with the offer no later than the time and date cited above.

Bid documents and specifications are available on Lake Havasu City's website at www.lhcaz.gov or on DemandStar at www.demandstar.com. For documents obtained outside of DemandStar please contact purchasing@lhcaz.gov to be added to the planholders' list.

For technical information, contact Jason Hart, Project Manager, at hartj@lhcaz.gov with a copy to purchasing@lhcaz.gov.

BONDS:

Bid Bond:	<u>10%</u>
Labor and Material Bond:	<u>100%</u>
Faithful Performance Bond:	<u>100%</u>

Project Completion Date: **80 calendar days** after Notice to Proceed.

Lake Havasu City reserves the right to accept or reject any or all bids or any part thereof and waive informalities deemed in the best interest of the City.

Pursuant to the Americans with Disabilities Act (ADA), Lake Havasu City endeavors to ensure the accessibility of all of its programs, facilities and services to all persons with disabilities. If you need an accommodation for this meeting, please contact the City Clerk's office at (928) 453-4142 at least 24 hours prior to the meeting so that an accommodation may be arranged.

Publication Dates: TODAY'S NEWS HEARLD - July 25, 2023 and August 1, 2023
ARIZONA BUSINESS GAZETTE - July 27, 2023 and August 3, 2023

**** END OF SECTION ****

SECTION 00100
INFORMATION FOR BIDDERS

1. RECEIPT AND OPENING OF BIDS

The City of Lake Havasu City, Arizona, (hereinafter called the "Owner") invites Bids on the form attached hereto. All blanks must be appropriately filled in. The Bidder shall also complete and submit a form listing proposed subcontractors as enclosed herein. Any subcontractors proposed to be used on the project but not listed on this form shall not be considered when evaluating the Contractor's qualifications and ability to perform the work. Bids **Vadose Well Design & Expansion, Project No. B24-PW-107015-500403** will be received by the **City Clerk's office, 2330 N. McCulloch Boulevard, Lake Havasu City, Arizona 86403 no later than 3:00 P.M., Arizona Time, August 23, 2023**, where said Bids will be publicly opened and virtually read aloud immediately thereafter in the Room 109 of Lake Havasu City Hall.

The Owner may consider informal any Bid not prepared and submitted in accordance with the provisions hereof and may waive any informalities or reject any and all Bids. Any Bid may be withdrawn prior to the above scheduled time for the opening of Bids or authorized postponement thereof. Any Bid received after the time and date specified shall not be considered. No Bidder may withdraw a Bid within ninety (90) days after the actual date of the opening thereof.

2. PREPARATION OF BID

Each Bid must be submitted on the prescribed Form. Each Document must be submitted with an original signature of the Bidder, as well as all witnesses indicated therein. All blank spaces for Bid prices must be filled in, in ink or typewritten, in both words and figures.

Each Bid must be submitted in a sealed envelope bearing on the outside the name of the Bidder, the Bidder's address, and the name and number of the project for which the Bid is submitted. If forwarded by mail, the sealed envelope containing the Bid must be enclosed in another envelope addressed as specified in the Bid form.

3. FACSIMILE BIDS OR MODIFICATIONS

No facsimile ("FAX") Bids or bid modifications will be accepted. Any modifications to the Bid shall be made by an authorized representative of the bidding company in person.

4. QUALIFICATIONS OF BIDDER

The Owner may make such investigations as he deems necessary to determine the qualifications of and the ability of the Bidder to perform the Work, and the Bidder shall furnish the Owner such information and data for this purpose as the Owner may request. The Owner may request that the Bidder provide a list of key people for the project with their related work experience.

The Owner reserves the right to reject any Bid if the evidence submitted by or investigation of such Bidder fails to satisfy the Owner that such Bidder is properly qualified to carry out the

obligations of the Contract and to complete the work contemplated therein in a timely manner. Conditional Bids will not be accepted.

All Bidders and listed subcontractors must be valid Arizona Licensed Contractors at the time of Bidding, approved by the Arizona State Registrar of Contractors to do the type and amount of work specified in these documents. In accordance with the Arizona State Registrar of Contractors, the Bidder must possess a minimum of a Class A Arizona Contractor's License to perform the type and amount of work specified in these documents. **Failure of any bidder to possess all contractors' licenses as listed in the bid packet, at the time of bidding, shall result in the bid being considered non-responsive and not in substantial compliance, and any such bid shall not be considered.** Refer to Section 00420, page 3, item 13.

5. ARITHMETIC DISCREPANCIES IN THE BID

A. For the purpose of the evaluation of Bids, the following will be utilized in resolving arithmetic discrepancies found on the face of the Bid Schedule as submitted by Bidders:

1. Obviously misplaced decimal points will be corrected;
2. In case of discrepancy between unit price and extended price, the unit price will govern;
3. Apparent errors in extension of unit prices will be corrected;
4. Apparent errors in addition of lump sums and extended prices will be corrected; and
5. In case of discrepancy between words and figures in unit prices, the amount shown in words shall govern.

B. For the purpose of Bid evaluation, the Owner will evaluate the bids on the basis of the unit prices, extensions, and totals arrived at by resolution of arithmetic discrepancies as provided above.

6. INCOMPLETE BIDS

Failure to submit a Bid on all items in the Schedule will result in an incomplete Bid and the Bid may be rejected. **UNIT OR LUMP SUM PRICES MUST BE SHOWN FOR EACH BID ITEM WITHIN THE SCHEDULE.**

NOTE: FAILURE TO INDICATE UNIT OR LUMP SUM PRICES IN THE APPROPRIATE COLUMN, WITH THE EXTENSION OF THE PRICES IN THE FAR RIGHT COLUMN, WILL CAUSE THE BID TO BE "NON-RESPONSIVE".

All forms indicated in the Bid Proposal, Section 00300, must be completely filled out, executed, and submitted with the Bid. Failure to do so will render the bid "non-responsive" and the bid will not be accepted.

7. BID SECURITY

Each Bid must be accompanied by certified check, cashier's check, or a Bid Bond prepared on the form attached hereto or on a similar form acceptable to the Owner, duly executed by the Bidder as principal and having as surety thereon a surety company approved by the Owner, in the amount of ten percent (10%) of the Bid. Bid Bonds shall be valid for at least ninety (90) days after the date of the receipt of Bids. Such cash, check or Bid Bond will be returned to all except the three (3) lowest Bidders within fifteen (15) business days after the opening of Bids. The remaining checks, or Bid Bonds will be returned promptly after the Owner and the accepted Bidder have executed the Contract, or if no award has been made within ninety (90) days after the date of the opening of Bids, upon demand of the Bidder at any time thereafter, so long as he has not been notified of the acceptance of his Bid.

8. LIQUIDATED DAMAGES FOR FAILURE TO ENTER INTO CONTRACT

The successful Bidder, upon his failure or refusal to execute and deliver the Contract, Bonds, and certificates required within ten (10) calendar days from the date of the Notice of Award, shall forfeit to the Owner, as liquidated damages for such failure or refusal, the difference between his bid and the amount of the contract actually entered into with another party should he not enter into a contract at the bid price and provide the required payment and performance bonds and certificates of insurance. Liquidated damages for failure to enter into the contract shall not exceed the amount of the Bid Bond.

9. SECURITY FOR FAITHFUL PERFORMANCE AND PAYMENT

Simultaneously with his delivery of the executed Contract, the Bidder shall furnish **on the forms provided herein**, in 100% of the amount of this Contract, 1) a surety bond as security for faithful performance of this Contract, and 2) a surety bond as security for the payment of all persons performing labor on the project under this Contract and persons furnishing materials in connection with this Contract, and 3) a listing of all subcontractors who will be performing or providing more than one-half percent (0.50%) of the contract work, as specified in the General Conditions included herein. The surety on such bond or bonds shall be a duly authorized surety company satisfactory to the Owner, listed on the Treasury Department's most current list (Circular 570 as amended), and authorized to transact business in the State of Arizona.

10. POWER OF ATTORNEY

Attorneys-in-fact who sign Bid Bonds or Contract bonds must file with each bond a certified and effectively dated copy of their power-of-attorney.

11. LAWS AND REGULATIONS

The Bidder's attention is directed to the fact that all applicable Federal Laws, State Laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the Contract throughout, and they will be deemed to be included in the Contract the same as though herein written out in full.

12. METHOD OF AWARD

A. The City will award the Contract on the basis of the Bid or Bids most advantageous to the City. In determining whether a Bid is most advantageous, in addition to price, the City may consider the following:

1. The ability, capacity, and skill of the Bidder to perform the Contract or provide the service indicated;
2. Whether the Bidder can perform the Contract or provide the service promptly, and within the time specified without delay or interference;
3. The character, integrity, reputation, judgment, experience, and efficiency of the Bidder;
4. The quality of performance on previous contracts;
5. The previous compliance with laws and ordinances by the Bidder;
6. The financial responsibility of the Bidder to perform under the Contract or provide the service;
7. The limitations of any license the Bidder may be required to possess;
8. The quality, availability, and adaptability of the product or service;
9. The ability of the Bidder to provide future maintenance and/or service;

The number and scope of any conditions attached to the Bid; and;

The life cycle, maintenance, and performance of the equipment or product being offered.

13. OBLIGATION OF THE BIDDER

At the time of the opening of Bids, each Bidder will be presumed to have inspected the site and to have read and to be thoroughly familiar with the Plans and Contract documents (including all Addenda, if applicable). The failure or omission of the Bidder to examine any form, instrument or document, or site changes due to natural causes, shall in no way relieve any Bidder from any obligation in respect to his Bid. Site changes due to natural causes prior to Bid opening shall not be cause for Bid alteration or withdrawal.

14. TIME OF COMPLETION AND LIQUIDATED DAMAGES

The Bidder must agree to commence work on or before a date to be specified in a written "Notice to Proceed" from the Owner, and to complete the work within **80 calendar days** of the date of the Notice to Proceed.

The Bidder further agrees to pay as liquidated damages, the sum indicated in the following Schedule of Liquidated Damages for each consecutive calendar day thereafter, plus any additional costs incurred by the Engineer as provided in Section 17 of the General Conditions, that the Contract remains incomplete. For the purposes of determining the Liquidated Damages for the project, the Original Contract Amount shall be that which is included in the Contract between the Owner and the Contractor for the project.

SCHEDULE OF LIQUIDATED DAMAGES		
Original Contract Amount		Daily Charges
From More Than	To and Including	Calendar Day or Fixed Rate
0	25,000	210
25,000	50,000	250
50,000	100,000	280
100,000	500,000	430
500,000	1,000,000	570
1,000,000	2,000,000	710
From More Than	To and Including	Calendar Day or Fixed Rate
2,000,000	5,000,000	1,070
5,000,000	10,000,000	1,420
10,000,000	---0---	1,780

15. CONDITIONS OF WORK

Each Bidder must inform himself fully of the conditions relating to the construction of the project and the employment of labor thereon. Failure to do so will not relieve a successful Bidder of his obligation to furnish all material and labor necessary to carry out the provisions of his Contract. Insofar as possible, the Contractor, in carrying out his work, must employ such methods or means as will not cause any interruption of or interference with the work of any other Contractor.

16. ADDENDA AND INTERPRETATIONS

All questions that arise relating to this solicitation shall be directed in writing to: purchasing@lhcaz.gov with a copy to engineeringinfo@lhcaz.gov.
 Administrative Services Department, Procurement Division
 Lake Havasu City
 2330 McCulloch Blvd. North
 Lake Havasu City, AZ 86403

Updated 10/23/2018

To be considered, written inquiries shall be received by the above-referenced contact by **August 11, 2023, 3:00 p.m. Arizona Time**. Inquiries received will then be answered in an Addendum. Any and all such interpretations and any supplemental instructions will be in the form of written Addenda to the Specifications which, if issued, will be available to all prospective Bidders, not later than five (5) calendar days prior to the date fixed for the opening of Bids. Failure of any Bidder to incorporate any such Addendum or interpretation shall not relieve such Bidder from any obligation under his/her Bid as submitted. All Addenda so issued shall become part of the Contract documents.

No informal contact initiated by offerors on this solicitation will be allowed with members of City staff from the date of distribution of this solicitation until after the closing date and time for the submissions of quotations. All questions or issues related to this solicitation shall be submitted in writing.

17. CONFLICT OF INTEREST

Pursuant to A.R.S. Section 38-511, this Contract is subject to cancellation by Buyer if any person significantly involved initiating, negotiating, securing, drafting or creating the Contract on behalf of Lake Havasu City is, at any time while the Contract is in effect, an employee of any other party to the Contract in any capacity or a consultant to any other party of the Contract with respect to the subject matter of the Contract.

18. NO COLLUSION

The bidder will be required to complete, notarize and submit as part of this bid package the "No Collusion Affidavit" form, as attached herein. Failure of the bidder to submit a properly executed affidavit may be grounds for rejection of the bid.

19. EMPLOYMENT ELIGIBILITY VERIFICATION

The bidder will be required to complete, notarize and submit as part of this bid package the "Employer Verification of Employment Eligibility" form, as attached herein. Failure of the bidder to submit a properly executed verification of eligibility form may be grounds for rejection of the bid.

20. EXAMINATION OF THE PLANS AND SPECIFICATIONS

Each Bid shall be made in accordance with the Plans and Specifications which may be examined at the following locations:

Lake Havasu City, 2330 N. McCulloch Boulevard, Lake Havasu City, AZ 86403, 928.855.2116

Dodge Data & Analytics, 3315 Central Avenue, Hot Springs, AR, 71913, 871.375.2946, FAX: 501.625.3544, www.construction.com, dodge.bidding@construction.com

Colorado River Building Industry Association, 2182 McCulloch Blvd, Suite 3, Lake Havasu City AZ

Updated 10/23/2018

86403, 928.453.7755, FAX: 928.453.3175, www.criba.org, frontdesk@criba.org

Northern AZ Home Builders, 1500 E. Cedar Avenue, Suite 86, Flagstaff AZ 86004, 928.779.3071, FAX: 928.779.4211, www.nazba.org, info@nazba.org

Performance Graphics Blueprinting, 4140 Lynn Drive, Suite 107, Fort Mohave, AZ, 86426, 928.763.6860, FAX 928.763.6835, prints@pgblueprinting.net

Construction Market Data, 30 Technology Parkway South, Suite 500, Norcross, GA 30092-2912, 800.876.4045, FAX: 800.303.8629, www.cmdgroup.com, projects@cmdgroup.com

ISqFt, 3301 N 24th Street, Phoenix, AZ, 85016, 800.364.2059, FAX: 800.792.7508, www.isqft.com, arizonaplanroom@isqft.com

Integrated Digital Technologies, LLC, 4633 E Broadway Blvd., Tucson, AZ 85711, PO Box 13086, Tucson AZ, 85732, 520.319.0988, FAX: 520.319.1430, www.contractorsplanroom.com, content@idtplans.com

Yuma/Southwest Contractors Association, 350 W. 16th Street, Suite 207, Yuma, AZ 85364, Phone: 928-539-9035, FAX: 928-539-9036, www.yswca.com, plans@yswca.com

Arizona Builders Exchange, 1700 N. McClintock Drive, Tempe, AZ, 85281, (480) 227-2620, www.azbex.com, rkettenhofen@azbex.com

Construction Reports.com, 4110 N Scottsdale Road, Suite 335, Scottsdale, AZ, 85251, 480.994.0020, FAX: 480.994.0030, www.constructionreports.com, jess@constructionreports.com

Construction Reporter, 1609 2nd Street NW, Albuquerque, NM, 87102, 505.243.9793, FAX: 505.242.4758, www.constructionreporter.com, jane@constructionreporter.com

PlanRoom Central at A&E Reprographics, 1030 Sandretto Drive, Suite F, Prescott, AZ, 86305, 928.442.9116, www.a-erepro.com, planroom1@a-erepro.com

Shirley's Plan Service, 425 S. Plumer Ave, Tucson, AZ, 85719, 520.791.7436, FAX: 520.882.9208, www.shirleysplanservice.com, bids@shirleysplanservice.com

Construction Notebook Nevada, 3131 Meade Ave, Suite B, Las Vegas, NV, 89102-7885, 702.876.8660, FAX: 702.876.5683, www.constructionnotebook.com

The Blue Book Building & Construction Network, Jefferson Valley, NY 10535, 800.431.2584, www.thebluebook.com, info@thebluebook.com, tdizon@mail.thebluebook.com

Integrated Marketing Systems (IMS), 945 Hornblend Street, Suite G, San Diego, CA 92109, 888.467.3151, FAX: 858.490.8811, www.imsinfo.com , ims@imsinfo.com

** END OF SECTION **

SECTION 00300
BID PROPOSAL

Lake Havasu City, Arizona

The undersigned, as bidder, declares that we have received and examined the documents entitled "**Vadose Well Design & Expansion, Project No. B24-PW-107015-500403**" and will contract with the Owner, on the form of Contract provided herewith, to do everything required for the fulfillment of the contract for the construction of the **Vadose Well Design & Expansion, Project No. B24-PW-107015-500403** at the prices and on the terms and conditions herein contained.

We agree that the Contract Documents include Divisions 1, 2, and 3 of the Contract Documents as well as the referenced documents.

We agree that the following shall form a part of this proposal and are included herein as our submittal:

Enclosed

<u>Section</u>	<u>Title</u>	<u>✓</u>
00300	Bid Proposal	_____
00310	Bid Schedule	_____
00400	Arizona Statutory Bid Bond	_____
00420	Bidder's Statement of Qualifications	_____
00430	Affidavit of Contractor Certifying That There Was No Collusion In Bidding For Contract	_____
00450	Hazard Communication Program	_____
00460	Employment Eligibility Verification	_____

We acknowledge that addenda numbers _____ through _____ have been received and have been examined as part of the Contract Documents.

We certify that our proposal is genuine, and not sham or collusive, nor made in the interest or behalf of any undisclosed person, organization, or corporation, and that we have not directly or indirectly induced or solicited any other bidder to put in a sham bid, or directly or indirectly induced or solicited any other potential bidder to refrain from bidding, and that we have not in any manner sought by collusion to secure an advantage over any other bidder.

The bidder agrees that this Bid shall be good and may not be withdrawn for a period of ninety (90) calendar days after the scheduled closing time for receiving Bids.

Upon receipt of written notice of the acceptance of this bid, Bidder shall execute the formal Contract attached within 10 days and deliver a Performance Bond, Payment Bond, and Certificates of Insurance as required by Paragraph 25 of the General Conditions and the Special Provisions.

We hereby declare that we have visited the site and have carefully examined the Contract Documents relating to the work covered by the above bid or bids.

Enclosed herewith is a certified or cashier's check or bid bond, payable to Lake Havasu City, Arizona, in the amount of ten percent (10%) of the total bid. This check or bond is submitted as a guarantee that we will enter into a Contract, and furnish the required bonds in the event a contract is awarded us. The bid security attached, without endorsement, is to become the property of Lake Havasu City, Arizona, in the event the Contract and Bonds are not executed within the time set forth, as liquidated damages for delay and additional work caused thereby.

Cooperative Use of Contract

This solicitation is being prepared by the City of Lake Havasu, Arizona ("City") for the use of the City. While this solicitation is for the use of the City, other eligible public agencies may have an interest in utilizing the resulting contract. After an award, and with the approval of the bidder, this solicitation may be utilized by eligible public agencies. Any such usage by other entities must be in accordance with the ordinance, charter and/or procurement rules and regulations of the respective political entity.

Please indicate below your acceptance or rejection regarding such participation of other governmental entities. Your response will not be considered a bid response requirement in awarding a contract. If you do not wish to grant such access to other eligible public agencies, please so state in your bid response below. In the absence of a statement to the contrary, the City will assume that you do wish to grant access to any contract that may result from this solicitation.

Bidder hereby grants _____, or does not grant _____, cooperative purchase access to other eligible public agencies.

We understand that Lake Havasu City, Arizona reserves the right to reject any and/or all bids, or to waive any informalities in any bid, deemed by them to be for the best interests of Lake Havasu City, Arizona.

Dated in _____ this _____ day of _____, ____.

Respectfully Submitted By:

By: _____

Title: _____

Name of Firm: _____

Address: _____

Phone: _____ FAX: _____

Email Address: _____

Seal - If bid by a Corporation:

Arizona Contractor's License No.: _____ Type: _____

Federal Tax ID No.: _____

**** END OF SECTION ****

BID SCHEDULE
LAKE HAVASU CITY

Vadose Well Design & Expansion
B24-PW-107015-500403

City Lake Havasu City Council
La Lake Havasu City
2330 N. McCulloch Boulevard
Lake Havasu City, AZ 86403

The City Council:

Pursuant to request for bids to be opened the **August 23, 2023 at 3:00 P.M.**, Arizona Time, at Room 109 of Lake Havasu City Hall, for the above project, the Contractor proposes to complete work, including furnishing all labor and materials, per the Specifications and Plans at the Following prices.

This Schedule of Items and Prices shall be completed in ink or typed by the Bidding Contractor. In case of discrepancy between the word and figure amount description, the word description shall control extensions.

Prices must be entered for each item and the appropriate subtotal and total blank shall be filled out. Bid prices shall include sales tax and all other applicable taxes and fees.

Bidder agrees to perform all the necessary work to complete the **Vadose Well Design & Expansion, Project No. B24-PW-107015-500403**

SECTION 310

BID SCHEDULE – Vadose Well Design & Expansion B24-PW-107015-500403

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>EST QTY</u>	<u>UNIT OF MEASURE</u>	<u>UNIT PRICE¹ (Word)</u>	<u>UNIT PRICE (Figure)</u>	<u>ITEM TOTAL² COSTS</u>
<u>BASE BID</u>						
1	Mobilization, Bonds, Insurance	1	L.S.	_____	\$ _____	\$ _____
2	Well drilling, construction, development, and testing	1	L.S.	_____	_____	_____
3	Pipeline from existing force main to new vadose zone injection well	1	L.S.	_____	\$ _____	\$ _____
4	Access road, wellhead pad, ramp and associated civil improvements	1	L.S.	_____	\$ _____	\$ _____
5	Wellhead piping and appurtenances	1	L.S.	_____	\$ _____	\$ _____
6	Electrical improvements and instrumentation and controls	1	L.S.	_____	\$ _____	\$ _____
7	Force Account	1	L.S.	Fifty Thousand Dollars	\$ 50,000	\$ 50,000
<u>BID TOTAL³ + FORCE ACCOUNT</u>				_____	\$ _____	\$ _____

Above line items and totals shall include all work shown on the plans and specified herein, including taxes, insurance and bonding.

¹ The “Unit Price” column shall indicate unit or lump sum prices for each bid item and shall be indicated in written and numerical form.

² The “Item Total Costs” column shall indicate the extension of the unit prices, which is obtained by multiplying the “Estimated Quantity” column by the “Unit Price” column.

³ The “Bid Total” amount shall be the sum of all costs listed in the “Item Total Costs” column.

The unit prices for **Vadose Well Design & Expansion, Project No. B24-PW-107015-500403**, shall include all labor, materials, water disposal, bailing, shoring, removal, disposal, overhead, profit, insurance, and all other related costs and work to cover the finished work of the several kinds called for. Changes in the Contract shall be processed in accordance with Paragraph 16 of the General Conditions.

Bidder understands that the Owner reserves the right to reject any or all Bids, or portions thereof, and to waive any informalities in the bidding.

The Bidder agrees that this Bid shall be good and may not be withdrawn for a period of ninety (90) calendar days after the scheduled closing time for receiving Bids.

Upon receipt of written notice of the acceptance of this Bid, Bidder shall execute the formal Contract attached within 10 days and deliver a Performance Bond, Payment Bond, and Certificates of Insurance as required by Paragraph 25 of the General Conditions and the Special Provisions.

The Bid security attached in the sum of \$_____ is to become the property of the Owner in the event the Contract and Bond(s) are not executed and provided within the time above set forth, as liquidated damages for the delay and additional expense to the Owner caused thereby.

Bidder hereby acknowledges receipt of the following Addenda: ____, ____, ____.

RESPECTFULLY SUBMITTED BY:

BY: _____

TITLE: _____

FIRM: _____

ADDRESS: _____

PHONE: _____ FAX _____

EMAIL: _____

Seal - if Bid by a corporation

AZ Contractor's License No: _____ Type _____

**** END OF SECTION ****

SECTION 00400
ARIZONA STATUTORY BID BOND

PURSUANT TO TITLES 28, 34 AND 41, ARIZONA REVISED STATUTES
(Penalty of this bond must not be less than 10% of the bid amount)

KNOW ALL MEN BY THESE PRESENTS:

That, _____(hereinafter "Principal"), as Principal, and _____, (hereinafter "Surety"), a corporation organized and existing under the laws of the State of _____, with its principal offices in the City of _____, holding a certificate of authority to transact surety business in Arizona issued by the Director of the Department of Insurance pursuant to Title 20, Chapter 2, Article 1, as Surety, are held and firmly bound unto Lake Havasu City, Arizona, (hereinafter "Obligee"), as Obligee, in the amount of Ten Percent (10%) of the amount of the bid of Principal, submitted by Principal to the Obligee for the work described below, for the payment of which sum, the Principal and Surety bind themselves, and their heirs, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a bid for

Vadose Well Design & Expansion, B24-PW-107015-500403

NOW, THEREFORE, if the Obligee shall accept the proposal of the Principal and the Principal shall enter into a contract with the Obligee in accordance with the terms of the proposal and give the bonds and certificates of insurance as specified in the standard specifications with good and sufficient surety for the faithful performance of the contract and for the prompt payment of labor and materials furnished in the prosecution of the contract, or in the event of the failure of the Principal to enter into the contract and give the bonds and certificates of insurance, if the Principal pays to the Obligee the difference not to exceed the penalty of the bond between the amount specified in the proposal and such larger amount for which the Obligee may in good faith contract with another party to perform the work covered by the proposal then this obligation is void. Otherwise it remains in full force and effect provided, however, that this bond is executed pursuant to the provisions of Section 34-201, Arizona Revised Statutes, and all liabilities on this bond shall be determined in accordance with the provisions of that section to the extent as if it were copied at length herein.

SECTION 00420
BIDDER'S STATEMENT OF QUALIFICATIONS

The Undersigned certifies the truth and correctness of all statements and of all answers to questions made hereinafter.

SUBMITTED TO: Lake Havasu City, Arizona
2330 N. McCulloch Boulevard
Lake Havasu City, AZ 86403

SUBMITTED BY: _____ NAME: _____
[] Corporation
[] Partnership
ADDRESS: _____ [] Individual
[] Joint Venture
PRINCIPAL OFFICE: _____ [] Other

(NOTE: Attach separate sheets as required)

1. How many years has your organization been in business as a Contractor?
2. How many years has your organization been in business under its present business name?

3. If a Corporation, answer the following:

Date of Incorporation: _____
State of Incorporation: _____
President: _____
Vice President(s): _____
Secretary: _____
Treasurer: _____

4. If a Partnership, answer the following:

Date of organization: _____
Type of Partnership: _____
(General/Limited/Assoc.)

Name and Address of all partners.

5. If other than a Corporation or Partnership, describe Organization and name Principals:

6. What percent of the work do you normally perform with your own forces?

List trades:

7. Have you ever failed to complete any work awarded to you? If so, indicate when, where and why:

8. Has any Officer or Partner of your Organization ever been an Officer or Partner of another Organization that failed to complete a construction contract? _____ If so, state circumstances:

9. List major construction projects your Organization has under contract on this date:

Project Name	Name, Email Address & Telephone Number of Owner	Project Location	Contract Amount	Contract Date	Percent Complete	Scheduled Completion

10. List similar construction projects your Organization has completed in the past five years:

Project Name	Name, Email Address & Telephone Number of Owner	Project Location	Contract Amount	Date Awarded	Date Completed	Percent with Own Forces

11. List the construction experience of the principal individuals in your Organization:

Individual's Name	Construction Experience - Years	Within Your Organization		
		Present Position & Years Experience	Dollar Volume Responsibility	Previous Position & Years Experience

12. List states and categories in which your Organization is legally qualified to do business:

13. List all Arizona Contractor licenses currently held by your Organization; the status of each license; and provide a photocopy of each license with your bid proposal.

	<u>License Class / #</u>	<u>Status</u>
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____

Please attach a list of additional Arizona Contractor licenses, if any.

14. Bank References:

15. Trade References:

16. Name of Bonding and Insurance Companies and Name and Address of Agents: Maximum

Bonding Capacity _____

17. The Undersigned agrees to furnish, upon request by the Owner, within seven days after the Bid Opening, a current Statement of Financial Conditions, including Contractor's latest regular dated financial statement or balance sheet which must contain the following items:

Current Assets: (Cash, joint venture accounts, accounts receivable, notes receivable, accrued interest on notes, deposits, and materials and prepaid expenses), net fixed assets and other assets.

Current Liabilities: (Accounts payable, notes payable, accrued interest on notes, provision for income taxes, advances received from owners, accrued salaries, accrued payroll taxes), other liabilities, and capital (capital stock, authorized and outstanding shares par values, earned surplus).

Date of statement or balance sheet: _____

Name of firm preparing statement: _____

By: _____
(Agent and Capacity)

18. List of Subcontractors. In accordance with paragraph 1.0 of Instructions to Bidders, the following is a breakdown of all subcontractors anticipated to be used for completing this project and their approximate percentage of work to be performed.

The Bidder certifies that all Subcontractors listed are eligible to perform Work on public works projects pursuant to ARS 34-241.

<u>Subcontractor</u>	<u>Description of Work</u>	<u>% of Total Project</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
	Total % of all Subcontractor's work on	_____

_____ project _____

Total % for Prime Contractor _____

19. Dated at _____ this _ day of _____, _____

Name of Organization: _____

By: _____

Title: _____

** END OF SECTION **

SECTION 00430
**AFFIDAVIT OF CONTRACTOR
CERTIFYING THAT THERE WAS
NO COLLUSION IN BIDDING
FOR CONTRACT**

STATE OF)
) ss
CITY OF)

(NAME OF INDIVIDUAL)

BEING DULY SWORN, DEPOSES AND SAYS:

THAT HE IS _____

(TITLE)

OF _____

(NAME OF BUSINESS)

THAT PURSUANT TO SECTION 34-253 OF THE ARIZONA REVISED STATUTES, HE CERTIFIES AS FOLLOWS:

THAT NEITHER HE NOR ANYONE ASSOCIATED WITH SAID

(NAME OF BUSINESS)

HAS DIRECTLY, OR INDIRECTLY, ENTERED INTO ANY CONTRACT, PARTICIPATED IN ANY COLLUSION OR OTHERWISE TAKEN ANY ACTION IN RESTRAINT OF FREE COMPETITIVE BIDDING IN CONNECTION WITH THIS PROJECT.

NAME

TITLE

NAME OF BUSINESS

SUBSCRIBED AND SWORN TO BEFORE ME THIS ___ DAY OF _____, _____

MY COMMISSION EXPIRES: _____

NOTARY PUBLIC: _____

** END OF SECTION **

SECTION 00450
HAZARD COMMUNICATION PROGRAM
Lake Havasu City

HAZARD COMMUNICATION PROGRAM FOR _____

(Name of Company)

The purpose of this program is to ensure that potential hazards and hazard control measures for chemicals used by this company are understood by company employees.

The written program is available for employee review at any time. It is located _____ . A copy of the program will be provided to any employee or employee representative, upon request.

CONTAINER LABELING:

_____ will verify that all containers received for use by this company will: (name/title of individual)

- * be clearly labeled as to the contents, matching identification on SDS;
- * note the appropriate hazard warnings;
- * List the name and address of the manufacturer.

No containers will be released for use until the above data is verified.

MATERIAL SAFETY DATA SHEETS:

Copies of SDS's for all hazardous chemicals to which employees may be exposed will be kept

_____ will be responsible for ensuring that:
(name/title of individual)

- * SDS's for the new chemicals are available;
- * SDS's will be available for review to all employees during each work shift;
- * Copies will be available on request.

EMPLOYEE TRAINING AND INFORMATION:

Each employee will be provided the following information and training before working in areas where hazardous chemicals exist. In addition, if a new hazardous material is introduced into the workplace, affected employees will be given new information and training concerning that material.

A. Minimum Information Provided:

- (1) All operations and locations in the work area where hazardous chemicals are present.

GENERAL INDUSTRY

A. Minimum Information Provided:

- (1) The location and availability of the written hazard communication program, including list(s) of hazardous chemicals used and related material safety data sheets;
- (2) The method the company will use to inform employees of potential hazards of non-routine tasks (jobs that are not routine for an individual because of infrequency, location or type.)

B. Minimum Training Provided:

- (1) Methods and observations used to detect the presence or release of a hazardous chemical in the work area (such as company monitoring programs, continuous monitoring device, visual appearance, odor or to other characteristics of hazardous chemicals;
- (2) The physical and health hazards of chemicals in the assigned work area;
- (3) The measures to take to protect against such hazards, including specific company procedures concerning work practices, emergencies and care and use of protective equipment.
- (4) Details of the company hazard communication program, including explanation of the labeling system, the material safety data sheets, and how to obtain and use the appropriate hazard information.

(OPTIONAL) Upon completion of the training, each employee will sign a form acknowledging receipt of the written hazard communication program and related training.

HAZARDOUS NON-ROUTINE TASKS: (If applicable.)

If company employees are required to do hazardous non-routine tasks, such as welding in confined spaces, or cleaning of tanks, the employer must address how the employees doing the work will be informed about the specific hazards to which they will be exposed, what personal protective equipment will be provided and who will be responsible to oversee the operation or operations. If the company does not have any hazardous non-routine tasks, line through this section and state "NO HAZARDOUS NON-ROUTINE TASKS".

CHEMICALS IN UNLABELED PIPES: (If applicable.)

If the company has chemicals in unlabeled pipes, the company must inform the employees of the hazards associated with those chemicals. If the company does not have any chemicals in unlabeled pipes, line through this section and state "NO CHEMICALS IN UNLABELED PIPES".

INFORMING CONTRACTORS:

Providing contractors and their employees with the following information is the responsibility of _____.

(Name/title of individual)

- (1) Hazardous chemicals to which they may be exposed while on the job site;
- (2) Measures the employees may take to lessen the possibility of exposure;
- (3) Steps the company has taken to lessen the risks;
- (4) Where the SDS's are for chemicals to which they may be exposed;
- (5) Procedures to follow if they are exposed.

CONTRACTORS INFORMING EMPLOYERS:

Contractors entering this workplace with hazardous materials will supply this employer with SDS's covering those particular products the contractor may expose this company's employees to while working at this site.

LIST OF HAZARDOUS CHEMICALS IN THIS WORKPLACE

CONTRACTOR:

By: _____

Name: _____

Title: _____

Address: _____

END OF SECTION

SECTION 00460

LAKE HAVASU CITY
EMPLOYMENT ELIGIBILITY VERIFICATION & FORM

INSTRUCTIONS FOR COMPLETION OF EMPLOYMENT ELIGIBILITY VERIFICATION FORM

WHO MUST COMPLETE THIS FORM:

In accordance with Lake Havasu City Code Chapter 3.30, Employment of Unauthorized Aliens, all contractors and subcontractors furnishing labor, time, or effort for construction or maintenance of any structure, building, transportation facility, or improvements of real property must complete this form.

Contractors or subcontractors, as described above, must certify that they have complied, in good faith, with the applicable requirements of the Federal Immigration Control and Reform Act with respect to the hiring of covered employees. This certification must be executed by an authorized representative.

WHEN THIS FORM MUST BE COMPLETED:

This form must be completed by all contractors and subcontractors and submitted to the City department awarding the contract, license agreement, or lease no later than notification of successful direct selection, bid, request for proposals, request for qualification, or any similar competitive or noncompetitive procurement or bidding process.

SECTION 00460

**LAKE HAVASU CITY
EMPLOYMENT ELIGIBILITY VERIFICATION & FORM**

LIST OF ACCEPTABLE DOCUMENTS:

LIST A		LIST B		LIST C
Documents that Establish Both	OR	Documents that Establish	AND	Documents that Establish
U.S. Passport (unexpired or expired)		Driver's license or ID Card issued by a state or outlying possession of the United States provided it contains a photograph or information such as name date of birth		U.S. social security card issued by the Social Security Administration
Certificate of U.S. Citizenship		ID card issued by a federal, state or local government agencies or entities, provided it contains a photograph or information		Certification of Birth Abroad issued by the Department of State
Certificate of Naturalization		School ID card with photograph		Original or certified copy of a birth certificate issued by a state, county, municipal authority or outlying
Unexpired foreign passport with I-551 stamp or attached federal Form I-94		Voter's registration card		Native American tribal document
Permanent Resident Card or Alien		U.S. Military card or draft record		U.S. Citizen ID Card
Unexpired Temporary		Military dependent's ID card		ID Card for the use of Resident Citizen in the
Unexpired Employment		U.S. Coast Guard Merchant Mariner Card		Unexpired employment authorization document issued by DHS
Unexpired Reentry		Native American tribal		
Unexpired Refugee Travel Document		Driver's license issued by a		
Unexpired Employment Authorization Document issued by DHS that contains a		For persons under age 18 who are unable to present a document listed above: School record or report card; Clinic.		

LAKE HAVASU CITY
EMPLOYER VERIFICATION OF EMPLOYMENT ELIGIBILITY & FORM

The undersigned attests under penalty of perjury, that they have reviewed the documents presented to them by their employees, and that the documents provided to the undersigned by their employees, as more particularly identified in the attached exhibit entitled "list of acceptable documents" appear to be genuine and appear to relate to the employee name, and to the best of the undersigned's knowledge, the employee is eligible to work in the United States based upon the undersigned's review of the documents presented.

Signature of Authorized Representative of Covered Employer/Contractor/Subcontractor	Print Name	Title
Business or Organization Name	Business Phone Number	Date (month/date/year)
Address (Street Name and Number)		
City, State, Zip Code		

SECTION 00500
CONTRACT

THIS CONTRACT is entered into by and between LAKE HAVASU CITY, ARIZONA, a municipal corporation ("OWNER"), and _____ an ARIZONA corporation, **Federal I.D. #** ("CONTRACTOR").

WHEREAS, OWNER has developed plans for and desires to commence the **Vadose Well Design and Expansion, Project No. B24-PW-107015-500403** ("PROJECT"); and

WHEREAS, CONTRACTOR represents that it possesses the experience, competence, equipment and financing to properly complete the PROJECT, and has formally proposed to do so, and to furnish all necessary labor, materials, and equipment and services therefore in accordance with said plans, and subject to the terms and conditions hereof.

NOW, THEREFORE, in consideration of these promises and the mutual covenants herein, it is hereby agreed as follows:

1. CONTRACTOR shall commence and complete the construction of the PROJECT;
2. CONTRACTOR shall furnish all of the material, supplies, tools, equipment, labor and other services necessary for the construction and completion of the PROJECT.
3. CONTRACTOR shall commence the PROJECT in accordance with the CONTRACT DOCUMENTS within TEN (10) calendar days after the date of the Notice to Proceed. Final completion of the PROJECT shall occur within **80 calendar days** of the date of the Notice to Proceed. The period for completion may be extended through the authorized and approved change order process.
4. Liquidated Damages: OWNER and CONTRACTOR recognize that time is of the essence of this CONTRACT and that OWNER will suffer financial loss if the PROJECT is not completed within the time specified in paragraph 3 above, plus any extensions thereof allowed in accordance with the General Conditions. They also recognize the delays, expense and difficulties involved in proving in a legal or arbitration proceeding the actual losses or damages (including special, indirect, consequential, incidental and any other losses or damages) suffered by OWNER if a complete acceptable PROJECT is not delivered on time.

Accordingly, and instead of requiring proof of such losses or damages, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty) CONTRACTOR shall pay the OWNER **\$XXX** for each calendar day that expires after the time specified in paragraph 3 for delivery of acceptable Bid Items, plus any costs incurred by the Engineer as provided in Section 17 of the General Conditions.

5. CONTRACTOR agrees to complete the PROJECT in accordance with all of the

terms and conditions of the CONTRACT DOCUMENTS for the sum of \$_____ as shown in the Bid Schedule.

6. CONTRACTOR shall submit a completed Section 00450 entitled Hazard Communication Program with the executed copy of this CONTRACT.
7. The term "CONTRACT DOCUMENTS" means and includes the following:
 - 00020 Notice Inviting Bids
 - 00100 Information for Bidders
 - 00300 Bid Proposal
 - 00310 Bid Price Schedule
 - 00400 Bid Bond
 - 00420 Bidder's Statement of Qualifications
 - 00430 Bidder's Affidavit of No Collusion
 - 00450 Hazard Communication Program
 - 00460 Employment Eligibility Verification
 - 00500 CONTRACT
 - 00500A Indemnification and Insurance Requirements
 - 00500B Contractor Claim Handling Procedure
 - 00510 Arizona Statutory Performance Bond
 - 00520 Arizona Statutory Payment Bond
 - 00670 Notice of Award
 - 00680 Notice to Proceed
 - 00685 Certificate of Substantial Completion
 - 00690 Certificate of Final Completion
 - 00700 General Conditions
 - 00800 Special Provisions
 - Technical Specifications and Details
 - Construction Contract Drawings
 - Change Orders
 - Lien Releases (Conditional and Final)
 - Addenda
8. OWNER shall pay CONTRACTOR in the manner and at such times as set forth in the General Conditions and in such amounts as required by the CONTRACT DOCUMENTS.
9. In the event CONTRACTOR fails to perform any portion of the PROJECT or satisfy any term or condition of the CONTRACT DOCUMENTS, OWNER may at its sole discretion file notice and/or claim of such failure with CONTRACTOR'S surety.
10. Israel. If applicable, Contractor certifies that it is not currently engaged in, and agrees for the duration of this Contract that it will not engage in, a boycott of goods and services from Israel, as defined in A.R.S. § 35-393.
11. Conflict of Interest. The Contract may be cancelled in accordance with Arizona Revised Statutes Section 38-511.

12. Forced Labor of Ethnic Uyghurs Certification. If applicable, Contractor certifies that it does not currently, and agrees for the duration of the Contract that it will not, use: (1) the forced labor of ethnic Uyghurs in the People's Republic of China; (2) any goods or services produced by the forced labor of ethnic Uyghurs in the People's Republic of China; or (3) any contractors, subcontractors, or suppliers that use the forced labor or any goods or services produced by the forced labor of ethnic Uyghurs in the People's Republic of China. If Contractor becomes aware it is not in compliance with this certification, it shall notify the City within five business days after becoming aware. This Contract will terminate upon failure to remedy the noncompliance within 180 days of the notification. (A.R.S. § 35-394)
13. Export Administration Act. The CONTRACTOR warrants compliance with the Export Administration Act.
14. Recyclable Products. The CONTRACTOR shall use recyclable products and products which contain recycled content to the maximum extent economically feasible in the performance of the work set forth in the CONTRACT.
15. Asbestos License. The CONTRACTOR shall possess an asbestos abatement license if required under A.R.S. Title 32 or 49.
16. Assignment. No right or interest in this CONTRACT shall be assigned by CONTRACTOR without prior, written permission of the OWNER signed by the City Manager; and no delegation of any duty of CONTRACTOR shall be made without prior written permission of the OWNER signed by the City Manager. Any attempted assignment or delegation by CONTRACTOR in violation of this provision shall be a breach of this CONTRACT by CONTRACTOR.

[SIGNATURES ON FOLLOWING PAGE]

IN WITNESS WHEREOF, the parties hereto have executed, or caused to be executed by their duly authorized officials, this CONTRACT in two (2) copies, each of which shall be deemed an original. The last date of signature shall be the effective date of this CONTRACT.

OWNER:

Lake Havasu City, Arizona

By: _____

Date: _____

Name: _____

Title: _____

APPROVED AS TO FORM:

Lake Havasu City Attorney's Office

By: _____

Date: _____

CONTRACTOR:

By: _____

Date: _____

Name/Title: _____

Address: _____

ATTEST:

BY: _____

Name/Title: _____

** END OF SECTION **

LAKE HAVASU CITY CONSTRUCTION CONTRACT
INDEMNIFICATION AND INSURANCE REQUIREMENTS
(long form)

I. INDEMNIFICATION

Contractor shall indemnify and hold harmless City, its officers, employees and volunteers from and against any and all liabilities, damages, losses, and costs, including reasonable attorney's fees, but only to the extent caused by the negligence, recklessness, or intentional wrongful conduct of Contractor or other persons employed or used by the Contractor in the performance of this Contract. It is agreed that Contractor will be responsible for primary loss investigation, defense, and judgment costs where this indemnification is applicable.

II. INSURANCE REQUIREMENTS

A. CONTRACTOR and its subcontractors shall procure and maintain until all of their obligations have been discharged, including any warranty periods under this CONTRACT, are satisfied, insurance against claims for injury to persons or damage to property which may arise from or in connection with the performance of the work hereunder by the CONTRACTOR, its agents, representatives, employees or subcontractors.

B. The insurance requirements herein are minimum requirements for this CONTRACT and in no way limit the indemnity covenants contained in this CONTRACT. City in no way warrants that the minimum limits contained herein are sufficient to protect the CONTRACTOR from liabilities that might arise out of the performance of the work under this CONTRACT by the CONTRACTOR, its agents, representatives, employees or subcontractors, and CONTRACTOR is free to purchase additional insurance.

C. MINIMUM SCOPE AND LIMITS OF INSURANCE: CONTRACTOR shall provide coverage with limits of liability not less than those stated below.

1. **Commercial General Liability – Occurrence Form**

Policy shall include bodily injury, property damage, personal injury and broad form contractual liability coverage.

- | | |
|---|-------------|
| a. General Aggregate | \$3,000,000 |
| b. Products – Completed Operations Aggregate | \$5,000,000 |
| c. Personal and Advertising Injury | \$5,000,000 |
| d. Blanket Contractual Liability – Written and Oral | \$1,000,000 |
| e. Fire Legal Liability | \$ 50,000 |
| f. Each Occurrence | \$1,000,000 |

- i. The policy shall be endorsed to include the following additional insured language: "**Lake Havasu City, its**

00500A-1

departments, agencies, boards, commissions, and its officers, officials, agents, volunteers and employees shall be named as additional insureds with respect to liability arising out of the activities performed by or on behalf of the CONTRACTOR."

- ii. Policy shall contain a waiver of subrogation against Lake Havasu City, its departments, agencies, boards, commissions, and its officers, officials, agents, volunteers and employees for losses arising from work performed by or on behalf of the CONTRACTOR.
- iii. Completed operations coverage shall remain effective for at least two years following expiration of CONTRACT.

2. Business Automobile Liability

a. Bodily Injury and Property Damage for any owned, hired, and/or non-owned vehicles used in the performance of this CONTRACT.

Combined Single Limit (CSL) \$1,000,000

- i. The policy shall be endorsed to include the following additional insured language: "Lake Havasu City, its departments, agencies, boards, commissions, and its officers, officials, agents, volunteers and employees shall be named as additional insureds with respect to liability arising out of the activities performed by or on behalf of the CONTRACTOR, involving automobiles owned, leased, hired or borrowed by the CONTRACTOR."
- ii. Policy shall contain a waiver of subrogation against Lake Havasu City, its departments, agencies, boards, commissions, and its officers, officials, agents, volunteers and employees for losses arising from work performed by or on behalf of the CONTRACTOR.

3. Workers' Compensation and Employers' Liability

a. Workers' Compensation	Statutory
b. Employers' Liability Each Accident	\$ 500,000
Disease – Each Employee	\$ 500,000
Disease – Policy Limit	\$1,000,000

- i. Policy shall contain a waiver of subrogation against Lake Havasu City, its departments, agencies, boards,

commissions, and its officers, officials, agents, volunteers and employees for losses arising from work performed by or on behalf of the CONTRACTOR.

- ii. This requirement shall not apply if exempt under A.R.S. Section 23-901.

4. Professional Liability (Errors and Omissions Liability) (if applicable)

- a. Each Claim \$1,000,000
- b. Annual Aggregate \$2,000,000

- i. In the event that the professional liability insurance required by this CONTRACT is written on a claims-made basis, CONTRACTOR warrants that any retroactive date under the policy shall precede the effective date of this CONTRACT; and that either continuous coverage will be maintained or an extended discovery period will be exercised for a period of two (2) years beginning at the time work under this CONTRACT is completed.
- ii. The policy shall cover professional misconduct or lack of ordinary skill for those positions defined in the Scope of Work of this CONTRACT.

5. Contractor's Pollution Liability

- a. Each Claim \$1,000,000
- b. Annual Aggregate \$2,000,000

- i. The policy shall provide coverage for damages against, but not limited to, bodily injury, third-party liability, clean up, corrective action including assessment, remediation and defense costs. When a self-insured retention or deductible exceeds \$25,000, the Lake Havasu City reserves the right, but not the obligation, to review and request a copy of the CONTRACTOR'S most recent annual report or audited financial statements.
- ii. The pollution liability policy shall be endorsed to include the following additional insured language:
"Lake Havasu City, its departments, agencies, boards, commissions, and its officers, officials, agents, volunteers and employees shall be named as additional insureds with respect to liability arising out of the activities performed by or on behalf of the CONTRACTOR."

iii. In the event that the pollution liability insurance required by this CONTRACT is written on a claims-made basis, CONTRACTOR warrants that any retroactive date under the policy shall precede the effective date of this CONTRACT; and that either continuous coverage will be maintained or an extended discovery period will be exercised for a period of seven (7) years beginning at the time work under this CONTRACT is completed.

6. Builders' Risk (Property) Insurance (Vertical Construction Only)

a. CONTRACTOR shall purchase and maintain, on a replacement cost basis Builders' Risk insurance in the amount of the initial CONTRACT amount as well as subsequent modifications thereto, including modifications through Change Order, for the entire work at the site. Such Builders' Risk insurance shall be maintained until final payment has been made or until no person or entity other than CITY has an insurable interest in the property required to be covered, whichever is earlier. This insurance shall include interests of CITY, CONTRACTOR and any tier of CONTRACTOR's subcontractors in the work during the life of the CONTRACT and course of construction, and shall continue until the work is completed and accepted by CITY. For new construction projects, CONTRACTOR agrees to assume full responsibility for loss or damage to the work being performed and to the buildings or structures under construction. For renovation construction projects, CONTRACTOR agrees to assume responsibility for loss or damage to the work being performed at least up to the full CONTRACT amount, unless otherwise required by the Contract documents or amendments thereto.

b. Builders' Risk insurance shall be on an all-risk policy form and shall also cover false work and temporary buildings or structures and shall insure against risk of direct physical loss or damage from external causes including debris removal, demolition occasioned by enforcement of any applicable legal requirements and shall cover reasonable compensation for architects' and engineers' services and expenses, and other "soft costs," required as a result of such insured loss.

c. Builders' Risk insurance must provide coverage from the time any covered property falls within CONTRACTOR's control and/or responsibility and continue without interruption during construction or renovation or installation, including any time during which covered property is being transported to the construction or installation site, and while on the construction or installation site awaiting installation. The policy will

provide coverage while the covered premises or any part thereof is occupied. Builders' Risk insurance shall be primary and not contributory.

d. If the CONTRACT requires testing of equipment or materials or other similar operations, at the option of CITY, CONTRACTOR will be responsible for providing property insurance for these exposures under a Boiler Machinery insurance policy.

7. Contractor's Personal Property

CONTRACTOR and each of its subcontractors and suppliers shall be solely responsible for any loss or damage to its or their personal property and that of their employees and workers, including, without limitation, property or materials created or provided pursuant to this CONTRACT, any subcontract or otherwise, its or their tools, equipment, clothing, fencing, forms, mobile construction equipment, scaffolding, automobiles, trucks, trailers or semi-trailers including any machinery or apparatus attached thereto, temporary structures and uninstalled materials, whether owned, used, leased, hired or rented by CONTRACTOR or any subcontractor, consultant or supplier or employee or worker (collectively, "Personal Property"). CONTRACTOR and its subcontractors, consultants and suppliers, at its or their option and own expense, may purchase and maintain insurance for such Personal Property and any deductible or self-insured retention in relation thereto shall be its or their sole responsibility. Any such insurance shall be CONTRACTOR's and the subcontractors', suppliers' volunteers and employees' and workers' sole source of recovery in the event of loss or damage to its or their Personal Property. Any such insurance purchased and maintained by CONTRACTOR and any subcontractor, consultant or supplier shall include a waiver of subrogation as to Owner. CONTRACTOR waives all rights of recovery, whether under subrogation or otherwise, against all such parties for loss or damage covered by CONTRACTOR's property insurance. CONTRACTOR shall require the same waivers from all subcontractors and suppliers and from the insurers issuing property insurance policies relating to the Work or the Project purchased and maintained by all subcontractors and suppliers. The waivers of subrogation referred to in this subparagraph shall be effective as to any individual or entity even if such individual or entity (a) would otherwise have a duty of indemnification, contractual or otherwise, (b) did not pay the insurance premium, directly or indirectly, and (c) whether or not such individual or entity has an insurable interest in the property which is the subject of the loss or damage.

8. Theft, Damage, or Destruction of Work

00500A-5

In the event of theft, damage or destruction of the Work, CONTRACTOR will re-supply or rebuild its Work without additional compensation and will look to its own resources or insurance coverages to pay for such re-supply or rebuilding. CONTRACTOR will promptly perform, re-supply or rebuild, regardless of the pendency of any claim by CONTRACTOR against any other party, including Owner, that such party is liable for damages, theft or destruction of CONTRACTOR's Work. This subparagraph shall apply except to the extent that the cost of re-supply or rebuilding is paid by Owner's builder's risk insurance; in such event, Owner waives (to the fullest extent permitted by the builder's risk policy) all rights of subrogation against CONTRACTOR and each of its subcontractors to the extent of such payment by Owner's builder's risk insurer.

- D. ADDITIONAL INSURANCE REQUIREMENTS: The policies shall include, or be endorsed to include, the following provisions:
1. Lake Havasu City, its departments, agencies, boards, commissions and its officers, officials, agents, volunteers and employees wherever additional insured status is required. Such additional insured shall be covered to the full limits of liability purchased by the CONTRACTOR, even if those limits of liability are in excess of those required by this CONTRACT.
 2. The Contractor's insurance coverage shall be primary insurance with respect to all other available sources.
 3. Coverage provided by the Contractor shall not be limited to the liability assumed under the indemnification provisions of this CONTRACT.
- E. NOTICE OF CANCELLATION: Each insurance policy required by the insurance provisions of this CONTRACT shall not be suspended, voided, cancelled, reduced in coverage or in limits without ten (10) business days written notice to City. Such notice shall be mailed directly to Lake Havasu City, Community Investment Department, Procurement Division, 2330 McCulloch Blvd. North, Lake Havasu City, AZ 86403 and shall be sent by certified mail, return receipt requested.
- F. ACCEPTABILITY OF INSURERS: Insurance is to be placed with duly licensed or approved non-admitted insurers in the state of Arizona with an "A.M. Best" rating of not less than A-VII. CITY in no way warrants that the above-required minimum insurer rating is sufficient to protect the CONTRACTOR from potential insurer insolvency.
- G. VERIFICATION OF COVERAGE:

00500A-6

1. CONTRACTOR shall furnish CITY with certificates of insurance as required by this CONTRACT. The certificates for each insurance policy are to be signed by a person authorized by that insurer to bind coverage on its behalf and the Project/contract number and project description shall be noted on the certificate of insurance.
 2. All certificates and endorsements are to be received and approved by CITY at least ten (10) days before work commences. Each insurance policy required by this CONTRACT must be in effect at or prior to commencement of work under this CONTRACT and remain in effect for the duration of the Project. Failure to maintain the insurance policies as required by this CONTRACT, or to provide evidence of renewal, is a material breach of contract.
 3. All renewal certificates required by this CONTRACT shall be sent directly to Lake Havasu City, Community Investment Department, Procurement Division, 2330 McCulloch Blvd. North, Lake Havasu City, AZ 86403. The Project/contract number and project description shall be noted on the certificate of insurance. CITY reserves the right to require complete, certified copies of all insurance policies required by this CONTRACT at any time.
- H. **SUBCONTRACTORS:** CONTRACTOR's certificate(s) shall include all subcontractors as insureds under its policies **or** CONTRACTOR shall furnish to CITY separate certificates and endorsements for each subcontractor. All coverages for subcontractors shall be subject to the minimum requirements identified above.
- I. **APPROVAL:** Any modification or variation from the insurance requirements in this CONTRACT must have prior approval from the CITY's Human Resources/Risk Management Division, whose decision shall be final. Such action will not require a formal CONTRACT amendment, but may be made by administrative action.
- J. **EXCEPTIONS:** In the event the CONTRACTOR or sub-contractor(s) is/are a public entity, then the Insurance Requirements shall not apply. Such public entity shall provide a Certificate of Self-Insurance.

SECTION 00500B
CONTRACTOR Claim Handling Procedure

1. Claimant is to submit in writing to the OWNER or their REPRESENTATIVE the details of the claim to include the where, when, and how of the claim, and an estimate of damage, if applicable.
2. OWNER or their REPRESENTATIVE will forward the claim directly to the CONTRACTOR for handling. The CONTRACTOR is to respond to the claimant, in writing, within 30 calendar days of receipt with copies to:

Lake Havasu City Human Resources/Risk Management Division
Lake Havasu City Public Works Department
OWNER'S REPRESENTATIVE, if applicable

If the CONTRACTOR denies the claim, the reasons for such denial must be included in the response to the claimant.

SECTION 00510
ARIZONA STATUTORY PERFORMANCE BOND

PURSUANT TO TITLES 28, 34, AND 41, ARIZONA REVISED STATUTES
(Penalty of this bond must be 100% of the Contract amount)

KNOW ALL MEN BY THESE PRESENTS THAT: _____
(hereinafter "Principal"), as Principal, and _____
(hereinafter "Surety"), a corporation organized and existing under the laws of the State of with
its principal office in the City of _____, holding a certificate of authority to
transact surety business in Arizona issued by the Director of Insurance pursuant to Title 20,
Chapter 2, Article 1, as Surety, are held and firmly bound unto Lake Havasu City, Arizona
(hereinafter "Obligee") in the amount of _____(Dollars) (\$), for the payment
whereof, Principal and Surety bind themselves, and their heirs, administrators, executors,
successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated
the ____ day of _____, _____, to furnish all of the material, supplies, tools, equipment, labor
and other services necessary for the construction and completion of

VADOSE WELL DESIGN & EXPANSION, PROJECT NO. B24-PW-107015-500403

which contract is hereby referred to and made a part hereof as fully and to the same extent as if
copied at length herein.

NOW, THEREFORE, THE CONDITION OF THE OBLIGATION IS SUCH, that if the Principal
faithfully performs and fulfills all of the undertakings, covenants, terms, conditions and
agreements of the contract during the original term of the contract and any extension of the
contract, with or without notice of the Surety, and during the life of any guarantee required under
the contract, and also performs and fulfills all of the undertakings, covenants, terms, conditions
and agreements of all duly authorized modifications of the contract that may hereafter be made,
notice of which modifications to the Surety being hereby waived, the above obligation is void.
Otherwise it remains in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Title 34,
Chapter 2, Article 2, Arizona Revised Statutes, and all liabilities on this bond shall be determined
in accordance with the provisions of Title 34, Chapter 2, Article 2, Arizona Revised Statutes, to
the same extent as if it were copied at length in this agreement.

The prevailing party in a suit on this bond shall recover as part of the judgment reasonable
attorney fees that may be fixed by a judge of the court.

Witness our hands this ____ day of _____, _____.

PRINCIPAL SEAL

AGENCY OF RECORD BY: _____

AGENCY ADDRESS SURETY SEAL

BY: _____

** END OF SECTION **

SECTION 00520
ARIZONA STATUTORY PAYMENT BOND
PURSUANT TO TITLES 28, 34, AND 41, ARIZONA REVISED STATUTES
(Penalty of this bond must be 100% of the Contract amount)

KNOW ALL MEN BY THESE PRESENTS THAT: _____
(hereinafter "Principal"), as Principal, and _____ (hereinafter Surety), a corporation organized and existing under the laws of the State of _____ with its principal office in the City of _____, holding a certificate of authority to transact surety business in Arizona issued by the Director of the Department of Insurance pursuant to Title 20, Chapter 2, Article 1, as Surety, are held and firmly bound unto Lake Havasu City, Arizona (hereinafter "Obligee") in the amount of _____ (Dollars) (\$ _____), for the payment whereof, Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated the _____ of _____, _____, to furnish all of the material, supplies, tools, equipment, labor and other services necessary for the construction and completion of

VADOSE WELL DESIGN & EXPANSION, PROJECT NO. B24-PW-107015-500403

which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFOR, THE CONDITION OF THE OBLIGATION IS SUCH, that if the Principal promptly pays all monies due to all persons supplying labor or materials to the Principal or the Principal's subcontractors in the prosecution of the work provided for in the contract, this obligation is void. Otherwise it remains in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Title 34, Chapter 2, Article 2, Arizona Revised Statutes, and all liabilities on this bond shall be determined in accordance with the provisions, conditions and limitations of Title 34, Chapter 2, Article 2, Arizona Revised Statutes, to the same extent as if it were copied at length in this agreement.

The prevailing party in a suit on this bond shall recover as part of the judgment reasonable attorney fees that may be fixed by a judge of the court.

Witness our hands this ____ day of _____, _____.

PRINCIPAL SEAL

BY: _____

AGENCY OF RECORD

AGENCY ADDRESS SURETY SEAL

BY: _____

** END OF SECTION **

SECTION 00670
NOTICE OF AWARD

TO:

DATE:

PROJECT DESCRIPTION: Vadose Well Design and Expansion, Project 107015

The OWNER has considered the BID submitted by you for the above-described WORK in response to its Advertisement for BIDS dated _____, and Information for Bidders.

You are hereby notified that your BID has been accepted for items in the amount of \$_____, to include all work for the project entitled, "Vadose Well Design and Expansion", Lake Havasu City Project 107015.

You are required by the Information for Bidders to execute the Contract and furnish the required CONTRACTOR'S Performance Bond, Payment Bond, and Certificates of Liability, Vehicular, and Workmen's Compensation Insurance within ten (10) calendar days from the postmark date when this notice was sent by U.S. Mail.

If you fail to execute said Contract and to furnish said BONDS within ten (10) days from the date of this Notice, said OWNER will be entitled to consider all your rights arising out of the OWNER'S acceptance of your BID as abandoned and as a forfeiture of your BID BOND. The OWNER will be entitled to such other rights as may be granted by law.

You are required to return an acknowledged copy of this NOTICE OF AWARD to the OWNER.

Dated this _____ day of _____, 2023.

Lake Havasu City, Arizona

BY: _____

NAME: Susan C. Fox

TITLE: Administrative Assistant II

Acceptance of Notice

(NOTE: The contractor shall return a signed copy of this notice to the owner.)

Receipt of this NOTICE OF AWARD is hereby acknowledged by:

Contractor

This the _____ day of _____, 2023.

BY: _____

TITLE: _____

** END OF SECTION **

**SECTION 00685
CERTIFICATE OF SUBSTANTIAL COMPLETION**

I hereby state that the degree of completion of:

**VADOSE WELL DESIGN AND EXPANSION
PROJECT NO. B24-PW-107015-500403**

Provides the full-time use of the project, or defined portion of the project, for the purposes for which it was intended and is the commencement of the Guarantee Period.

"Substantial Completion" shall not be considered as final acceptance.

Lake Havasu City, Arizona

Date: _____

By: _____

Name: _____

Title: _____

ACCEPTANCE OF NOTICE

(NOTE: The Contractor shall return a signed copy of this Notice to the Owner)

Receipt of the above **CERTIFICATE OF SUBSTANTIAL COMPLETION** is hereby acknowledged this the _____ day of _____, _____.

By: _____

Name: _____

Title: _____

CERTIFICATE OF COMPLETION

I hereby state that all goods and services required by:

**Vadose Well Design and Expansion
Project No. B24-PW-107015-500403**

have been delivered in conformance with the Contract, and all activities required by the Contractor under the Contract were completed as of _____.
(Date)

Lake Havasu City, Arizona

By: _____

Name: _____

Title: _____

SECTION 00700
GENERAL CONDITIONS

This section of the Contract Documents is pre-printed. Any modifications to the following Articles, as may be required for this Project, are made in the Special Provisions.

1.0 DEFINITIONS

Wherever in the Contract Document the following terms are used, the intent and meaning shall be interpreted as follows:

1.1 Addenda

Written or graphic instruments issued prior to the opening of Bids which modify or interpret the Contract Documents, Drawings and Specifications, by additions, deletions, clarifications or corrections.

1.2 As Approved

The words "as approved," unless otherwise qualified, shall be understood to be followed by the words "by the Owner."

1.3 As Shown, and as Indicated

The words "as shown" and "as indicated" shall be understood to be followed by the words "on the Drawings" or "in the Specifications."

1.4 Award

The acceptance, by the Owner, of the successful Bidder's proposal.

1.5 Bid

The offer or proposal of the Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

1.6 Bidder

Any individual, firm partnership or corporation, or combination thereof submitting a proposal for the Work contemplated, acting directly or through a duly authorized representative.

1.7 Bonds

Bid, Performance, and Payment Bonds and other instruments of security, furnished by the Contractor and its surety in accordance with the Contract Documents.

1.8 Calendar Day

Every day shown on the calendar, measured from midnight to the next midnight.

1.9 Change Order

A written order to the Contractor, signed by the Owner, covering changes in the Plans, Specifications, or proposal quantities and establishing the basis of payment and contract time adjustment, if any, for the Work affected by such changes.

If the Change Order increases the existing Contract Amount, the Builder's Risk Insurance limit must be increased to the adjusted Contract Amount.

1.10 Contract

The "Contract" is the written Contract covering the performance of the Work and the furnishing of labor, materials, incidental services, tools, and equipment in the construction of the Work. It includes Supplemental Contracts amending or extending the Work contemplated in the manner hereinafter described and which may be required to complete the Work in a substantial and acceptable manner to the Owner. The Contract may include Contract Change Orders.

1.11 Contract Documents

The "Contract Documents" consist of the Bidding Requirements, Contract Forms, Conditions of the Contract including General and/or Supplemental General Conditions, Special Provisions, the Technical Specifications, and the Drawings, including all Addenda and modifications thereafter incorporated into the Documents before execution and including all other requirements incorporated by specific reference thereto.

1.12 Contract Price

The total monies payable by Owner to the Contractor under the terms and conditions of the Contract Documents.

1.13 Contract Time

The number of calendar days stated in the Contract Documents for the completion of the Work.

1.14 Contractor

The individual, partnership, firm, or corporation primarily liable for the acceptable performance of the Work contracted for and the payment of all legal debts pertaining to the Work who acts directly or through lawful agents or employees to complete the Contract Work.

1.15 Days

Unless otherwise specifically stated, the term "days" will be understood to mean calendar days.

1.16 Drawings

The term "Drawings," also described as "Plans," refers to the official drawings, profiles, cross sections, elevations, details, and other working drawings, and supplementary drawings, or reproductions thereof, which show the locations, character, dimensions, and details of the Work to be performed. Drawings may either be bound in the same book as the balance of the Contract Documents or bound in separate sets, and are a part of the Contract Documents, regardless of the method of binding.

1.17 Engineer

The individual, partnership, firm, or corporation duly authorized by the Owner (sponsor) to be responsible for the Engineering of the contract Work and acting directly or through an authorized representative.

1.18 Field Order

A written order effecting a change in the Work not involving an adjustment in the Contract Price or an extension of the Contract Time, issued by the Engineer to the Contractor during construction.

1.19 Final Acceptance

Upon due notice from the Contractor of presumptive completion of the entire project, the Owner will make an inspection. If all construction provided for and contemplated by the contract is found completed to the Owner's satisfaction and all requirements of the contract have been met, that inspection shall constitute the final inspection and the Owner will make the final acceptance and issue the Certificate of Completion.

If, however, the inspection discloses any work, in whole or in part, as being unsatisfactory or that all requirements of the contract have not been met, the Owner will give the Contractor the necessary instructions for correction or completion, and the Contractor shall immediately comply with and execute the instructions. Upon correction of the work, completion of contract requirements, and notification to Owner, another inspection will be made which shall constitute the final inspection provided the work has been satisfactorily completed and all requirements of the contract met. In such event, the Owner will make the final acceptance and issue the Certificate of Completion.

1.20 Inspector

An authorized representative of the Owner assigned to make all necessary inspections and/or tests of the Work performed or being performed, or of the materials furnished or being furnished by the Contractor.

1.21 Methodology and Quality of Workmanship

The manner and sequence of construction which considered to be the acceptable standard in which to perform the Work.

1.22 Notice

The term "notice" or the requirement to notify, as used in the Contract Documents or applicable State or Federal statutes, shall signify a written communication delivered in person or by certified or registered mail to the individual, or to a member of the firm, or to an officer of the corporation for whom it is intended. Certified or registered mail shall be addressed to the last business address known to him who gives the notice.

1.23 Notice of Award

The written notice of the acceptance of the Bid from the Owner to the successful Bidder.

1.24 Notice to Proceed

Written communication issued by the Owner to the Contractor authorizing him to proceed with the Work and establishing the date of commencement of the Work.

1.25 Or Equal

The phrase "or equal" shall be understood to indicate that the "equal" product is the same or better than the product names in function, performance, reliability, quality, and general configuration. Determination of equality in reference to the project design requirements will be made by the Owner.

1.26 Owner

The term "Owner" shall be understood to be Lake Havasu City, Arizona.

1.27 Payment Bond

The approved form of security furnished by the Contractor and its surety as a guaranty that it will pay in full all bills and accounts for materials and labor used in the construction of Work.

1.28 Performance Bond

The approved form of security furnished by the Contractor and its surety as a guarantee that the Contractor will complete the Work in accordance with the terms of the Contract and guarantee the Work for a period of one (1) year after the date of Certificate of Substantial Completion.

1.29 Plans

Plans shall have the same meaning as "Drawings," see Section 1.16.

1.30 Project

The undertaking to be performed as provided in the Contract Documents, see Section 1.11.

1.31 Proposal

The offer of the Bidder for the Work when made out and submitted on the prescribed proposal form, properly signed and guaranteed.

1.32 Proposal Guarantee

The cash, or cashier's check or certified check, or bidder's bond accompanying the Proposal submitted by the Bidder, as a guarantee that the Bidder will enter into a contract with the Owner for the construction or doing of the Work, if it is awarded to it, and will provide the contract bonds and insurance required.

1.33 Shop Drawings

All drawings, diagrams, illustrations, brochures, schedules and other data which are prepared by the Contractor, a Subcontractor, manufacturer, supplier or distributor, which illustrate how specific portions of the Work shall be fabricated or installed.

1.34 Specifications

The directions, provisions and requirements pertaining to the method and manner of performing the Work or to the quantities and qualities of the materials to be furnished under the Contract, together with all other directions, provisions and requirements, plus such amendments, deletions from or additions which may be provided for by Supplemental Contract or Change Orders.

1.35 Subcontractor

A Subcontractor is a person or entity who has a direct or indirect contract with a Contractor to perform any of the Work at the site. For convenience, the term Subcontractor is referred to throughout the Contract Documents as if singular in number and masculine in gender but includes the plural and feminine gender and includes a Sub-Subcontractor or an authorized representative thereof. The term Subcontractor does not include any separate Contractor or its Subcontractors.

1.36 Substantial Completion

"Substantial Completion" shall be that degree of completion of the project or a defined portion of the project, sufficient to provide the Owner, at its discretion, the full-time use of the project or defined portion of the project for the purposes for which it was intended. "Substantial Completion" shall not be considered as final acceptance.

1.37 Supplemental General Conditions

Modifications to General Conditions required by a Federal Agency for participation in the Project and approved by the agency for participation in the Project and approved by the agency in writing prior to inclusion in the Contract Documents and such requirements that may be imposed by applicable state laws. The term also includes modifications or additions to the General Conditions required by the Owner or Engineer.

1.38 Supplier

Any person or organization who supplies materials or equipment for the Work, including that fabricated to a special design, but who does not perform labor at the site.

1.39 Surety

The corporation, partnership, or individual, other than the Contractor, executing Payment, or Performance Bonds which are furnished to the Owner by the Contractor.

1.40 Work

The word "Work" within these Contract Documents shall include all material, labor, tools, utilities, and all appliances, machinery, transportation, and appurtenances necessary to perform and complete the Contract, and such additional items not specifically indicated or described which can be reasonably inferred as belonging to the item described or indicated and as required by good practice to provide a complete and satisfactory system or structure.

1.41 Working Day

A working day shall be any day, other than a legal holiday, Saturday or Sunday, on which the normal working forces of the Contractor may proceed with regular work.

2.0 NOTICE TO PROCEED

2.1 After the Owner has issued the Notice Of Award, the Contractor shall provide the Performance Bond, the Payment Bond, the Certificate Of Insurance, the Work Schedule, the monthly cash flow, and a signed Contract within ten (10) calendar days. The Owner's attorney will review each document and, if they are found to be acceptable, the Owner will sign and execute the Contract. Within a period of sixty (60) calendar days after executing the Contract,

the Owner will issue the Notice To Proceed. Within ten (10) calendar days of the postmark date of the Notice To Proceed, the Work shall commence. The Contractor shall not commence any Work until such time that the Notice To Proceed has been issued.

3.0 ADDITIONAL INSTRUCTIONS AND DETAIL DRAWINGS

3.1 The Engineer may furnish additional instructions to the Contractor by means of Drawings or otherwise, during the progress of the Work as necessary to make clear or to define in greater detail the intent of the Specifications and Contract Drawings.

The additional drawings and instruction thus supplied will become a part of the Contract Documents. The Contractor shall carry out the Work in accordance with the additional detail drawings and instructions.

4.0 SCHEDULES, REPORTS AND RECORDS

4.1 The Contractor shall submit to the Owner payrolls, reports, estimates, records and other data where applicable as are required by the Contract Documents for the Work to be performed.

4.2 The Contractor, after the Contract award and prior to the Pre-Construction Conference, shall prepare for submittal to the Engineer for review, a detailed progress schedule. The progress schedule shall be brought up to date and submitted to the Engineer prior to each progress payment request, and at such other time intervals as the Engineer may request.

A. Progress Schedule

The schedule shall be a time-scaled critical path progress schedule showing in detail the proposed sequence of activity. The critical path analysis shall consist of a graphic network diagram and shall clearly show start and completion dates and percentage of work completed.

4.3 The Contractor shall also forward to the Engineer, prior to each progress payment request, an itemized report of the delivery status of major and critical items of purchased equipment and material, including Shop Drawings and the status of shop and field fabricated work. These progress reports shall indicate the date of the purchase order, the current percentage of completion, estimated delivery, and cause of delay, if any.

4.4 If the completion of any part of the Work or the delivery of materials is behind the approved schedule, the Contractor shall submit in writing a plan acceptable to the Engineer for bringing the Work up to schedule.

4.5 The Owner shall have the right to withhold progress payments for the Work if the Contractor fails to update and submit the progress schedule and reports as specified, and such withholding shall not constitute grounds for additional claims by the Contractor against the Owner.

4.6 The Contractor shall submit an estimated monthly cash flow, based upon the progress schedule with the bonds, schedules, and Certificate Of Insurance.

5.0 DRAWINGS AND SPECIFICATONS

5.1 The intent of the Drawings and Specifications is that the Contractor shall furnish all labor, materials, tools, equipment, utilities, and transportation necessary for the proper execution of the Work in accordance with the Contract Documents and all incidental work necessary to complete the Project in an acceptable quality and manner, ready for use, occupancy or operation by the Owner.

5.2 In case of conflict between the Drawings and Specifications, the Specifications shall govern. Figure dimensions on Drawings shall govern over scale dimensions, and detailed Drawings shall govern over general Drawings.

5.3 Any discrepancies found between the Drawings and Specifications and site conditions or any inconsistencies or ambiguities in the Drawings or Specifications shall be immediately reported verbally and within 24 hours of such a discovery, in writing to the Engineer, who shall promptly correct such inconsistencies or ambiguities in writing. Work done by the Contractor after his discovery of such discrepancies, inconsistencies or ambiguities shall be done at the Contractor's risk, and the Contractor shall assume full responsibility therefor and shall bear all costs attributable thereto, if not acceptable to the Owner.

6.0 SHOP DRAWINGS

6.1 The Contractor shall provide seven (7) copies of the Shop Drawings as specified or as may be necessary for the prosecution of the Work as required by the Contract Documents. All drawings and schedules shall be submitted sufficiently in advance to allow the Engineer not less than 20 regular working days for checking the submittal. The Engineer's approval of any Shop Drawings shall not release the Contractor from responsibility for deviations from the Contract Documents.

6.2 When submitted for the Engineer's review, Shop Drawings shall bear the Contractor's certification by means of a signed Stamp, that he has reviewed, checked and approved the Shop Drawings and that they are in conformance with the requirements of the Contract Documents. Shop Drawings, which in the opinion of the Engineer are incomplete or unchecked by the Contractor, will be returned to the Contractor for resubmission in the proper form.

If Shop Drawings or submittals are rejected by the Engineer, all costs incurred by the Engineer Or The Owner for reviewing the resubmittals shall be charged to the Contractor, and the Owner has the right to deduct such costs from any monies owed the Contractor by the Owner.

6.3 When Shop Drawings have been reviewed by the Engineer, two sets of submittals will be returned to the Contractor appropriately stamped. If major changes or corrections are necessary, the Shop Drawing may be rejected and one set will be returned to the Contractor with such changes or corrections indicated, and the Contractor shall correct and resubmit the Shop Drawings. No changes shall be made by the Contractor to resubmitted Shop Drawings other than those changes indicated by the Engineer, unless such changes are clearly described in a letter

accompanying the resubmitted Shop Drawings.

6.4 The review of such Shop Drawings and catalog cuts by the Engineer shall not relieve the Contractor from responsibility for corrections of dimensions, fabrication details, and space requirements, or for deviations from the Contract Drawings or Specifications, unless the Contractor has called attention to such deviations in writing by a letter accompanying the Shop Drawings and the Engineer approves the change or deviation in writing at the time of submission; nor shall review by the Engineer relieve the Contractor from the responsibility for errors in the Shop Drawings. When the Contractor does call such deviations to the attention of the Engineer, the Contractor shall state in his letter whether or not such deviations involve any deduction or extra cost adjustment.

6.5 Portions of the Work requiring a Shop Drawing or sample submission shall not begin until the Shop Drawing or submission has been approved by the Engineer. A copy of each approved Shop Drawing and each approved sample shall be kept in good order by the Contractor at the site and shall be available to the Engineer.

7.0 RECORD DRAWINGS

7.1 During construction, the Contractor shall keep an accurate record of the following:

- A. Deviations between the Work as shown on the Plans and the Work as actually installed.
- B. The specific locations of piping, valves, electric conduits, duct work, equipment, and other such work which was not located on the Plans. The Record Drawings shall show distances to these locations from known points on the Plans.
- C. Equipment schedules indicating manufacturer's names and model numbers. When all revisions showing work as installed are made, the corrected set of plans shall be delivered to the Engineer before the final pay request is processed. These plans shall be clearly marked "Record Drawings."

7.2 Nothing contained in this section shall be construed as authorizing any deviation in the Work as shown on the Contract Drawings without a written Change Order or written authority to the Contractor from the Engineer.

8.0 MATERIALS, SERVICES, AND FACILITIES

8.1 It is understood that, except as otherwise specifically stated in the Contract Documents, the Contractor shall provide and pay for all materials, labor, tools, equipment, water, light, power, transportation, supervision, temporary construction of any nature, and all other services and facilities of any nature whatsoever necessary to execute, complete, and deliver the Work within the specified time.

8.2 The Contractor shall furnish the Owner a list of materials and the source of supply of each

of the materials on the list. The source of supply of each of the materials shall be approved by the Owner before the delivery of said materials is started. Only materials conforming to these Specifications and approved by the Owner shall be used in the Work. All materials proposed for use may be inspected or tested at any time during their preparation and use. After trial, if it is found that sources of supply which have been approved do not furnish a uniform product, or if the product from any source proves unacceptable at any time, the Contractor shall furnish approved material from other approved sources. No material which, after approval, has in any way become unfit for use shall be used in the Work.

8.3 The Contractor warrants to the Owner and Engineer that the materials and equipment furnished under the Contract will be new and of a quality equal to that specified or approved and, that all Work will be of good quality, free from faults and defects and in conformance with the Contract Documents. Mechanical and electrical equipment shall be the products of manufacturers of established good reputations and regularly engaged in the fabrication of such equipment. Unless otherwise noted, any equipment offered shall be current models which have been in successful regular operation under comparable conditions for a period of at least two years. This time requirement, however, does not apply to minor details nor to thoroughly demonstrated improvements in design or in material of construction. Work shall be done and completed in a thorough and workmanlike manner and if required by Engineer, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment used.

8.4 All materials which the Engineer or its authorized Inspector has determined do not conform to the requirements of the Plans and Specifications will be rejected. They shall be removed immediately from the vicinity of the Work by the Contractor at his own expense, unless otherwise permitted by the Engineer. No rejected material, the defects of which have been subsequently corrected, shall be used in the Work, unless approval in writing has been given by the Engineer. Upon failure of the Contractor to comply promptly with any order of the Engineer made under the provisions in this section, the Engineer shall have authority to cause the removal and replacement of rejected material and to deduct the cost thereof from any monies due or to become due the Contractor.

8.5 If any part or portions of the Work done or material furnished under this Contract shall prove defective or non-conforming with the Drawings and Specifications, and if the imperfection in the same shall not be of sufficient magnitude or importance as to make the Work dangerous or unsuitable, or if the removal of such Work will create conditions which are dangerous or undesirable, the Engineer shall have the right and authority to retain such Work but shall make such deductions in the final payment therefor as may be just and reasonable. Such adjustment shall be effected whether or not final payment has been made.

8.6 Materials and equipment shall be so stored as to insure the preservation of their quality and fitness for the Work. Stored materials and equipment to be incorporated in the Work shall be located so as to facilitate prompt inspection.

8.7 Manufactured articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer.

8.8 Materials, supplies or equipment to be incorporated into the Work shall not be purchased by the Contractor or the Subcontractor subject to a chattel mortgage or under a conditional sale contract or other Contract by which an interest is retained by the seller.

9.0 INSPECTION AND TESTING

9.1 All material and equipment used in the construction of the Project shall be subject to adequate inspection and testing in accordance with generally accepted standards, as required and defined in the Contract Documents.

9.2 The Owner shall provide all inspection and testing services not required by the Contract Documents.

9.3 The Contractor shall provide at its expense the testing and inspection services required by the Contract Documents.

9.4 If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any Work to specifically be inspected, tested, or approved by someone other than the Contractor, the Contractor will give the Engineer timely notice of readiness, the minimum of which shall be forty-eight (48) hours. The Contractor will then furnish the Engineer the required certificates of inspection, testing or approval.

9.5 Inspections, tests or approvals by the Engineer or others shall not relieve the Contractor from its obligations to perform the Work in accordance with the requirements of the Contract Documents.

9.6 The Engineer and its representatives will at all times have access to the Work. In addition, authorized representatives and agents of any participating Federal or State agency shall be permitted to inspect all Work, materials, payrolls, records of personnel, invoices of materials, and other relevant data and records. The Contractor will provide proper facilities for such access and observation of the Work and also for any inspection, or testing thereof.

9.7 If any Work is covered contrary to the written instructions of the Engineer or prior to inspection, if must, if requested by the Engineer, be uncovered for his observation and replaced at the Contractor's expense.

9.8 If the Engineer considers it necessary or advisable that Work that has already been approved be inspected or tested by the Engineer or others, the Contractor, at the Engineer's request, will uncover, expose or otherwise make available for observation, inspection or testing as the Engineer may require, that portion of the Work in question, furnishing all necessary labor, materials, tools, and equipment. If it is found that such Work is defective, the Contractor will bear all the expenses of such uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction. If, however, such Work is not found to be defective, the Contractor will be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to such uncovering, exposure, observation, inspection, testing and reconstruction and an appropriate Change Order shall be issued.

10.0 SUBSTITUTIONS

10.1 Whenever a material, article or piece of equipment is identified on the Drawings or Specifications by reference to brand name or catalogue number, it shall be understood that this is referenced for the purpose of defining the performance or other salient requirements and that other products of equal capacities, quality and function shall be considered. The Contractor may recommend the substitution of a material, article, or piece of equipment of equal substance and function for those referred to in the Contract Documents by reference to brand name or catalogue number, and if, in the opinion of the Engineer, such material, article, or piece of equipment is of equal substance and function to that specified, the Engineer may approve its substitution and use by the Contractor. Any cost differential shall be deductible from the Contract Price and the Contract Documents shall be appropriately modified by Change Order. The Contractor warrants that if substitutes are approved, no major changes in the function or general design of the Project will result. Incidental changes or extra component parts required to accommodate the substitute will be made by the Contractor without a change in the Contract Price or Contract Time. Any substitutions not properly approved and authorized by the Engineer may be considered defective and the Engineer may require the Contractor to remove the substituted material, article or piece of equipment and the Contractor shall bear any and all costs associated with the removal of the substituted item, including all engineering, inspection, testing or surveying costs incurred by the Owner or the Engineer.

10.2 Determination of equality in reference to the project design requirements will be made by the Owner. "Equal" products shall not be purchased or installed by the Contractor without the Owner's written approval. Contractor shall have fourteen (14) days after issuance of Notice to Proceed for submission of data substantiating a request for substitution of an "or equal" item.

11.0 PATENTS

11.1 The Contractor shall pay all applicable royalties and license fees. The Contractor shall defend all suits or claims for infringement of any patent rights and indemnify and hold the Owner and Engineer harmless from loss on account thereof, except that the Owner shall be responsible for any such loss when a particular process, design, or the product of a particular manufacturer or manufacturers is specified, however if the Contractor has reason to believe that the design, process or product specified is an infringement of a patent, it shall be responsible for such loss unless it promptly gives such information to the Engineer.

12.0 SURVEYS, PERMITS, REGULATIONS

12.1 The Owner shall furnish all boundary surveys and establish all base lines for locating the principal component parts of the Work together with a suitable number of bench marks adjacent to the Work as shown in the Contract Documents. The Contractor shall satisfy itself as to the accuracy of all measurements before constructing any permanent structure and shall not take advantage of any errors which may have been made in laying out the Work. From the information provided by the Owner, unless otherwise specified in the Contract Documents, the Contractor shall develop and make all detail surveys needed for construction such as slope stakes, batter

boards, stakes for pile locations and other working points, lines, elevations and cut sheets.

12.2 Such stakes and markings as the Engineer may set for either its own or the Contractor's guidance shall be scrupulously preserved by the Contractor. In the event the Contractor, or its employees, destroy or otherwise remove or obliterate such stakes or markings, an amount equal to the cost of replacing the same may be deducted from subsequent estimates due the Contractor at the discretion of the Owner.

12.3 Permits and licenses of a temporary nature necessary for the prosecution of the Work shall be secured and paid for by the Contractor unless otherwise stated in the Supplemental General Conditions. Permits, licenses and easements for permanent structures or permanent changes in existing facilities shall be secured and paid for by the Owner, unless otherwise specified. The Contractor shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the Work as drawn and specified. If the Contractor perceives that the Contract Documents are at variance therewith, he shall promptly notify the Engineer in writing, and any necessary changes shall be adjusted as provided in Section 16. Changes In The Work. If the Contractor performs and works knowing it to be contrary to such laws, ordinances, rules and regulations, and without such notice to the Engineer, he shall assume full responsibility therefore and shall bear all costs attributable thereto.

13.0 PROTECTION OF WORK, PROPERTY AND PERSONS

13.1 The Contractor shall have sole responsibility for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. The Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to, all employees on the Work and other persons who may be affected thereby, all the Work and all materials or equipment to be incorporated therein, whether in storage on or off the site, and other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and other items not designated for removal, relocation or replacement in the course of construction.

13.2 The Contractor shall comply with all applicable laws, ordinances, rules, regulations and orders of any public body having jurisdiction. The Contractor shall erect and maintain, as required by the conditions and progress of the Work, all necessary safeguards for safety and protection. The Contractor shall notify Owners of adjacent utilities when prosecution of the Work may affect them. The Contractor shall remedy all damage, injury or loss to any property caused, directly or indirectly, in whole or in part, by the Contractor, any Subcontractor or anyone directly or indirectly employed by any of them or anyone for whose acts any of them be liable, except damage or loss attributable to the fault of the Contract Documents or to the acts or omissions of the Owner or the Engineer or anyone employed by either of them or anyone for whose acts either of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of the Contractor.

13.3 In emergencies affecting the safety of persons or the Work or property at the site or adjacent thereto, the Contractor, without special instruction or authorization from the Engineer or Owner, shall act to prevent threatened damage, injury or loss. He shall give the Engineer

prompt Written Notice of any significant changes in the Work or deviations from the Contract Documents caused thereby, and a Change Order shall thereupon be negotiated and issued covering the changes and deviations involved, as provided in Section 16.0, Changes in the Work.

13.4 The Contractor shall designate a responsible member of its organization at the site whose duty shall be the prevention of accidents and the safety of all those at the site. The person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and the Engineer. The Engineer will not be responsible for safety precautions and programs in connection with the Work or for the Contractor's failure to properly perform its responsibilities with respect to initiating, maintaining and supervising all safety precautions and programs.

14.0 PUBLIC SAFETY

14.1 Whenever the Contractor's operations create a condition hazardous to traffic or to the public, it shall furnish at its own expense, and without cost to the Owner, such flagmen and guards as are necessary to give adequate warning to the public of any dangerous conditions to be encountered and he shall furnish, erect, and maintain such fences, barricades, lights, signs, and other devices as are necessary to prevent accidents and avoid damage or injury to the public.

14.2 Should the Contractor appear to be neglectful or negligent in furnishing warning and protective measures as above provided, the Engineer may direct attention to the existence of a hazard and the necessary warning and protective measures shall be furnished and installed by the Contractor at its own expense without cost to the Owner. Should the Engineer point out the inadequacy of warning and protective measures, such action on the part of the Engineer shall not relieve the Contractor from responsibility for public safety or abrogate his obligation to furnish and pay for these devices.

14.3 Should the Contractor fail to, be neglectful, or be negligent in furnishing or maintaining warning and protective facilities as required herein, the Owner may furnish or maintain such facilities and charge Contractor therefor by deducting the cost thereof from periodic progress payments due the Contractor as such costs are incurred by Owner.

14.4 No material or equipment shall be stored where it will interfere with the free and safe passage of public traffic, and at the end of each day's Work and at other times when construction operations are suspended for any reason, the Contractor shall remove all equipment and other obstructions from that portion of the right-of-way open for use by public traffic.

15.0 SUPERVISION BY CONTRACTOR

15.1 The Contractor shall supervise and direct the Work, using its best skill and attention. The Contractor shall be solely responsible for the means, methods, techniques, sequences and procedures of construction. The Contractor shall employ and maintain on the Work a qualified supervisor or superintendent who shall have been designated in writing by the Contractor as the Contractor's representative at the site, and who shall have been approved by the Engineer, which approval shall not be unreasonably withheld. The supervisor shall have full authority to act on

behalf of the Contractor and all communications given to and by the supervisor shall be as binding as if given to and by the Contractor. The supervisor shall be present on the site at all times. The Contractor shall be responsible to the Owner for the acts and omissions of the employees, subcontractors, and the agents and employees, and other persons performing any other Work under the Contract with the Contractor.

16.0 CHANGES IN THE WORK

16.1 The Owner may at any time, as the need arises, order changes within the scope of the Work without invalidating the Contract. If such changes increase or decrease the amount due under the Contract Documents, or in the time required for performance of the Work, an equitable adjustment shall be authorized by Change Order.

16.2 The Engineer, also, may at any time, by issuing a Field Order, make changes in the details of the Work. The Contractor shall proceed with the performance of any changes in the Work so ordered by the Engineer unless the Contractor believes that such Field Order entitles him to a change in Contract Price or Time, or both, in which event he shall give the Engineer Written Notice thereof within seven (7) days after the receipt of the ordered change. Thereafter the Contractor shall document the basis for the change in Contract Price or Time within fourteen (14) days. The Contractor shall not execute such changes pending the receipt of an executed Change Order or further instruction from the Owner.

16.3 If the Contractor wishes to make a claim for an increase in the Contract sum, it shall give the Engineer written notice thereof within fourteen (14) days after the occurrence of the event giving rise to such claim. This notice shall be given by the Contractor before proceeding to execute the Work, except in an emergency endangering life or property, in which case Contractor shall proceed in accordance with the provisions of the Contract. No such claim shall be valid unless so made. If the Owner and Contractor cannot agree on the amount of adjustment in the Contract sum, it shall be determined by the Engineer. Any change in the Contract sum resulting from such claim shall be authorized in a Change Order.

16.4 The value of any Work covered by a Change Order shall be determined by one or more of the following methods in the order of precedence listed below:

- A. Unit prices previously approved.
- B. An agreed lump sum.
- C. Cost plus percentage.

17.0 TIME FOR COMPLETION AND LIQUIDATED DAMAGES

17.1 The date of beginning and the time for completion of the Work are essential conditions of the Contract Documents and the Work embraced shall be commenced on a date specified in the Notice To Proceed.

17.2 The Contractor shall proceed with the Work at such rate of progress to insure full completion within the Contract Time. It is expressly understood and agreed, by and between the

Contractor and the Owner, that the Contract Time for the completion of the Work described herein is a reasonable time, taking into consideration the average climatic and economic conditions and other factors prevailing in the locality of the Work.

17.3 The Contractor shall only work an eight (8) hour day consisting of Monday through Friday, between 6:00 a.m. to 6:00 p.m., and do not include local municipal holidays. If the Contractor desires to carry on Work more than eight (8) hours each day, or work at night or outside the regular hours, it shall give timely notice (72 hours) to the Engineer and receive the Owner's written approval to allow satisfactory arrangements to be made for inspecting the Work in progress. Should the prosecution of the Work be discontinued for any reason, the Contractor shall notify the Engineer at least 24 hours in advance of resuming operations. The Contractor shall be responsible for any extra compensation due or costs incurred as a result of Contractor's desire to carry out Work beyond an eight (8) hour day, or at night or outside regular hours, including but not limited to, any additional costs or compensation due the Engineer And Owner or its employees or agents as a result of having to be present at the site. The costs or extra compensation necessitated by the Contractor's Work beyond an eight (8) hour day, or at night or outside regular business hours may be deducted or withheld from progress payment or any other payments due to Contractor.

17.4 If for any reason a suspension of the work should occur; the Contractor, at its own expense, shall do all the Work necessary to provide a safe, smooth and unobstructed passageway through construction for use by public traffic or to provide for the proper and efficient operation of sewer, drainage and other facilities within the site of the Work, during the period of such suspension. In the event that the Contractor fails to perform the Work specified in this Subsection, the Owner will perform such Work and the cost thereof will be deducted from periodic progress payments due the Contractor.

17.5 During inclement weather and other conditions, the Contractor shall pursue only such portions of the Work as shall not be damaged thereby. No portions of the Work which satisfactory quality or efficiency will be affected by an unfavorable condition shall be constructed while these conditions remain, unless by special means or precautions, approved by the Engineer, the Contractor is able to overcome them.

17.6 Delays in delivery of equipment or material purchased by the Contractor or its Subcontractor, including Engineer-selected equipment, shall not be considered as a just cause for delay as this is not beyond the control of the Contractor. The Contractor shall be fully responsible for the timely ordering, scheduling, expediting, delivery, and installation of all equipment and materials.

17.7 In case of failure on the part of the Contractor to complete the Work within the time affixed in the Contract, or such extension thereof as may be allowed by Engineer or Owner, the Contract shall by that fact be terminated by written notice. The Owner shall not thereafter pay or allow the Contractor any further compensation for any Work done by it under said Contract, and the Contractor and its sureties shall be liable to the Owner for all loss or damage which it may suffer by reason of his failure to complete the Contract within such time. Failure to prosecute the Work diligently shall be grounds for termination by the Owner pursuant to this paragraph.

In the event the Contract should be terminated, the Owner shall have the right to take over the Work and to proceed with the same until it is completed, either by performing said Work itself directly or by contracting it out to some other person or persons, and in such event the Owner may take possession of and utilize, in completing the Work, such materials, appliances and plant as may be on the site of the Work and necessary for its completion. Nothing herein contained shall be deemed to limit the right of the Owner in the event of any breach of Contract by the Contractor; but all rights herein given to the Owner are and shall be deemed to be additional to any other rights or remedies which the Owner shall have under any provision of law.

17.8 Should the Contractor fail to complete the Work, or any part thereof, in the time agreed upon in the Contract or within such extra time as may have been allowed for delays by extensions granted as provided in the Contract, the Contractor shall reimburse the Owner for the additional expense and damage for each calendar day that the Contract remains uncompleted after the Contract completion date. It is agreed that the amount of such additional expense and damage incurred by reason of failure to complete the Work is the per diem rate, as stipulated in Section 15, Information For Bidders, plus any costs incurred by the Engineer including, but not limited to: the Engineer's costs for additional inspection, testing or surveying as a result of the Contractor's failure to complete the Work in the time agreed upon. The said amounts are agreed upon as liquidated damages for the loss to the Owner on account of expense due to the employment of Engineers, inspectors, and other employees after the expiration of the time of completion, and on account of the value of the operation of the Works dependent thereon. It is expressly understood and agreed that this amount is not to be considered in the nature of a penalty, but as liquidated damages which have accrued against the Contractor. The Owner shall have the right to deduct such damages from any amount due, or that may become due the Contractor, or the amount of such damages shall be due and collectible from the Contractor or its Surety.

17.9 The Contractor shall not be charged with liquidated damages or any excess costs when the delay in completion of the Work is due to any of the reasons set forth below provided the Contractor has given Written Notice of the delay within three (3) days of the occurrence of the cause of the delay to the Owner or Engineer. In the event notice is not given as provided, liquidated damages may be assessed.

A. To unforeseeable causes beyond the control and without the fault or negligence of the Contractor, including but not restricted to: acts of God, or of the public enemy, acts of the Owner, acts of another Contractor in the performance of a separate contract with the Owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and abnormal and unforeseeable weather.

18.0 CORRECTION OF WORK

18.1 The Contractor shall promptly correct all work rejected by the engineer as defective or as failing to conform to the contract documents, whether observed before or after substantial completion and whether or not fabricated, installed or completed. Contractor shall bear all costs of correcting such rejected work, including compensation for the engineer's additional services made necessary thereby. Contractor shall also bear the costs of making good all work of the

Owner or separate Contractor destroyed or damaged by such correction or removal.

18.2 All removal and replacement work shall be done at the Contractor's expense. If the Contractor does not take action to remove such rejected work within ten (10) days after receipt of Written Notice, the Owner may remove such work and store the materials at the expense of the Contractor, including compensation for the engineer's additional services made necessary thereby.

19.0 SUBSURFACE CONDITIONS

19.1 The Contractor shall promptly, and before such conditions are disturbed, except in the event of an emergency, notify the Owner by Written Notice of:

- A. Subsurface or latent physical conditions at the site differing materially from those indicated in the Contract Documents; or
- B. Unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in Work of the character provided for in the Contract Documents.

19.2 The Owner shall promptly investigate the conditions, and if it finds that such conditions do so materially differ and cause an increase or decrease in the cost of, or in the time required for, performance of the Work, an equitable adjustment shall be made and the Contract Documents shall be modified by a Change Order. Any claim of the Contractor for adjustment hereunder shall not be allowed unless he has given the required Written Notice; provided that the Owner may, if he determines the facts so justify, consider and adjust any such claims asserted before the date of final payment.

20.0 SUSPENSION OF WORK, TERMINATION AND DELAY

20.1 The Owner may suspend the Work or any portion thereof for a period of not more than ninety (90) days or such further time as agreed upon by the Contractor, by Written Notice to the Contractor and the Engineer which notice shall fix the date on which Work shall be resumed. The Contractor shall resume that Work on the date so fixed. The Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to any suspension.

20.2 In addition to any other reasons for termination provided in the Contract, the Contractor shall be considered in default of the Contract and such default will be considered as cause for the Owner to terminate the Contract for any of the following reasons if the Contractor:

- A. Fails to begin the Work under the Contract within the time specified in the "Notice To Proceed," or
- B. Fails to perform the Work or fails to provide sufficient workers, equipment or materials to assure completion of Work in accordance with the terms of the

Contract, or

- C. Performs the Work unsuitably or neglects or refuses to remove materials or to perform such new Work as may be rejected as unacceptable and unsuitable, or
- D. Discontinues the prosecution of the Work, or
- E. Fails to resume Work which has been discontinued within a reasonable time after notice to do so, or
- F. Becomes insolvent or is declared bankrupt, or commits any act of bankruptcy or insolvency, or
- G. Allows any final judgment to stand against him unsatisfied for a period of 10 days, or
- H. Makes an assignment for the benefit of creditors, or acceptable manner, or
- I. Is otherwise in breach of the Contract and has failed to remedy the breach within ten (10) days of written notice of the existence of such breach, or
- J. Fails to provide safe conditions for its workers and/or the general public.

Should the Owner consider the Contractor in default of the Contract for any reason above, he shall immediately give Written Notice to the Contractor and the Contractor's surety as to the reasons for considering the Contractor in default and the Owner's intentions to terminate the Contract.

If the Contractor or Surety, within a period of 10 days after Written Notice, does not proceed in accordance therewith, then the Owner shall have, upon written notification of the facts of such delay or neglect, the power and authority without violating the Contract, to take the prosecution of the Work out of the hands of the Contractor. The Owner may appropriate or use any or all materials and equipment that have been mobilized for use in the Work and are acceptable and may enter into an Contract for the completion of said Contract according to the terms and provisions thereof, or use such other methods as in the opinion of the Owner will be required for the completion of said Contract in an acceptable manner.

All costs and charges incurred by the Owner, together with the cost of completing the Work under Contract, will be deducted from any monies due or which may come due the Contractor. If such expense exceeds the sum which would have been payable under the Contract, then the Contractor and the Surety shall pay to the Owner the amount of such excess.

20.3 Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of monies due Contractor by Owner will not release Contractor from liability.

20.4 Upon seven days Written Notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, elect to terminate the Contract. In such case, Contractor shall be paid (without duplication of any items):

20.4.1 for completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such work;

20.4.2 for expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead on such expenses;

20.4.3 for reasonable costs incurred in settlement of terminated contracts with Subcontractors, Suppliers and others; and

20.4.4 for reasonable expenses directly attributable to termination.

Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

20.5 If the Work should be stopped under an order of any court or other public authority for a period of more than ninety (90) days, through no act or fault of the Contractor or of anyone employed by him, or if the Owner should fail to pay the Contractor within 45 days after the time specified in the Payments To Contractor, Section 22.0, then the Contractor may, upon 15 days Written Notice to the Owner, stop Work until payment of the amount owing has been received.

20.6 The Owner may terminate the Contract or a portion thereof if conditions encountered during the progress of the Work make it impossible or impracticable to proceed with the Work or a local or national emergency exists.

When Contracts, or any portion thereof, are terminated before completion of all Work in the Contract, adjustments in the amount bid for the pay items will be made on the actual quantity of Work performed and accepted, or as mutually agreed for pay items of Work partially completed or not started. No claim for loss of anticipated profits will be considered.

Termination of the Contract or any portion thereof shall not relieve the Contractor of its responsibilities for the completed work nor the surety of its obligation for and concerning any just claims arising out of the Work performed.

21.0 ISSUANCE OF NOTICE OF COMPLETION AND FINAL ACCEPTANCE BY OWNER

21.1 Upon completion of the Project, a Final Inspection shall be requested by the Contractor in writing and the Owner will make an inspection within seven (7) days. If all construction provided for and contemplated by the contract is found completed to his satisfaction, that inspection shall constitute the final inspection and the Owner will make the final acceptance and issue a Certificate

Of Completion to the Contractor.

If, however, the inspection discloses any Work, in whole or in part, as being unsatisfactory, the Owner will give the Contractor the necessary instructions for correction of same, and the Contractor shall immediately comply with and execute such instructions. Upon correction of the Work, another inspection will be made which shall constitute the final inspection provided the Work has been satisfactorily completed. In such event, the Owner will make the final acceptance and issue a Certificate Of Completion to the Contractor.

22.0 PAYMENTS TO CONTRACTOR

22.1 In addition to any documents required by the Engineer to be submitted to Engineer at the time a partial pay estimate is submitted, including partial lien released as specified in Section 22.9 of the General Conditions, the Contractor shall, at least ten (10) days before each progress payment falls due (but not more often than once a month), submit to the Engineer a partial payment estimate filled out and signed by the Contractor covering the Work performed during the period covered by the partial payment estimate and supported by such data as the Engineer may reasonably require. If payment is requested on the basis of materials and equipment not incorporated in the Work, title to such materials and equipment shall vest in the Owner, and Contractor shall supply, at the time of submission of payment estimate, supporting documents satisfactory to the Owner, to establish and protect Owner's interest in the materials and equipment, and Contractor shall maintain appropriate insurance on same until such time as actual possession by the Owner of the materials and equipment shall occur. The Engineer will, within seven (7) days after receipt of each partial payment estimate, either indicate in writing his approval of payment and present the partial payment estimate to the Owner or return the partial payment estimate to the Contractor indicating in writing his reasons for refusing to approve payment. In the latter case, the Contractor may make the necessary corrections and resubmit the partial payment estimate. The Owner will, within fourteen (14) days of presentation to him of an approved partial payment estimate, pay the Contractor a progress payment on the basis of the approved partial payment estimate. The Owner shall retain ten (10) percent of the amount of each payment until final completion and acceptance of all Work covered by the Contract Documents. When the Contract is fifty percent completed, one-half of the amount retained shall be paid to the Contractor provided the Contractor makes a written request for the payment and the Contractor is making satisfactory progress on the Contract and there is no specific cause or claim requiring a greater amount to be retained. After the Contract is fifty per cent completed, no more than five per cent of the amount of any subsequent progress payments made under the Contract may be retained providing the Contractor is making satisfactory progress on the project, except that if at any time the Owner determines satisfactory progress is not being made, ten per cent retention shall be reinstated for all progress payments made under the Contract subsequent to the determination.

22.2 In lieu of ten percent (10%) retention provided for in paragraph 22.1, of this Article, the Owner shall, at the Contractor's option, accept as a substitute an assignment of any of the following:

- A. Time certificates of deposit of banks licensed by the State of Arizona; or

- B. Securities of or guaranteed by the United States of America; or
- C. Securities of the State of Arizona, or any county, municipality or school district thereof; or
- D. Shares of savings and loan institutions authorized to transact business in the State of Arizona.

Such assigned instruments shall have a face value in an amount equal to ten percent (10%) of the progress payment for which such instruments are tendered and shall be retained by the Owner as a guarantee for complete performance of the Contract.

In the event the Owner accepts substitute security as provided herein for the ten percent (10%) retention, the Contractor shall be entitled to all interest or income earned by such security, and all such security in lieu of retention shall be returned to the Contractor within sixty (60) days after final completion and acceptance of all material, equipment and work covered by the contract if the Contractor has furnished the Owner satisfactory receipts for all labor and material billed and waivers of liens from any and all persons holding claims against the work.

In no event shall the Owner accept a time certificate of deposit of a bank or shares of a savings and loan institution in lieu of the retention specified in paragraph 22.1 of this Article unless accompanied by a signed and acknowledged waiver of the bank or savings and loan institution of any right or power to set off against either the Owner or the Contractor in relationship to the certificates or shares assigned.

22.3 The Contractor shall promptly pay each Subcontractor, upon receipt of payment from the Owner out of the amount paid to the Contractor on account of such Subcontractors' Work, the amount to which said Subcontractor is entitled, reflecting the percentage actually retained, if any, from payments to the Contractor on account of such Subcontractors' Work. The Contractor shall, by an appropriate Contract with each Subcontractor, require each Subcontractor to make payments to his Sub-subcontractors in similar manner.

22.4 Prior to Substantial Completion, the Owner, with the approval of the Engineer and with the concurrence of the Contractor, may use any completed or substantially completed portions of the Work. Such use shall not constitute an acceptance of such portions of the Work.

22.5 The Owner shall have the right to enter the premises for the purpose of doing Work not covered by the Contract Documents. This provision shall not be construed as relieving the Contractor of the sole responsibility for the care and protection of the Work, or the restoration of any damaged Work except such as may be caused by agents or employees of the Owner.

22.6 Upon final completion and acceptance of the Work, the Engineer shall issue a certificate attached to the final payment request that the Work has been accepted under the conditions of the Contract Documents. No retention of payments may be delayed or retained without a specific written finding by the Engineer or Owner of the reasons justifying the delay in payment. The

entire balance found to be due the Contractor, including the retained percentages, except the amount necessary to pay the expenses the Owner reasonably expected to incur in order to pay or discharge the expenses determined by the Engineer or Owner in the finding justifying the retention or delay, shall be paid to the Contractor, within sixty (60) days of completion or proper filing of the Notice of Completion.

22.7 The Contractor shall indemnify and save the Owner or the Owner's agents harmless from all claims growing out of the lawful demands of Subcontractors, laborers, workmen, mechanics, materialmen, and furnishers of machinery and parts thereof, equipment, tools, and all supplies, incurred in the furtherance of the performance of the Work. The Contractor shall, at the Owner's request, furnish satisfactory evidence, in the form of lien releases or other documents deemed appropriate by the Owner, that all obligations of the nature designated above have been paid, discharged, or waived. If the Contractor fails to do so the Owner may, after having notified the Contractor, either pay unpaid bills or withhold from the Contractor's unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged whereupon payment to the Contractor shall be resumed, in accordance with the terms of the Contract Documents, but in no event shall the provisions of this sentence be construed to impose any obligations upon the Owner to either the Contractor, his Surety, or any third party. In paying any unpaid bills of the Contractor, any payment so made by the Owner shall be considered as a payment made under the Contract Documents by the Owner to the Contractor and the Owner shall not be liable to the Contractor for any such payments made in good faith.

22.8 If any payment to Contractor is delayed after the date due, interest shall be paid at the rate of one percent per month or fraction of a month on such unpaid balance as may be due. If the Owner fails to make payment sixty (60) days after final completion and acceptance, in addition to other remedies available to the Contractor, interest shall be paid at the rate of one per cent per month or fraction of the month on such unpaid balance as may be due, except for that amount necessary to pay the expenses the Owner reasonably expects to incur in order to pay or discharge the expense determined by the Engineer or Owner in the finding justifying the retention or delay.

22.9 The Owner may require the Contractor to furnish partial releases or liens executed by all persons, firms and corporations who have furnished labor services or materials incorporated into the Work during the period of time for which the progress payment is due, releasing such lien rights as these persons, firms or corporations may have for that period.

23.0 ACCEPTANCE OF FINAL PAYMENT AS RELEASE

23.1 Following the Owner's acceptance of the Work, the Owner will issue a Notice of Completion to the Contractor. Sixty days after the issuing of the Notice of Completion, and upon receipt of the necessary Unconditional lien releases executed by all persons, firms and corporations who have furnished labor services or materials incorporated into the work evidencing that all liabilities have been fully discharged, the Owner will pay to the Contractor the entire sum so found to be due after deducting therefrom all previous payments and all amounts to be kept and all amounts to be retained under the provisions of the Contract. All previous prior partial estimates and

payments shall be subject to correction in the final estimate and payment.

23.2 The acceptance by the Contractor of final payment shall be and shall operate as a release to the Owner of all claims and all liability to the Contractor other than claims in stated amounts as may be specifically excepted by the Contractor for all things done or furnished in connection with this Work and for every act and neglect of the Owner and others relating to or arising out of this Work. Any payment, however, final or otherwise, shall not release the Contractor or his sureties from any obligations under the Contract Documents or the Performance Bond and Payment Bonds.

24.0 INSURANCE

24.1 The Contractor shall give special attention to Section 00500-A of the Bid Documents when preparing a bid, which outline the insurance requirements of Owner and the Contractor shall consider these insurance requirements part of the Bid/Contract documents.

The Contractor shall purchase and maintain such insurance as will protect him from claims set forth below which may arise out of or result from the Contractor's execution of the Work, whether such execution be by itself or by any Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

- A. Claims under worker's compensation, disability benefit and other similar employee benefit acts;
- B. Claims for damages because of bodily injury, occupational sickness or disease, or death of his employees;
- C. Claims for damages because of bodily injury, sickness or disease, or death of any person other than his employees;
- D. Claims for damages insured by usual personal injury liability coverage which are sustained (1) by any person as a result of an offense directly or indirectly related to the employment of such person by the Contractor, or (2) by any other person; and
- E. Claims for damages because of injury to or destruction of tangible property, including loss of use resulting therefrom.

The Contractor is responsible to respond to claims arising as a result of its work. See Section 500-B for specific procedures.

24.2 Certificates of Insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work. These Certificates shall contain a provision that coverages afforded under the policies will not be canceled unless at least ten (10) days prior Written Notice has been given to the Owner, "Attention: Contract Administrator, 2330 McCulloch Boulevard North, Lake Havasu City, AZ, 86403".

24.3 The Contractor shall procure and maintain, at its own expense, during the Contract Time, liability insurance as specified in Section 500-A, incorporated herein.

25.0 CONTRACT SECURITY

25.1 The Contractor shall within ten (10) days after the receipt of the Notice Of Award furnish the Owner with a Performance Bond and a Payment Bond in sums equal to the amount of the Contract PRICE, conditioned upon the performance by the Contractor of all undertakings, covenants, terms, conditions and Contracts of the Contract Documents, and upon the prompt payment by the Contractor to all persons supplying labor and materials in the prosecution of the Work provided by the Contract Documents. Such Bonds shall be executed by the Contractor and a corporate bonding company licensed to transact such business in the state in which the Work is to be performed and named on the current list of "Surety Companies Acceptable on Federal Bonds" as published in the Treasury Department Circular Number 570. The expense of these Bonds shall be borne by the Contractor. If at any time a surety on any such Bond is declared a bankrupt or loses its right to do business in the state in which the Work is to be performed or is removed from the list of Surety Companies accepted on Federal Bonds, Contractor shall within ten (10) days after notice from the Owner to do so, substitute an acceptable Bond (or Bonds) in such form and sum and signed by such other surety or sureties as may be satisfactory to the Owner. The premiums on such Bond shall be paid by the Contractor. No further payments shall be deemed due nor shall be made until the new surety or sureties shall have furnished an acceptable Bond to the Owner.

26.0 ASSIGNMENTS

26.1 Neither the Contractor nor the Owner shall sell, transfer, assign or otherwise dispose of the Contract or any portion thereof, or of his right, title or interest therein, or his obligations thereunder, without written consent of the other party. Nor shall the Contractor assign any monies due or to become due to him hereunder without the previous written consent of the Owner.

26.2 The Owner and Contractor each bind itself, its partners, successors and assigns and legal representatives to the other party hereto and to the partners, successors, assigns and legal representatives of such other party in respect to all covenants, Contracts and obligations contained in the Contract Documents.

27.0 INDEMNIFICATION

27.1 Contractor shall indemnify and hold harmless City, its officers and employees from and against any and all liabilities, damages, losses, and costs, including reasonable attorney's fees, but only to the extent caused by the negligence, recklessness, or intentional wrongful conduct of Contractor or other persons employed or used by the Contractor in the performance of this Contract. It is agreed that Contractor will be responsible for primary loss investigation, defense, and judgment costs where this indemnification is applicable.

27.2 In any and all claims against the Owner or the Engineer, or any of their agents or

employees, by any employee of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, the indemnification obligation shall not be limited in any way by any limitation on the amount or type of damages, compensation of benefits payable by or for the Contractor or any Subcontractor under worker's compensation acts, disability benefit acts or other employee benefits acts.

27.3 The obligation of the Contractor under this paragraph shall not extend to the liability of the Engineer, his agents or employees arising out of the preparation or approval of maps, DRAWINGS, opinions, reports, surveys, Change Orders, designs or Specifications.

28.0 SEPARATE CONTRACTS

28.1 The Owner reserves the right to let other contracts in connection with this Project. The Contractor shall afford other Contractors reasonable opportunity for the introduction and storage of their materials and the execution of their Work, and shall properly connect and coordinate its Work with theirs. If the proper execution or results of any part of the Contractor's Work depends upon the Work of any other Contractor, the Contractor shall inspect and promptly report to the Engineer any defects in such Work that render it unsuitable for such proper execution and results.

28.2 The Owner may perform additional Work related to the Project by itself, or it may let other contracts containing provisions similar to these. The Contractor shall afford the other Contractors who are parties to such Contracts (or the Owner, if he is performing the additional Work himself), reasonable opportunity for the introduction and storage of materials and equipment and the execution of Work, and shall properly connect and coordinate his Work with theirs.

28.3 If the performance of additional Work by other Contractors or the Owner is not noted in the Contract Documents prior to the execution of the Contract, written notice thereof shall be given to the Contractor prior to starting any such additional Work. If the Contractor believes that the performance of such additional Work by the Owner or others involves it in additional expense or entitles him to an extension of the Contract Time, it may make a claim therefore as provided in Sections 16 and 17.

29.0 SUBCONTRACTING

29.1 The Contractor may utilize the services of specialty Subcontractors on those parts of the Work which come under normal contracting practices or are typically performed by specialty Subcontractors, provided the Contractor, simultaneously with the delivery of the executed Contract, shall furnish to the Owner and the Engineer in writing the names of the persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each of the principal portions of the Work. The engineer will promptly reply to the Contractor in writing stating whether or not the Owner or the Engineer, after due investigation, has reasonable objection to any such proposed person or entity. Failure of the Owner or Engineer to promptly reply shall constitute notice of no reasonable objection. The Contractor shall not contract with any such proposed person or entity to whom the Owner or Engineer has made reasonable objection and the Contractor shall not be required to contract with anyone to whom

he has a reasonable objection. If the Owner or Engineer has a reasonable objection to any proposed person or entity, the Contractor shall submit a substitute to whom the Owner or the Engineer has no reasonable objection. The Contractor shall make no substitution for any Subcontractor, person or entity previously selected if the Owner or Engineer makes reasonable objection to such substitution.

29.2 The Contractor shall not award Work to Subcontractor(s), in excess of forty-nine (49%) percent of the Contract Price, without prior written approval of the Owner.

29.3 The Contractor shall be fully responsible to the Owner for the acts and omissions of its Subcontractors, and of persons either directly or indirectly employed by them, as it is for the acts and omissions of persons directly employed by it.

29.4 The Contractor shall not employ any Subcontractors that are not properly licensed with Lake Havasu City and the State of Arizona. Changes of Subcontractors listed with the Proposal shall be made only with the approval of the Owner.

29.5 Nothing contained in these Contract Documents shall be construed as creating any contractual relationship between any Subcontractor and the Owner; the Contractor shall be as fully responsible to the Owner for the acts and omissions of Subcontractors, and of persons employed by them, as he is for the acts and omissions of persons directly employed by him.

29.6 The Contractor shall, without additional expense to the Owner, utilize the services of specialty Subcontractors on those parts of the Work which are specified or required by State or local laws to be performed by specialty Subcontractors.

29.7 The Contractor shall be responsible for the coordination of all trades, Subcontractors, material and people engaged upon this Work. The Owner will not undertake to settle any differences between the Contractor and his Subcontractors or between Subcontractors.

29.8 The Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the Work to bind Subcontractors to the Contractor by the terms of the Contract Documents insofar as applicable to the Work of Subcontractors and to give the Contractor the same power as regards terminating any subcontract that the Owner may exercise over the Contractor under any provision of the Contract Documents.

29.9 Nothing contained in this Contract shall create any contractual relation between any Subcontractor and the Owner.

30.0 ENGINEER'S AUTHORITY

30.1 The Engineer shall act as the Owner's representative during the construction period. The Engineer shall decide questions which may arise as to quality and acceptability of materials furnished and Work performed and shall interpret the intent of the Contract Documents in a fair and unbiased manner. The Engineer will make periodic visits to the site and determine if the Work is proceeding in accordance with the Contract Documents.

30.2 The Contractor will be held strictly to the intent of the Contract Documents in regard to the quality of materials, workmanship and execution of the Work. Inspections may be made at the factory or fabrication plant of the source of material supply.

30.3 The Engineer shall not be responsible for the construction means, controls, techniques, sequences, procedures, or construction safety precautions and programs in connection with the Work and will not be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents. The Engineer shall not be responsible or have control or charge over the acts or omissions of the Subcontractors, or any of their agents or employees, or any other person performing any of the Work.

30.4 The Engineer shall promptly make decisions relative to interpretation of the Contract Documents.

30.5 The Engineer will have the authority to reject Work which does not conform to the Contract Documents. Whenever, in its opinion, it is considered necessary or advisable for the implementation of the intent of the Contract Documents, the Engineer will have authority to require special inspection or testing of the Work in accordance with the other terms of this Contract whether or not such Work be then fabricated, installed or completed.

31.0 LAND AND RIGHTS-OF-WAY

31.1 Prior to issuance of Notice To Proceed, the Owner shall obtain all land and rights-of-way necessary for carrying out and for the completion of the Work to be performed pursuant to the Contract Documents, unless otherwise mutually agreed.

31.2 The Owner shall provide to the Contractor information which delineates and describes the lands owned and rights-of-way acquired.

31.3 The Contractor shall provide at its own expense and without liability to the Owner any additional land and access thereto that the Contractor may desire for temporary construction facilities, or for storage of materials.

32.0 GUARANTEE

32.1 Except as otherwise specified, all Work shall be guaranteed by the Contractor against defects resulting from the use of inferior materials, equipment, or workmanship for a period of one (1) year from the date the Certificate of Substantial Completion is issued by the Owner, or within such longer period of time as may be prescribed by law or by the terms of any applicable special guarantee required by the Contract Documents.

32.2 If, within any guarantee period, repairs or changes are required in connection with guaranteed Work, which, in the opinion of the Owner, is rendered necessary as the result of the use of materials, equipment, or workmanship which are inferior, defective, or not in accordance with the terms of the Contract, the Contractor shall, promptly upon receipt of

notice from the Owner, and without expense, (1) place in satisfactory condition in every particular all of such guaranteed Work, correcting all defects therein; (2) make good all damage to the building, site or Work, or equipment or contents thereof, which in the opinion of the Owner, is the result of the use of materials, equipment, or workmanship which are inferior, defective, or not in accordance with the terms of the contract; and (3) make good any Work or material, or the equipment and contents of said building, site or Work disturbed in fulfilling any such guarantee. If the Contractor, after notice, fails to proceed promptly to comply with the terms of the guarantee, the Owner may have the defects corrected and the Contractor and his surety shall be liable for all expense incurred. The Performance Bond shall remain in full force and effect through the guarantee period.

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GUARANTEE

32.3 The Contractor agrees to execute, and to cause each Subcontractor to execute, a written guarantee to the Owner, in substantially the following form:

GUARANTEE FOR:

We hereby guarantee, both jointly and severally, that the improvement which we have installed for the Owner of Project, specifically described as:

Vadose Well Design and Expansion Project No. B24-PW-107015-500403

has been done in accordance with the Contract Drawings and Specifications.

We agree, both jointly and severally, to repair and replace any or all Work included in said improvement, together with any other adjacent work which may be displaced or damaged by so doing, that may prove to be defective in its workmanship or material within a period of one year from date of the Certificate of Substantial Completion, ordinary wear and tear and unusual abuse or neglect accepted.

In the event of our failure to comply with the above mentioned conditions within a reasonable period of time (as determined by the Owner) after being notified in writing by the Owner, we both jointly and severally, do hereby authorize the Owner to proceed to have said defects repaired and made good at our expense, and we will honor and pay the costs and charges therefore upon demand.

Signed _____

Countersigned _____

Local Representative to be contacted for service:

Name _____

Address _____

Phone No. _____

FAX _____

The guarantee form(s) shall be completed and returned with the acknowledgement of the Certificate of Completion.

The failure of the Contractor or any Subcontractor to execute, such guarantee shall not affect the right of the Owner to rely on and enforce the guarantee and the obligations respectively assumed by the Contractor and each Subcontractor under Subparagraph 32.1 and 32.2 hereof.

33.0 ARBITRATION

33.1 Provided both parties mutually agree, all claims, disputes and other matters in question arising out of, or relating to, the Contract Documents or the breach thereof, except for claims which have been waived by the making and acceptance of final payment as provided by Section 23, may be decided by arbitration in accordance with the American Arbitration Association or any other similar body. The foregoing Contract to arbitrate shall be specifically enforceable under the prevailing arbitration law (Arizona Revised Statutes Sections 12-1501, *et seq.*) of the State of Arizona. The award rendered by the arbitrators shall be final, and judgment may be entered upon it in any court having jurisdiction thereof.

33.2 Notice of the demand for arbitration shall be filed in writing with the other party to the Contract Documents and with the American Arbitration Association and a copy shall be filed with the Engineer. The party filing for arbitration may select which arbitration service to use. Demand for arbitration shall in no event be made on any claim, dispute or other matter in question which would be barred by the applicable statute of limitations.

33.3 The Contractor shall carry on the Work and maintain the progress schedule during any arbitration proceedings, unless otherwise mutually agreed in writing.

33.4 The provisions of the Contract pertaining to arbitration are not binding upon Engineer and Engineer cannot be compelled to participate against his will in an arbitration arising out of a dispute over the Contract or Contract Documents unless Engineer so consents in writing to be a party to the arbitration.

34.0 TAXES AND CHARGES

34.1 The Contractor shall pay all State and local sales and use taxes on items, and in a manner as required by the laws and statutes of the State of Arizona and its political subdivisions. The Contractor shall withhold and pay any and all withholding taxes, whether State or Federal, and pay all Social Security charges, State Unemployment Compensation charges, industrial insurance, workers' compensation charges, and pay or cause to be withheld, as the case may be, any and all taxes, charges, or fees, or sums whatsoever, which are now or may hereafter be required to be paid or withheld under any laws.

35.0 MISCELLANEOUS CONDITIONS

35.1 In the event that either party to the Contract is required to institute arbitration or litigation

to enforce its rights under the terms of the Contract, then the prevailing party in the arbitration or litigation shall be entitled to recover all costs and attorney's fees incurred.

35.2 In the event that any provision contained in the Contract is found to be contrary to the applicable law, then it shall be severed and the remaining provisions of the Contract shall remain in full force and effect.

35.3 The Contract shall be governed by the laws of the State of Arizona.

36.0 CONFLICTS WITHIN THE PLANS OR SPECIFICATIONS

36.1 In the event that a conflict is discovered between sections of the Specifications or between the Plans and the Specifications, the following list of priority shall be used to resolve the conflict:

- A. Executed Change Orders
- B. Addenda
- C. Contract
- D. Special Provisions
- E. General Conditions
- F. Instructions to Bidders
- G. Technical Specifications
- H. Plans
- I. Referenced Standard Specifications or Other Documents

37.0 NONDISCRIMINATION

37.1 The Contractor, with regard to the work performed pursuant to this contract, shall not discriminate on the grounds of race, color, sex, religion, creed, age, physical or mental disability, or national origin or ancestry in any contracts with the public and in the selection and retention of employees or subcontractors, nor in the procurement of materials and leases of equipment.

38.0 INTEGRATION

38.1 This Contract represents the entire Contract between the parties hereto and supersedes any and all prior negotiations or representations, either written or oral.

38.2 Amendments or modifications to the Contract shall be in writing, signed by both parties, or by Change Orders.

38.3 The Contract Documents shall not be construed to create any contractual relationship of any kind between the Engineer and the Contractor, but the Engineer shall be entitled to performance of obligations intended for his benefit, and to the enforcement thereof.

39.0 HAZARD COMMUNICATION PROGRAM

39.1 All contractors working on City projects shall submit a copy of their hazard communication

plan to the Fire Prevention Office prior to commencement of work on any project. This will ensure that other individuals on the job site are not unknowingly exposed to a hazardous substance or chemical.

The Fire Prevention Office shall be provided a list of the hazardous substances and the material safety data sheets that are applicable to the work areas of those contract employees.

All contract labor within City facilities will be treated the same as regular employees with regard to this hazard communication standard.

** END OF SECTION **

SECTION 00800
SPECIAL PROVISIONS

1.0 SCOPE

These Special Provisions supplement and modify the General Conditions, Technical Specifications, and Plans. All requirements and provisions of the General Conditions, Technical Specifications and Plans apply except where modified by these Special Provisions.

2.0 DEFINITION OF TERMS

Wherever in these documents the word "OWNER" appears, it shall be understood to mean Lake Havasu City, Arizona, the governing body of which is the City Council. Wherever in these documents the word "CONTRACTOR" appears, it shall be understood to mean the party or parties contracting with the Owner to perform the Work. Wherever in these documents the word "ENGINEER" appears, it shall be understood to mean Lake Havasu City Public Works Department, Engineering Division, or their appointed representative.

3.0 PRECONSTRUCTION CONFERENCE

Within ten (10) days after the contract has been awarded, but before the start of construction, the ENGINEER will schedule a conference to be held at the site of the project for the purpose of discussing such matters as project supervision, onsite inspections, progress schedules and reports, payrolls, payments to Contractors, equal employment opportunity, contract change orders, insurance, safety, and any other items pertinent to the project. The Contractor shall arrange to have all supervisory personnel connected with the project on hand to meet with the representatives of the Owner and the Engineer.

4.0 DRAWINGS OF RECORD

Two sets of the Contract Documents are to be kept at the job site, maintained in good condition, and marked daily by the Contractor as the work proceeds. The Contract Documents shall be kept available for inspection by the OWNER at all times, and shall be kept up to date.

5.0 SURVEYS

The CONTRACTOR shall layout the WORK, in accordance with the drawings, shall establish all necessary lines, etc., required to complete the work in accordance with the Contract Documents. The CONTRACTOR shall employ an experienced and competent Arizona Registered Land Surveyor (R.L.S.) satisfactory to the OWNER to layout the WORK and to verify lines and elevations as the WORK progresses.

6.0 WEATHER CONDITIONS

In the event of temporary suspension of work, or during inclement weather, or whenever the OWNER shall direct, the Contractor will and will cause his Subcontractors to protect carefully his

and their work and materials against damage or injury from the weather. If, in the opinion of the OWNER, any work or materials shall have been damaged or injured by reason of failure on the part of the Contractor or any of his subcontractors to so protect his work, such materials shall be removed and replaced at the expense of the Contractor.

7.0 SUBMITTALS

Prior to construction and as soon as possible, the Contractor shall supply all submittals required by the Technical Specifications or as requested by the Owner.

8.0 INSPECTION OF THE WORK

The Owner intends to provide a resident inspector for the project. The resident inspector will be available during the Contractors working time throughout the period of the Contract.

9.0 WATER AND POWER

A. WATER

Water is available from the Water Department at no cost to the Contractor. The Contractor shall make application and obtain a hydrant meter from the Water Department for the purpose of metering the use of water on the project. The Contractor shall adhere to all conditions stated in the Meter Application, including payment of a deposit for the meter, return of the meter to the Water Department each month during the project for reading, and notification to the Water Department prior to any change in the location of the hydrant meter. The maximum water to be drawn off a hydrant at any time is 200 gpm (water drawn from 4" hydrant whenever available). Water shall only be drawn off hydrants approved by the Lake Havasu City Water Superintendent or his authorized representative.

B. POWER

All power for lighting, operation of Contractor's plant or equipment or for any other use as may be required for proper completion of the work to be performed under the provisions of these contract documents, shall be provided by the Contractor at his sole cost and expense.

10.0 BURNING OF VEGETATION

No burning of vegetation will be allowed.

11.0 MATERIALS TESTING

A. CONSTRUCTION TESTING

All quality control testing must be provided by CONTRACTOR. The material and workmanship provided during construction will be tested on a regular basis by the CONTRACTOR. It shall be the responsibility of the CONTRACTOR, at no additional cost, to provide material samples for testing at the **OWNER's** request.

The CONTRACTOR shall be responsible for charges resulting from failed tests, costs for retesting shall be based upon hourly and/or individual test rates. In the event any portion of the project is rejected because of substandard work, all materials testing, engineering, and inspection costs associated with corrective measures shall be chargeable to the CONTRACTOR at the current respective rates.

B. PRELIMINARY MATERIALS TESTING

All preliminary materials testing and mix design testing required by the specifications to ensure materials and mix designs are suitable for project use will be the responsibility of the CONTRACTOR at no additional cost to the OWNER.

12.0 CLEANUP AND POLLUTION CONTROL

A. GENERAL

The CONTRACTOR shall be responsible for the removal of all debris, litter and waste from the job site(s) and/or equipment maintenance area and the restoration of any and all areas affected, directly or indirectly by the construction, transportation of equipment or materials and/or by the acts of neglect or omission by his employees.

All debris, litter, etc., shall be disposed of in accordance with prevailing ordinance or law. Open burning of trash, debris, etc., will not be permitted.

Such clean-up operations shall be on a daily basis. All pavement, concrete, brush, rocks, excess materials, etc. accumulated or removed during the course of construction must be disposed of in those areas designated by the Engineer or his authorized representative, including but not limited to the Lake Havasu City Landfill. All costs for disposal, including gate or tipping fees, etc. are the responsibility of the Contractor. This material must be disposed of within ten (10) days of time of removal. If the areas in question are not cleaned up to the satisfaction of the ENGINEER, progress payments will be withheld until clean-up is completed and approved by the ENGINEER, or, in the case of private projects, other legal action will be taken.

B. TEMPORARY FACILITIES

The CONTRACTOR shall provide temporary mailboxes and traffic control signs where necessary until completion of backfilling and clean-up.

C. SOLID WASTES

All solid wastes shall be removed and disposed of in accordance with prevailing ordinance or law. Clean-up shall be completed on a daily basis. All costs for disposal shall be the responsibility of the Contractor, and shall be considered incidental to the costs of the various bid items.

All spilled paving material shall be removed and disposed of prior to final acceptance and payment.

D. MAINTENANCE AREAS

Maintenance areas shall be kept clean during construction and shall be free of litter at all times. All empty containers, debris, waste, etc., shall be removed and disposed of prior to final acceptance. Upon inspection by the ENGINEER, the CONTRACTOR may be required to dress the surface of the ground, dependent upon the extent of spillage of petroleum products on the surface. If so directed, such dressing shall consist of scarifying the surface to a depth of six (6) inches and moving and compacting the soil in such a way as to blend the spill areas into clean soil and restore the surface by partial compaction.

E. POLLUTION

The CONTRACTOR shall be held responsible for acts leading to pollution of water, air or land by any means.

Open burning of trash, debris, etc., will not be permitted anywhere in the City limits.

The discharge of any pollutants upon the surface of the ground, or into any stream, ravine, wash or body of water which may result in pollution of the public water supply, or of groundwater contributory thereto, will not be permitted.

Violation of these conditions will be cause for the termination of work, and possible legal action.

F. REMOVAL AND REPLACEMENT OF SIGNS, MAILBOXES, ETC.

It is the responsibility of the CONTRACTOR to remove all poles, etc. which are located within the construction area and replace at the time of backfilling and clean-up in the locations determined by the Water Superintendent. In the case of landscaping or other private items located in the construction area, the CONTRACTOR shall hand-deliver a written notice to all residences in that area stating his intentions to perform construction activities and shall do so at least five (5) working days prior to work commencing. If, at the time of construction these items are still in the construction area, the CONTRACTOR is to remove and dispose of them properly. All signs and mailboxes shall be permanently installed within forty-eight (48) hours of completion of construction activities.

G. NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) GENERAL PERMIT

At the time of the preconstruction conference, the contractor shall submit, for the Engineer's approval, a program which includes all the measures which the contractor proposes to take for the construction of permanent erosion control work specified in the contract and all the temporary control measures to prevent erosion and pollution of streams, lakes and reservoirs.

Permanent erosion control work and pollution prevention measures shall be performed at the earliest practicable time consistent with good construction practices. Temporary work and measures are not meant to be performed in lieu of permanent work specified in the contract.

Construction of drainage facilities as well as the performance of other contract work which will contribute to the control of erosion and sedimentation shall be carried out in conjunction with earthwork operations or as soon thereafter as possible.

Except for that approved in writing by the Engineer, the contractor shall perform no clearing and grubbing or earthwork until the contractor's program has been approved.

If in the opinion of the Engineer, clearing and grubbing, excavation, or other construction operations are likely to create an erosion problem because of the exposure of erodible earth material, the Engineer may limit the surface area to be disturbed until satisfactory control measures have been accomplished. Unless otherwise permitted by the Engineer, the contractor shall not expose an area of erodible earth material greater than 217,800 square feet at any one location.

The Engineer may order the contractor to provide immediate measures to control erosion and prevent pollution. Such measures may involve the construction of temporary berms, dikes, dams, sediment basins and slope drains; the use of temporary mulches, mats and seeds and the use of other devices, methods, items, etc., as necessary.

At any time the contractor proposes to change his/her schedule of operations, the contractor shall review and update his/her erosion and pollution control program and submit it to the Engineer for approval.

The contractor shall not be entitled to additional compensation or an extension of contract time for any delays to the work because of the contractor's failure to submit an acceptable erosion and pollution control program.

Erosion control and pollution prevention work specified in the contract which is to be accomplished under any of the various contract items will be paid for by the bid item. Any additional work required by the Owner will be paid for by the Force Account set up for this work.

The cost of any erosion control and pollution prevention work which may be proposed by the contractor in his/her program, in addition to that specified in the contract, will be

considered as included in the prices bid for contract items.

13.0 DUST CONTROL

It shall be the Contractor's responsibility to provide adequate water for dust control. It is imperative that the air quality standards are maintained. In addition, dust could be quite hazardous in the everyday operations. It shall be the Contractor's responsibility to ensure that all regulations for air quality and safety are met.

14.0 SUPERVISORY PERSONNEL

It is the intent of these Specifications to provide a completed project which will in every way reflect the work of competent journeyman mechanics in the various trades represented. The Contractor shall ensure that each portion of the work is supervised by a qualified person, well versed in the operation of the various tools required for the trade, the method in which the work is to be done, and a knowledge of the general requirements of the construction work. All work is to be done in accordance with the latest methods devised for such work to ensure the highest quality product.

15.0 SAFETY REQUIREMENTS

The Contractor shall comply with all pertinent provisions of the Department of Labor "Safety and Health Regulations for Construction" (29 CFR Part 1518, 36 CFR 7340), with additions or modifications thereto, in effect during construction of this project.

THE FOLLOWING MEASURES OR PROVISIONS ARE TO BE ADHERED TO AT ALL TIMES DURING THE CONSTRUCTION OF THIS PROJECT:

- A. All heavy construction machinery to include trenching machines, bulldozers, backhoes, etc., must be equipped with a roll bar meeting the requirements of the above regulation.
- B. Safety helmets will be worn by all personnel working at the site. In addition, all spectators and inspectors will be required to wear safety helmets in construction zone.
- C. Steel toe safety shoes or boots will be worn by all personnel working at the site.

16.0 PRESERVATION OF BENCH MARKS AND MONUMENTS

The Contractor shall exercise caution to ensure that permanent bench marks, monuments, established property corners, survey lines, and points are not damaged or disturbed by this work. If any survey monuments, property corners, survey lines or points are damaged or disturbed, the Contractor's representative shall immediately notify the inspector. All centerline survey monumentation located in pavement removal areas shall be replaced by an Arizona Registered Land Surveyor (R.L.S.) after completion of the pavement removal and replacement operations. All costs incurred to re-establish such points shall be borne by the Contractor.

17.0 DISPOSAL OF EXCESS MATERIAL

Excess soil and unsuitable materials shall be removed from the site by the Contractor at his own expense and disposed of in accordance with the Contract Documents unless otherwise permitted herein. In the event the Contractor chooses to utilize local private lots to dispose of excess material, the Contractor must provide the Engineer with written permission from the lot owner prior to utilizing the lot. Placing material suitable for fill on vacant lots will require a Grading Permit in advance of placing the material.

18.0 REFERENCE STANDARD SPECIFICATIONS

Where standard specifications or testing methods have been referred to, such as ASTM or AASHTO, the intent is to refer to the latest applicable issue or revision of such specifications or testing methods. The following abbreviations are used in these specifications.

AWWA	American Waterworks Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AI	Asphalt Institute
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute (formerly the USA Standards Institute)
ASTM	American Society for Testing and Materials
API	American Petroleum Institute
NSF	National Sanitation Foundation
S.P.W.C.	Standard Specifications for Public Works Construction. (Wherever written herein shall mean "Maricopa Association of Governments, Arizona Specification for Public Works Construction".) The "Sample Forms" and "Part 100 – General Conditions" of these Standard Specifications for Public Works Construction are excluded from the documents for this project.

19.0 CODES, ORDINANCES AND LOCAL SPECIFICATIONS

All work under this project shall be performed in strict accordance with these specifications and the Standard Specifications for Public Works Construction (SPWC). Where any conflict occurs between these plans and specifications and the local codes and ordinances in effect at the time, such codes and ordinances shall take precedence over these plans and specifications only if these plans and specifications are inferior as to materials and workmanship called for by such codes

and ordinances.

20.0 INTERFERING STRUCTURES AND UTILITIES

The Contractor shall notify Blue Stake (1-800-782-5348) at least three (3) working days prior to any excavations.

The Contractor shall exercise all possible caution to prevent damage to existing structures and utilities, whether above ground or underground. The Contractor shall notify all utility offices concerned at least seventy-two (72) hours in advance of construction operations in which a utility's facilities may be involved.

Any structure or utility damage caused by the work shall be repaired or replaced in a condition equal to or better than the condition prior to the damage. Such repair or replacement shall be accomplished at the Contractor's expense without additional compensation from the Owner.

If interfering structures or installations such as vaults, manholes, valves, utility poles, guy wires, or anchors are encountered, the Contractor shall notify the Engineer and contact the appropriate utility or structure owner at least seven (7) days in advance of construction to arrange for protection or relocation of the structure.

The Contractor shall remove, protect and/or replace all existing structures, utilities or other improvements and similar items within the proposed improvements at his own expense without additional compensation from the Owner unless specifically provided for as a pay item of work by the Specifications or as otherwise provided for on the Plans. Replacement shall be in a manner and in a condition at least equivalent to, or better than, the original condition.

If the Contractor encounters existing facilities which will prevent the construction of any facility and which are not properly shown on the Plans, he shall notify the Owner before continuing with the construction in order that the Owner may make such field revisions as necessary to avoid conflict with the existing structure. The cost of waiting or "down" time during such field revision shall be borne by the Contractor without additional cost to the Owner. If the Contractor fails to notify the Owner when an existing structure is encountered, but proceeds with the construction despite this interference, he does so at his own risk. In particular, when the location of the new construction will prohibit the restoration of existing structures to their original condition; the Contractor shall notify the Engineer and contact the utility or structure owner so a field relocation may be made if possible to avoid the conflict.

In the event of interruption to any utility service as a result of accidental breakage or as a result of being exposed or unsupported, the Contractor shall promptly notify the proper authority. He shall cooperate with the said authority in restoration of service as promptly as possible and shall bear all costs of repair. In no case shall interruption of any utility service be allowed to exist outside working hours unless prior approval of the Owner is received.

Neither the Owner nor its officers or agents shall be responsible for damages to the Contractor as a result of the locations of the water and sewer lines or utilities being other than those shown

on the Plans or for the existence of water, sewer lines or utilities not shown on the Plans.

21.0 AIR QUALITY - OPERATING PERMITS

The Contractor may be required to obtain registration certificates and/or operating permits for sources of air pollution.

Information concerning these certificates and permits may be obtained from:

The Office of Air Quality
Arizona Department of Environmental Quality
P.O. Box 600
Phoenix, AZ 85001-0600
(602) 207-2300

22.0 ADJUST UTILITIES TO FINISHED GRADE

The Contractor shall be responsible for locating all manhole rims, valve boxes, meter boxes, utility vaults, etc., and setting them to finished grade. The Contractor shall adjust sewer and water facilities to finished grade in accordance with the specifications within seven (7) days after street surfacing has been completed on each street. All valves and/or manholes will be made visible and accessible for emergency use within 24 hours. It shall be the responsibility of the Contractor to coordinate with the various private utility companies so that they can adjust their facilities to finished grade at an appropriate time. Adjust all facilities in accordance with these specifications and the MAG Standard Details, as modified by Lake Havasu City.

23.0 SAFETY, HEALTH AND SANITATION PROVISIONS

The Contractor shall provide and maintain in a neat, sanitary condition such accommodations for the use of his employees as may be necessary to comply with the requirements and regulations of the Arizona State Department of Health.

The Contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions, on his own responsibility or as the Owner may determine, reasonably necessary to protect the life and health of employees on the job, the safety of the public and to protect property in connection with the performance of the work covered by the contract.

Precaution shall be exercised by the Contractor at all times for the protection of persons (including employees) and property. The Contractor shall comply with the provisions of all applicable laws, pertaining to such protection including all Federal and State occupational safety and health acts, and standards and regulations promulgated thereunder.

24.0 PUBLIC SAFETY AND TRAFFIC CONTROL

Every attempt shall be made to provide public safety during the construction of the project. Traffic control shall be performed in accordance with Section 2650, Traffic Control, of the Technical Specifications.

During all construction operations, the Contractor shall construct and maintain such facilities as may be required to provide access for all property owners to their property. No person shall be cut off from access to his residence or place of business for a period exceeding two (2) hours, unless the Contractor has made a special arrangement with the affected persons. It shall be the Contractor's responsibility to notify all adjacent property owners of the construction activity and the schedule of such activities.

The CONTRACTOR shall submit for approval a traffic control and barricade plan within ten (10) days of receipt of Notification of Award of Contract. There shall be no deviations from the approved barricade plan unless a revised barricade plan is submitted and approved. The CONTRACTOR shall issue a news release once a week for duration of the project. The release will be published in Sunday's newspaper and shall indicate the area in which the CONTRACTOR will be performing work for that week.

Businesses must be notified forty-eight (48) hours prior to any restrictions on normal parking areas used by their employees or patrons.

The CONTRACTOR shall contact, cooperate with, and give notice to each resident, homeowner, business or school that will be affected by any part of the construction process, particularly concerning temporary interruptions to vehicular access.

Written notice of the approximate schedule and explanation of work shall be given to each resident, homeowner, business or school at least five (5) days prior to commencement of work in the area. Verbal door-to-door communication shall be made at least twenty-four (24) hours prior to construction to remind all affected parties of the construction to take place.

The OWNER shall receive a copy of all notifications to residents. In the event of complaints by residents, the OWNER may require the CONTRACTOR to provide documentation (ie. check list) showing the date & time of the verbal door-to-door communication.

In addition, the CONTRACTOR is responsible to answer and resolve any conflicts that may arise between a homeowner or business owner and himself during the construction process.

The CONTRACTOR shall provide and station competent flaggers whose sole purpose shall be to direct the movement of public traffic through or around the work. Proper advanced

warning signs shall be in place when flaggers are working and removed when work requiring flaggers is completed. Flaggers must be used to assist trucks for safe ingress and egress whenever truck movements may interfere with safe passage through the work zone.

All traffic control devices that are not in use or will not be used for a period greater than 72 hours or that are determined by the Engineer to be unnecessary, confusing, or causing an unsafe condition, shall be removed by the CONTRACTOR from the public right-of-way immediately upon notification by the Engineer.

Every attempt shall be made to provide public safety during the construction of the project. Traffic control shall be performed in accordance with Section 2650, Traffic Control, of the Technical Specifications. No person shall be cut off from access to his residence or place of business for a period exceeding six (6) hours, unless the Contractor has made a special arrangement with the affected persons. In addition, no work will be scheduled which will interrupt regular trash pickup to either residential or commercial properties. It will be the CONTRACTOR'S responsibility to coordinate his activities with the local trash haulers.

No streets, avenues, boulevards or cul-de-sacs will be closed to traffic unless prior arrangements have been made and approval has been obtained from the ENGINEER.

25.0 TEMPORARY FACILITIES ON SITE

A. General

Except as otherwise provided, the Owner shall bear no costs of temporary facilities and their removal.

B. Temporary Utility Services

The Contractor shall provide temporary electric power as necessary for the execution of the Work, including that required by all Subcontractors. He shall make the necessary arrangements with Owner, shall bear all costs for these temporary services and shall furnish and install all necessary transformers, metering facilities and distribution centers from branch circuits as he may require.

The Contractor shall provide lighting and outlets in temporary structures throughout the project as may be required for safety, proper performance and inspection of the Work. If operations are performed during hours of darkness, or if natural lighting is deemed insufficient by Owner, the Contractor shall provide adequate floodlights, clusters and spot illumination. The use of permanently installed lighting fixtures, lamps and tubes for work will not be permitted except by special permission of Owner. The Contractor shall make arrangements with

Subcontractors for electrical services and lighting as may be necessary in the performance of their work.

Temporary water service lines, if required, shall be installed and removed by the Contractor, who shall pay all charges for making the connections, running the temporary lines, removing the temporary lines at the completion of the Work and disconnecting the services. All relocations required to clear the work of others shall be performed by the Contractor when requested by the Owner.

C. Temporary Structures

Prior to starting Work, the Contractor shall, as directed by Owner, provide and maintain suitable temporary office facilities for the duration of the Project as required for the Contractor's project administration; and all necessary sheds and facilities for the proper storage of tools, materials and equipment employed in the performance of the Work.

D. Toilet Facilities

The Contractor shall provide and maintain temporary toilet facilities for the duration of operations, which shall be maintained in a clean and sanitary condition acceptable to Owner and in full compliance with applicable regulations of any public authority.

E. Telephones

The Contractor shall provide, maintain and pay for telephone services for the duration of the Work as required for the Contractor's operation.

F. Fence and Barricades

The Contractor shall provide such protective fences and barricades as he may deem necessary for public safety and to protect his storage areas and the Work in place. The location and appearance of all fences shall be subject to the approval of the Owner.

G. Contractor Parking

The Contractor shall not park his equipment, nor allow his personnel to park, in any area except those specifically designated by the Owner.

H. Temporary Living Quarters

Temporary living quarters shall not be allowed on the job site or on publicly owned

properties. In addition, all Lake Havasu City Zoning Codes for the area in question shall be strictly adhered to.

I. Removal of Temporary Construction

The Contractor shall remove temporary office facilities, toilets, storage sheds and other temporary construction from the site as soon as, in Owner's opinion, the progress of Work permits. He shall recondition and restore those portions of the site occupied by the same to a condition equal to or better than it was prior to construction.

26.0 ACCESS TO WASHES

- A.** Unless otherwise mentioned herein, the Contractor must obtain written permission from the Owner prior to gaining access or utilizing washes or City parcels for any purpose. Request for access to washes and City parcels will be reviewed on a case by case basis. The Contractor shall have access to washes and City parcels via public streets and/or private easements only. For the purposes of this paragraph, "private easement" means an Contract by and between the Contractor and a property owner, in writing, authorizing the Contractor to travel across the property owner's real property in order to have ingress or egress to washes, parcels or any portion thereof. Such Contracts, if any, shall be filed with the Office of the City Engineer before the Contractor may exercise the rights thereunder granted. Access to any wash, parcels, or portion thereof by any means not in compliance with the terms of this paragraph shall be deemed a trespass and a breach of the terms of the Contract.
- B.** Violations of the provisions of subparagraph (a.) hereof, shall entitle the City to deduct the sum of One Thousand Dollars (\$1,000.00) from the monies due to Contractor as and for liquidated damages for each such violation. For the purposes of this paragraph, each entry by a vehicle upon land for which Contractor has not received permission to enter shall be deemed a separate violation of subparagraph (a.) hereof.

27.0 COORDINATION AND COOPERATION WITH UTILITY COMPANIES AND OTHER TRADES

A. Coordination/Interruption

The Contractor is responsible to coordinate work with all utility companies and other trades, on or affecting the job, for an efficient and effective execution of the complete project. The Contractor shall carefully examine all work that may conflict, and plan removal and/or installation details in advance of the construction to avoid any such conflict. Failure on the contractor's part to coordinate with any

and all utilities, public or private, shall preclude the City's consideration for additional time or cost.

B. Permission Required

Utility mains and utility service to buildings shall not be cut off or otherwise interrupted without the Contractor obtaining permission from the Owner in each and every instance.

C. Scheduling of Interruptions

Where utilities serve facilities or buildings in use, interruptions in service shall be scheduled during the hours when the facility is not in operation. Any overtime costs occasioned thereby shall be regarded as incidental to, and included within, the Contract Sum.

D. General Requirements

Prior to interrupting any utility service, the Contractor shall ascertain that he has the proper materials, together with adequate workmen and equipment, to complete the Work with a minimum of delay.

E. Project Electrical Service

The Contractor is responsible to coordinate with Unisource, Electric Division, to determine the extent of work to be performed by Unisource and by the Contractor to provide electric service for the finished product. The Contractor is also responsible to contact Unisource to determine the hardware required by Unisource to provide service to the final product. Unisource does not provide service to delta connections.

DIVISION II
GENERAL REQUIREMENTS

**SUMMARY OF
WORK**

PART 1 – GENERAL

1.1 Summary

- A.** This Section summarizes the Work covered in detail in the complete CONTRACT DOCUMENTS.
- B. OWNER:** Lake Havasu City is contracting for work described in the CONTRACT DOCUMENTS.
 - a. Contract Identification: **Vadose Well Design and Expansion, Project No. 107015**
- C. ENGINEER:** The CONTRACT DOCUMENTS were prepared by Jacobs Engineering, 1501 W. Fountainhead Pkwy, Suite 401 | Tempe, AZ 85282 | USA

1.2 Project Description

A. Description of Contract

This project consists of construction of one new vadose zone injection well (Vadose Zone Well 8); construction of a pipeline from the existing effluent force main to the new vadose zone injection well; construction of an access road, wellhead pad, ramp, and associated civil improvements; construction of wellhead piping and appurtenances; and electrical and instrumentation and controls improvements in accordance with the drawings and specifications.

B. Work Covered by Contract Documents

Includes all construction activities associated with construction of the Vadose Well 8 facilities. The work also provides for the complete restoration of all the areas disturbed by construction operations.

C. Drawings and Specifications

All work shall be performed in accordance with the drawings, special provisions, supplemental technical specifications, and Standard Technical Specifications for Public Works Construction as furnished by Lake Havasu City, and MAG, latest edition. Some Specifications have been revised and are different from specifications used in previous years. These changes reflect current design and construction conditions. It is the CONTRACTOR's responsibility to thoroughly review and adhere to the drawings and specifications.

1.3 Contractor's Use of Premises

A. Limited Use

1. CONTRACTOR shall restrict the construction operations to the project site and temporary construction easements as shown on the contract documents. Unauthorized use of washes, City Parcels, and Private Property is not permitted.
2. Conduct operations so as to ensure the least inconvenience to OWNER and the general public.

1.4 Work Sequence

- A. General: The general sequence of construction will be determined by the CONTRACTOR and submitted to the CITY for approval. See Section 00100, Item 15 for Time of Completion and Liquidated Damages.
- B. Continuous Service of Existing Facilities: Exercise caution and schedule operations to ensure that function of present facilities and adjacent facilities will not be disrupted.
- C. Prior to any construction activity in any area, the CONTRACTOR shall take digital photographs in sufficient detail to record the existing conditions of each area. The CONTRACTOR shall provide two copies of the photographs on a compact disk, according to Section 01325, to the Engineer for review and approval prior to commencing work in that area. Video of the areas will not be accepted as a substitute for photographs but may be submitted in addition.

1.5 Copies of Documents

- A. Furnished Copies: After execution of Agreement, CONTRACTOR will be furnished at no cost, electronic files (PDF and CADD e-files) in addition to those used in execution of the Agreement.

1.6 List of Drawings

A. Contract Drawings

1. Each sheet of the Contract Drawings will bear the following title: Construction of Vadose Zone Well 8 and Facilities

PART 2 – PRODUCTS – Not Applicable.

PART 3 – EXECUTION – Not Applicable.

PART 4 – MEASUREMENT & PAYMENT – Not Applicable.

**** END OF SECTION 01110 ****

SECTION 01200

MOBILIZATION/DEMOBILIZATION

PART 1 - GENERAL

1.1 Description

A. Description of Work

The work to be performed in accordance with this section includes the movement of personnel, equipment, supplies, and incidentals to the project site; for the establishment of offices, buildings and other facilities necessary for work on the project; for premiums on bonds and insurance for the project and for all other work and operations which must be performed or costs incurred before beginning work on the various contract items.

Demobilization at the end of the job includes removal of tools, materials, equipment and facilities used by the **CONTRACTOR** during construction of the project. Also included is final cleanup to leave the site with a neat, clean appearance.

PART 2 - MATERIALS

2.1 General

Materials shall consist of equipment, buildings, and tools necessary to move to the project site to perform work. Material for bid items shall not be included in Mobilization.

PART 3 - EXECUTION

3.1 General

Setting up of offices, and the use of private property for storage or work area shall be executed in a legal manner in accordance with local and state codes and ordinances.

Use of private property will require a signed agreement with the property owner, and shall be submitted to Engineer for approval prior to use. Sign off from property owner regarding restored property conditions will be required

prior to project closeout.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

No measurement will be made.

4.2 Payment

Payment for mobilization will be made as follows:

- A.** When 5% of the total original contract amount is earned from other Bid Items, 50% of the amount bid for Mobilization, or 5% of the total original contract amount, whichever is the least, will be paid.
- B.** When 10% of the total original contract amount is earned from other Bid Items, 100% of the amount bid for Mobilization, or 10% of the total original contract amount, whichever is the least, will be paid.
- C.** Upon completion of all work on the project, payment of any amount bid for Mobilization in excess of 10% of the total original contract amount will be paid. Demobilization shall be considered incidental to the Mobilization Bid Item.

Table A

Payment for Mobilization on First Partial Payment	Not to exceed 2.5% of the Lump sum Base Bid
Subsequent payments for Mobilization	Not to exceed 2.5% of the Lump sum Base Bid
Payment for Mobilization on Final Partial Payment	Any remaining Mobilization in excess of 5% of the Lump Sum Base Bid

See Section 00310 Bid Schedule for Bid Items.

SECTION 01210

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 Description

The outline of measurement and payment in this section is intended to provide a general guideline to the Contractor in preparing bids and submitting pay requests. The listing of work included in each bid item is not intended to include all work but is to provide general guidance to the Contractor for allocating costs. All work will be paid for on a unit price basis with payment made for the quantity of each item completed.

All materials required for construction shall be furnished by the Contractor unless specifically stated. Items not specifically measured and paid for shall be considered as subsidiary items required to complete the installation in accordance with the intent of the contract documents. The Contractor shall include in the unit price bid items, all costs associated with subsidiary items not being measured for payment.

1.2 Authority

Measurement methods delineated in the individual specification sections complement the criteria of this section. In the event of conflict, the requirements of the individual specification section govern.

Take all measurements and compute quantities. The Engineer will verify measurements and quantities.

1.3 Unit Quantities

Quantities indicated in the Bid Form are for bidding and contract purpose only. Quantities and measurements supplied or placed in the Work and verified by the Engineer shall determine payment.

If the actual Work requires more or fewer quantities than indicated, provide the required quantities at the unit prices contracted.

PART 2 – UNITS AND METHODS OF MEASUREMENT

2.1 General

All items that are included in the bid for measurement and payment are included herein. All other items of work shall be considered subsidiary to construction and will not be measured for payment.

2.2 Units and Methods of Measurement

2.2.1 Mobilization, Bonds, and Insurance

The Contract Lump Sum Price for this item shall constitute full compensation for furnishing all materials, labor, equipment and tools for all required bonds, insurance, mobilization of staff and equipment, and any other costs associated with complying with the contract administrative requirements and commencing work at the project site. This item also includes all work and materials necessary to complete the work as described in the plans and specifications. **Payment for this item shall be lump sum and shall not be requested until at least thirty days from the notice to proceed has elapsed.**

Payment for this item shall be made in accordance with Table A.

TABLE A

Payment for Mobilization on First Partial Payment	Not to exceed 2.5% of the Lump Sum Base Bid
Subsequent payments for Mobilization	Not to exceed 2.5% of the Lump Sum Base Bid
Payment For Mobilization on Final Partial Payment	Any remaining Mobilization in excess of 5% of the Lump Sum Base Bid

2.2.2 All Other Lump Sum Prices

Payment for lump sum price items covers all the labor, materials, and services necessary to furnish and install the item.

Payment for lump sum prices shall include the work listed in Table 01210-1 for that item. The Contractor acknowledges that certain miscellaneous work items not described in Table 01210-1 are also part of that Bid item if necessary to complete the work. The intent of the total of the Bid items is to provide for all work, labor, equipment, transportation, and materials, complete, whether specifically mentioned or not. The Contractor agrees to accept as full payment the sum of these Bid item unit prices as full compensation for all work required by these Contract Documents.

2.2.3 Force Account Work

The lump sum quantity shown in the "Force Account" shall be included in the Bid Schedule. Only the OWNER shall determine the use of monies in the "Force Account".

The OWNER will authorize the use of monies in the Force Account by Change Order. Unused Force Account monies will be removed from the Cost of the Work by Change Order.

Table 01210-1

Bid Item	Payment Includes
Mobilization, Bonds, Insurance	As specified in Sections 01200 and Section 01210.
Well Drilling, Construction, Development, and Testing	All work, equipment, tools, and materials to construct, develop and test Vadose Zone Injection Well 8 in accordance with the Drawings and Specifications.
Pipeline from existing force main to new vadose zone injection well	All work, equipment, tools, and materials to construct the pipeline from the existing force main to Vadose Zone Injection Well 8 in accordance with the Drawings and Specifications
Access road, wellhead pad, ramp and associated civil improvements	All work, equipment, tools, and materials to construct the access road, well pad, ramp and associated civil improvements in accordance with the Drawings and Specifications
Wellhead piping and appurtenances	All work, equipment, tools, and materials to construct the wellhead piping and appurtenances for Vadose Zone Injection Well 8 in accordance with the Drawings and Specifications
Electrical improvements and instrumentation and controls	All work, equipment, tools, and materials to construct electrical and instrumentation and controls improvements for Vadose Zone Injection Well 8 in accordance with the Drawings and Specifications
Force Account Work	As specified in Sections 01210 and Section 01300.

****END OF SECTION 01210****

SECTION 01300

FORCE ACCOUNT

PART 1 - GENERAL

1.1 Description of Work

The work to be performed in accordance with this section includes additional work that is outside the general scope of the proposed project. The work to be performed shall be specifically requested in writing by the **OWNER** or the **ENGINEER**. As the project is completed, it is anticipated that the **OWNER** may request additional work to be performed that currently is not a part of this Contract and it is the intent that the requested work shall be performed in accordance with this section.

PART 2 - MATERIALS

2.1 General

Any materials utilized under this Section shall conform specifically with the appropriate Materials Section of these Specifications unless the **OWNER** specifically requests in writing a deviation from the Specifications. If the materials are not covered by an appropriate Specification of this document, then the **OWNER** will provide a written specification for the materials requested.

PART 3 - EXECUTION

3.1 Workmanship

Furnish all materials, equipment and labor required to complete the work. All workmanship shall meet or exceed the appropriate Specifications included in this document or any supplemental Specifications that may be provided. Perform work in accordance with the contract Plans or in accordance with any supplemental plans that may be provided by the **OWNER**.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

The method of measurement shall be in accordance with the appropriate

specification or as included in specific written instructions from the **OWNER** or the **ENGINEER**.

4.2 Payment

Payment for work performed under this section shall be made for those items specifically requested in writing by the **OWNER**. The value of any work performed in this Section shall be determined by one or more of the following methods in the order of precedence listed below.

- A. Unit prices previously approved.
- B. An agreed upon price.

The amount specified for Force Account in the Bid Documents is an estimate that is provided so each potential bidder has an equal opportunity in the bidding. The amount does not in any way represent what work may be requested or the quantity or value of the work. The **CONTRACTOR** shall only be compensated for the actual work requested and performed.

See Section 00310 Bid Schedule for Bid Items.

SECTION 01320

PROJECT MEETINGS, SCHEDULES, AND REPORTS

PART 1 - GENERAL

1.1 Summary

- A.** This Section includes the following administrative and procedural requirements.
- B.** Project Meetings
 - 1.** Preconstruction conference.
 - 2.** Coordination schedules.
 - 3.** Progress meetings.
 - 4.** Coordination meetings.
- C.** Schedules and Reports
 - 1.** Initial coordination schedules.
 - 2.** Construction progress schedule.
 - 3.** Procurement schedule.
 - 4.** Construction progress reports.
 - 5.** Schedule of values.
 - 6.** Special reports.
- D.** Related Work Specified Elsewhere
 - Submittal Section 01330

1.2 Project Meetings

A. Preconstruction Conference

1. Engineer will conduct a meeting as described in Section 800, Special Provisions, Paragraph 3.0, to review items stated in the following agenda and to establish a working understanding between the parties as to their relationships during performance of the Work.
2. **Preconstruction conference shall be attended by the following.**
 - a. Contractor and his superintendent.
 - b. Engineer.
 - c. Representative(s) of Owner.
 - d. Representatives of principal Subcontractors and Suppliers.
3. **Meeting Agenda**
 - a. Construction schedules.
 - b. Critical Work sequencing.
 - c. Designation of responsible personnel.
 - d. Project coordination.
 - e. Procedures and Processing of:
 - (1) Field decisions.
 - (2) Substitutions.
 - (3) Submittals.
 - (4) Change Orders.
 - (5) Applications for Payment.

- f. Procedures for testing.
- g. Procedures for maintaining record documents.
- h. **Use of Premises:**
 - (1) Office, work, and storage areas.
 - (2) Owner's requirements.
- i. Construction facilities, controls, and construction aids.
- j. Temporary utilities.
- k. Safety and first-aid.
- l. Security.

4. **Location of Meeting:** To Be Determined.

5. **Reporting:**

- a. Within 5 working days after the meeting, Engineer will prepare and distribute minutes of the meeting to Owner and Contractor.
- b. Contractor shall provide copies to Subcontractors and major Suppliers.

B. Coordination Schedules

1. Engineer will conduct a meeting at least 10 days before submission of the first Application for Payment to update the initial coordination schedules requested under ARTICLE 1.3 this Section.

2. **The meeting shall be attended by:**

- a. Contractor and his superintendent.
- b. Representatives of principal Subcontractors and Suppliers.
- c. Engineer.

d. Representative(s) of Owner.

C. Progress Meetings

1. Engineer will schedule and conduct a meeting weekly and at other times requested by Engineer. Representatives of the Owner, Engineer, and Contractor shall be present at each meeting. With Engineer's concurrence, Contractor may request attendance by representatives of Subcontractors, Suppliers, or other entities concerned with current program or involved with planning, coordination, or performance of future activities. All participants in the meeting shall be familiar with the Project and authorized to conclude matters relating to the Work.
2. Contractor and each Subcontractor represented shall be prepared to discuss the current construction progress report and any anticipated future changes to the schedule. Each Subcontractor shall comment on the schedules of Contractor and other Subcontractors and advise if their current progress or anticipated activities are compatible with that Subcontractor's Work.
3. If one Subcontractor is delaying another, Contractor shall issue such directions as are necessary to resolve the situation and promote construction progress.
4. **Meeting Agenda:**
 - a. Review of construction progress since previous meeting.
 - b. Field observations, interface requirements, conflicts.
 - c. Problems which impede construction schedule.
 - d. Off-site fabrication.
 - e. Delivery schedules.
 - f. Submittal schedules and status.
 - g. Site use.

- h.** Temporary facilities and services.
- i.** Hours of Work.
- j.** Hazards and risks.
- k.** Housekeeping.
- l.** Quality and Work standards.
- m.** Change Orders.
- n.** Documentation of information for payment requests.
- o.** Corrective measures and procedures to regain construction schedule if necessary.
- p.** Revisions to construction schedule.
- q.** Review of proposed activities for succeeding Work period.
- r.** Review proposed Contract modifications for:
 - (1)** Effect on construction schedule and on completion date.
 - (2)** Effect on other contracts of the Project.
- s.** Other business.

5. Location of Meetings: Meeting shall be held at the Lake Havasu North Regional Wastewater Treatment Plant.

North Regional Wastewater Treatment Plant
7001 Whelan Drive
Lake Havasu City, Arizona 86406

6. Reporting:

- a. Within 5 working days after each meeting, Engineer will prepare and distribute minutes of the meeting to Owner and Contractor.
- b. Contractor shall distribute copies to principal Subcontractors and Suppliers.

1.3 Schedules and Reports

A. Initial Coordination Schedules

- 1. Within 10 days after the Effective Date of the Agreement, Contractor shall submit to Engineer for review and acceptance:
 - a. A preliminary procurement schedule of Equipment and Materials.
 - b. A preliminary schedule of values for partial pay purposes.
 - c. A preliminary schedule of Submittals, as stated in Section 01330.
 - d. Preliminary cash requirement prediction.

B. Baseline Construction Schedule

- 1. Within 20 days after issuance the Notice of Award of the Contract, Contractor shall submit to Engineer for review and acceptance a detailed baseline construction schedule employing the critical path scheduling method.
 - a. The schedule shall show the Work in a horizontal bar chart, and indicate the start date, duration, and end date for each activity.
 - b. The Contractor shall submit to the Engineer, 7 paper copies and 1 electronic copy in Suretrak® Version 3.0 or approved compatible format for review. Sheet size shall be a minimum 11 x 17-inches
 - c. No single activity shall be more than 15 days in duration.

- d. The Contractor shall include all work by Subcontractors in the baseline construction schedule.
 - e. The schedule shall be resourced base and include work breakdown structures.
 - f. The schedule shall indicate milestone from which the Contractor's progress will be measured for the purpose of determining liquidated damages.
 - g. In addition to submitting the schedule on paper, the schedule shall be provided electronically in a format compatible with SureTrack® Version 3.0 scheduling software.
 - h. Within each activity, indicate estimated completion percentage in 10% increments.
 - i. Scale and spacing shall allow room for notations and revisions.
2. After the construction schedule is approved, the schedule shall serve as the Contractor's Baseline Schedule for all Work on the project. Activity ID's shall not be changed without the Engineer's written permission from this point forward. New activity numbers will be allowed, but only for new work outside the original project baseline schedule activities.
 3. If necessary, the Contractor shall provide subschedules to define in more detail, critical portions of the baseline schedule, including inspections and tests.
 4. The Contractor shall coordinate the baseline construction progress schedule with the schedule of values, Submittal schedule, procurement schedule, progress reports, and payment requests.
 5. The Contractor shall revise the construction baseline schedule after each meeting, event, or activity where revisions have been recognized and accepted in accordance with the GENERAL CONDITIONS.

6. The Contractor shall update and submit 7 paper copies and 1 electronic copy in SureTrak® Version 3.0 compatible format of the revised schedule to the Engineer at least once each month to show actual progress compared to the originally accepted baseline construction schedule and any proposed changes in the schedule of remaining Work. The revised schedule shall be updated and submitted to the Engineer prior to each monthly payment request. Engineer's approval for payment will not be recommended to be paid by the Owner until the monthly revised schedule is accepted by the Engineer. Include the schedule with construction progress report (See Section 1320.1.3.D).

C. Procurement Schedule

1. After submittal of preliminary procurement schedule as stated above under "Initial Coordination Schedules", submit a detailed schedule for procurement of Equipment and Materials to be furnished by Contractor, Subcontractors, manufacturers, and Suppliers. Do not include minor items which are known to be regularly stocked by local suppliers or readily available upon short notice. Submit to Engineer for review with the construction progress schedule.
2. Engineer will review and comment on the schedule for procurement, and upon agreement with Contractor concerning any necessary revisions, the schedule will be accepted.
3. Procurement schedule shall coincide with the construction progress schedule and the Submittal schedule, and shall indicate the date each item will be needed at the Site and the time required for delivery after order is placed.
4. Update the accepted schedule for procurement at least once each month to show the status of orders placed, Submittals, and delivery. Submit with the construction progress report.
5. If requested by Engineer, submit copies of purchase orders placed by Contractor or Subcontractors.

D. Construction Progress Reports

- 1.** Submit a report on actual construction progress on a weekly basis. More frequent reports may be required should the Work fall behind the accepted schedule.
 - a.** Format shall be on 11 x 17-inch paper, submitted to Engineer electronically.

- 2.** Construction progress reports shall consist of the revised construction progress schedule and a narrative report which shall include but not be limited to the following:
 - a.** Comparison of actual progress to planned progress shown on originally accepted schedule.
 - b.** Summary of activities completed since the previous construction progress report.
 - c.** Identification of problem areas.
 - d.** A description of current and anticipated delaying factors, if any.
 - e.** Impact of possible delaying factors.
 - f.** Proposed corrective actions.

- 3.** Submit a construction progress report to Engineer with each application for partial payment. Work reported complete but not readily apparent to Engineer must be substantiated with supporting data when requested by Engineer.

- 4.** If a schedule update reveals that, through no fault of Owner, the Work is likely to be completed later than the Contract completion date, Contractor shall:
 - a.** Establish a plan for making up lost time.
 - (1)** Increase number of workers, or
 - (2)** Increase amount or kinds of tools, or

(b) The total installed value.

d. The sum of all values listed in the schedule shall equal the total Contract Price.

F. Special Reports

1. When an event of an unusual and significant nature occurs at the site, prepare and submit a special report. List the chain of events, persons participating, response by Contractor's personnel, an evaluation of the results or effects, and similar pertinent information. Advise the Owner in advance when such events are known or predictable.
2. Submit original report to Owner and copy to Engineer.

PART 2 - PRODUCTS - Not Applicable.

PART 3 - EXECUTION - Not Applicable.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable.

**** END OF SECTION 01320 ****

SECTION 01325

CONSTRUCTION PHOTOGRAPHS

PART 1 - GENERAL

1.1 Summary

- A. This Section specifies administrative and procedural requirements for construction photographs.

1.2 Submittals

- A. Submit CD's as specified in Section 01330, Submittals and in PART 3 - this Section.
- B. Photographer shall submit a digital sample set of the type and quality required during construction, for review and acceptance by Engineer.

1.3 Quality Assurance

- A. All photographs shall be taken and processed by a qualified photographer with experience in construction photography.

PART 2 - PRODUCTS

2.1 Photographic Requirements

Specified in PART 3, this Section.

PART 3 - EXECUTION

3.1 Photographs

- A. Contractor shall be responsible for photographs of the entire construction site to show the existing and general condition of the site prior to construction. Each photo will be required to have a date stamp in the lower right corner.

B. Photographs shall be taken of the following areas and at the following times.

1. Existing Site conditions before Site work is started. Number of views shall be adequate to cover the Site.
2. Finished Project after completion of Work. Number of views shall be adequate to show the finished Work. It is particularly important to provide a view of the restoration of the property upon completion of construction.
3. If Project is not completed during the Contract Time or authorized extensions, photographs shall continue to be taken at no increase in Contract Price.

C. The principal reason for obtaining photographs is so that items such as cracked curbs, and/or driveways, shrubs, trees, landscaping, decorative walls, privacy walls, mail boxes, lighting, broken pavement or sidewalks, or other problems along the construction route may be more clearly shown and recorded. This will to some degree preclude the possibility of post construction litigation between Contractor and property owners adjacent to the Work.

D. Digital Images

1. Submit two (2) complete sets of digital image electronic files on a CD for each area of work prior to starting work.
 - a. Provide images in JPEG format, with minimum sensor size of 5.0 mega pixels.
 - b. Submit images that have same aspect ratio as the sensor, uncropped.
 - c. The photos of each residence and areas adjacent shall be labeled electronically on each photograph by address.

E. Identification

1. Each disk submitted shall be labeled with Project name, area and street
2. Identify electronic media with date digital photographs were taken.

- F. Deliver prints to Engineer.

Jacobs Engineering
ATTN: Rick Edwards
1501 W. Fountainhead Parkway, Suite 401
Tempe, AZ 85282

3.2 Additional Photographs

- A. From time to time Engineer may issue requests for additional photographs, in addition to periodic photographs specified. Additional photographs will be paid for by Change Order, and are not included in the Contract Price or an Allowance.
1. Engineer will give the photographer 3 days' notice, where feasible.
 2. In emergency situations, the photographer shall take additional photographs within 24 hours of Engineer's request.
 3. Circumstances that could require additional photographs include, but are not limited to:
 - a. Substantial Completion of a major phase or component of Work.
 - b. Owner's request for special publicity photographs.
 - c. Special events planned at Project Site.
 - d. Immediate follow-up when on-site events result in construction damage or losses.
 - e. Photographs to be taken at fabrication locations away from Project Site.
 - f. Extra record photographs at time of final acceptance.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable

**** END OF SECTION 01325 ****

SECTION 01330

SUBMITTALS

PART 1 - GENERAL

1.1 Summary

A. This Section includes definitions, descriptions, transmittal, and review of Submittals.

B. Related Work Specified Elsewhere:

Project Meetings, Schedules, and Reports	Section 01320
Construction Photographs	Section 01325
Equipment and Materials.....	Section 01600
Substitutions.....	Section 01631
Contract Closeout.....	Section 01780

1.2 General Information

A. Definitions

1. Shop Drawings, product data, and Samples are technical Submittals prepared by Contractor, Subcontractor, manufacturer, or Supplier and submitted by Contractor to Engineer as a basis for approval of the use of Equipment and Materials proposed for incorporation in the Work or needed to describe installation, operation, maintenance, or technical properties.

a. Shop Drawings include custom-prepared data of all types including drawings, diagrams, performance curves, material schedules, templates, instructions, and similar information not in standard printed form applicable to other projects.

b. Product data includes standard printed information on materials, products, and systems; not custom-prepared for this Project, other than the designation of selections from available choices.

2. Documents submitted to Engineer that do not conform to specified requirements shall be subject to rejection by Engineer, and upon request by Engineer, Contractor shall resubmit conforming documents. If conforming Submittals cannot be obtained, such documents shall be retraced, redrawn, or photographically restored as may be necessary to meet such requirements. Contractor's (or his Subcontractor's) failure to initially satisfy the legibility quality requirements will not relieve Contractor (or his Subcontractors) from meeting the required schedule for Submittals.

C. Language and Dimensions

1. All words and dimensional units shall be in the English language.
2. Metric dimensional unit equivalents may be stated in addition to the English units. However, English units of measurement shall prevail.

D. Submittal Completeness

1. Submittals shall be complete with respect to dimensions, design criteria, materials of construction, and other information specified to enable Engineer to review the information effectively.
2. Where standard drawings are furnished which cover a number of variations of the general class of Equipment, each drawing shall be annotated to indicate exactly which parts of the drawing apply to the Equipment being furnished. Use hatch marks to indicate variations that do not apply to the Submittal. The use of "highlighting markers" will not be an acceptable means of annotating Submittals. Annotation shall also include proper identification of the Submittal permanently attached to the drawing.
3. Reproductions or copies of Contract Drawings or portions thereof will not be accepted as complete fabrication or erection drawings. Contractor may use a reproduction of Contract Drawings for erection drawings to indicate information on erection or to identify detail drawing references. Whenever the Drawings are revised to show this additional Contractor information, Engineer's title block shall

be replaced with a Contractor's title block, and Engineer's professional seal shall be removed from the drawing. The Contractor shall revise these erection drawings for subsequent Engineer revisions to the Contract Drawings.

1.3 Technical Submittals

A. Items shall include, but not be limited to, the following:

1. Manufacturer's specifications.
2. Catalogs, or parts thereof, of manufactured Equipment.
3. Shop fabrication and erection drawings.
4. Instruction books and operating manuals.
5. Material lists or schedules.
6. Performance tests on Equipment by manufacturers.
7. Concrete mix design information.
8. All drawings, catalogs or parts thereof, manufacturer's specifications and data, samples, instructions, and other information specified or necessary:
 - a. For Engineer to determine that the Equipment and Materials conform with the design concept and comply with the intent of the Contract Documents.
9. Equipment List.
10. Hourly rate for equipment and labor.

B. Schedule of Submittals

1. Schedule all submittals required prior to fabrication, manufacture, or installation for submission within 14 calendar days of the Notice to Proceed. Prepare for Engineer's concurrence, a schedule for submission of all Submittals specified or necessary for Engineer's approval of the use of Equipment and Materials proposed for incorporation in the Work or needed for proper installation, operation, or

maintenance. Submit the schedule with the procurement schedule and construction progress schedule. Schedule submission of all Submittals to permit review, fabrication, and delivery in time so as to not cause a delay in the Work of Contractor or his Subcontractors or any other contractors as described herein.

2. In establishing schedule for Submittals, allow 14 calendar days in Engineer's office for reviewing original Submittals and 5 calendar days in Engineer's office for reviewing resubmittals.
3. The schedule shall indicate the anticipated dates of original submission for each item and Engineer's approval thereof, and shall be based upon at least one resubmission of each item.
4. Schedule all Submittals required prior to fabrication or manufacture for submission within 45 calendar days of the Notice to Proceed. Schedule Submittals pertaining to storage, installation, and operation at the Site for Engineer's approval prior to delivery of the Equipment and Materials.
5. Resubmit Submittals the number of times required for Engineer's "Submittal Approved." However, any need for resubmittals in excess of the number set forth in the accepted schedule, or any other delay in obtaining approval of Submittals, will not be grounds for extension of the Contract Times, provided Engineer completes his reviews within the times specified.

C. Transmittal of Submittals

1. All Submittals for Equipment and Materials furnished by Contractor, Subcontractors, manufacturers, and Suppliers shall be submitted to Engineer by Contractor.
2. After checking and verifying all field measurements, transmit all Submittals to Engineer for approval as follows:
 - a. **Submittal Information Block:**
 - (1) Affix to all paper copies whether Submittal is prepared by Contractor, Subcontractor, or Supplier. Use transparent decal type Submittal

Information Blocks for Shop Drawings and use gummed paper type for product data Submittals. All Submittal Information Blocks needed for this Contract will be furnished to Contractor at no charge at the initial coordination conference.

- (2)** An example of the Submittal Information Block is included as an appendix to this Section.
- b.** Mark each Submittal by Project name and number, Contract title and number, and the applicable Specification Section and Article number. Include in the letter of transmittal the Drawing number and title, sheet number (if applicable), revision number, and electronic filename (if applicable). Unidentifiable Submittals will be returned for proper identification.
 - c.** Check and include Contractor's approval for Submittals of Subcontractors, Suppliers, and manufacturers prior to transmitting them to Engineer. Contractor's approval shall constitute a representation to Owner and Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data, or Contractor assumes full responsibility for doing so, and that Contractor has coordinated each Submittal with the requirements of the Work and the Contract Documents.
 - d.** At the time of each submission, call to the attention of Engineer in the letter of transmittal any deviations from the requirements of the Contract Documents.
 - e.** Make all modifications noted or indicated by Engineer and return revised Submittals until approved. Direct specific attention in writing, or on revised Submittals, to changes other than the modifications called for by Engineer on previous Submittals. After paper copy Submittals have been approved, submit copies thereof for final distribution. Previously approved Submittals transmitted for final distribution will not be further reviewed and are not to be revised. If errors are discovered during manufacture or

fabrication, correct the Submittal and resubmit for review.

- f. Following completion of the Work and prior to final payment, furnish record documents and approved Samples and Shop Drawings necessary to indicate "as constructed" conditions, including field modifications, in the number of copies specified. Furnish additional copies for insertion in Equipment instruction books and operating manuals as required. All such copies shall be clearly marked "PROJECT RECORD."
- g. Keep a copy or sample of each Submittal in good order at the Site.

3. Quantity Requirements:

- a. Except as otherwise specified, transmit all Shop Drawings in the following quantities:
 - (1) **Initial Submittal:** Electronic pdf copy to Engineer.
 - (2) **Resubmittals:** Electronic pdf copy to Engineer.
 - (3) **Submittal for final distribution:** Electronic pdf copy to Engineer.
 - (4) **As-constructed documents:** Electronic pdf copy to Engineer.
- b. Transmit Submittals of product data as follows:
 - (1) **Initial Submittal:** Email
 - (2) **Resubmittals:** Email
 - (3) **Submittal for final distribution:** Email
- c. **Transmit Submittals for reference only:** Email to Engineer.
- d. Owner may copy and use for internal operations and staff training purposes any and all document Submittals required by this Contract and approved for final distribution, whether or not such documents are copyrighted, at no additional cost to Owner. If

permission to copy any such Submittal for the purposes stated is unreasonably withheld from Owner by Contractor or any Subcontractor, manufacturer, or Supplier, Contractor shall provide to Engineer 50 copies plus the number of copies required by Contractor at each final distribution issue.

- 4. Information to Manufacturer's District Office:** Contractor shall arrange for manufacturers and Suppliers of Equipment and Materials to furnish copies of all agreements, drawings, specifications, operating instructions, correspondence, and other matters associated with this Contract to the manufacturer's district office servicing the Owner. Insofar as practicable, all business matters relative to Equipment and Materials included in this Contract shall be conducted through such local district offices.

D. Engineer's Review

- 1.** Engineer will review and take appropriate action on Submittals in accordance with the accepted schedule of Submittals. Engineer's review and approval will be only to determine if the items of Equipment and Materials covered by the Submittals will, after installation or incorporation into the Work, conform to information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
- 2.** Engineer's review and approval will not extend to design data reflected in Submittals, which is peculiarly within the special expertise of Contractor or Contractor's Subcontractors or Suppliers. Review and approval of a component item as such will not indicate approval of the assembly in which the item functions.
- 3.** Engineer's review and approval of Shop Drawings, product data, or Samples will not relieve Contractor of responsibility for any deviation from requirements of the Contract Documents unless Contractor has in writing called Engineer's attention to such deviation at the time of submission, and Engineer has given written approval of the specific deviation. Approval by Engineer shall not relieve Contractor from responsibility for errors or omissions in Submittals.

E. Submittal Action Stamp

1. Engineer's review action stamp, appropriately completed, will appear on all Submittals of Contractor when returned by Engineer. Review status designations listed on Engineer's action stamp are defined as follows:

A - SUBMITTAL APPROVED: Signifies Equipment or Material represented by the Submittal conforms with the design concept and complies with the intent of the Contract Documents and is approved for incorporation in the Work. Contractor is to proceed with fabrication or procurement of the items and with related Work. Copies of the Submittal are to be transmitted to Engineer for final distribution.

B - SUBMITTAL APPROVED AS NOTED (RESUBMIT): Signifies Equipment and Material represented by the Submittal conforms with the design concept and complies with the intent of the Contract Documents and is approved for incorporation in the Work in accordance with Engineer's notations. Contractor is to proceed with fabrication or procurement of the items and with related Work in accordance with Engineer's notations and is to submit a revised Submittal responsive to notations marked on the returned Submittal or written in the letter of transmittal.

C - SUBMITTAL RETURNED FOR REVISION (RESUBMIT): Signifies Equipment and Material represented by the Submittal appears to conform with the design concept and comply with the intent of the Contract Documents but information is either insufficient in detail or contains discrepancies which prevent Engineer from completing his review. Contractor is to resubmit revised information responsive to Engineer's annotations on the returned Submittal or written in the letter of transmittal. Fabrication or procurement of items represented by the Submittal and related Work is not to proceed until the Submittal is approved.

D - SUBMITTAL NOT APPROVED (SUBMIT ANEW): Signifies Equipment and Material represented by the

Submittal does not conform with the design concept or comply with the intent of the Contract Documents and is disapproved for use in the Work. Contractor is to provide Submittals responsive to the Contract Documents.

E - PRELIMINARY SUBMITTAL: Signifies Submittals of such preliminary nature that a determination of conformance with the design concept or compliance with the intent of the Contract Documents must be deferred until additional information is furnished. Contractor is to submit such additional information to permit layout and related activities to proceed.

F - FOR REFERENCE, NO APPROVAL REQUIRED: Signifies Submittals which are for supplementary information only; pamphlets, general information sheets, catalog cuts, standard sheets, bulletins and similar data, all of which are useful to Engineer or Owner in design, operation, or maintenance, but which by their nature do not constitute a basis for determining that items represented thereby conform with the design concept or comply with the intent of the Contract Documents. Engineer reviews such Submittals for general content but not for basic details.

G - DISTRIBUTION COPY (PREVIOUSLY APPROVED): Signifies Submittals which have been previously approved and are being distributed to Contractor, Owner, Resident Project Representative, and others for coordination and construction purposes.

F. Instruction Books and Operating Manuals

- 1.** Equipment instruction books and operating manuals prepared by the manufacturer shall include the following:
 - a.** Index and tabs.
 - b.** Instructions for installation, start-up, operation, inspection, maintenance, parts lists and recommended spare parts, and data sheets showing model numbers.
 - c.** Applicable drawings.

- d. Warranties and guarantees.
 - e. Address of nearest manufacturer-authorized service facility.
 - f. All additional data specified.
2. Information listed above shall be bound into hard-back binders of three-ring type. Sheet size shall be 8-1/2 x 11. Binder color shall be white. Capacity shall be a minimum of 1-1/2-inches, but sufficient to contain and use sheets with ease.
- a. Provide with following accessories:
 - (1) Label holder.
 - (2) Business card holder.
 - (3) Sheet lifters.
 - (4) Horizontal pockets.
 - b. The following information shall be imprinted, inserted or affixed by label on the binder front cover:
 - (1) Equipment name.
 - (2) Manufacturer's name.
 - (3) Project name.
 - (4) Contract name and number.
 - c. The following information shall be imprinted, inserted, or affixed by label on the binder spine:
 - (1) Equipment name.
 - (2) Manufacturer's name.
 - (3) Volume number (if applicable).

G. Samples

1. **Office Samples shall be of sufficient size and quantity to clearly illustrate the following:**
- a. Functional characteristics of the product, with integrally related parts and attachment devices.
 - b. Full range of color, texture, and pattern.

2. Field Samples and Mock-ups:

- a.** Contractor shall erect field Samples and mock-ups at the Project Site and at a location acceptable to Engineer.
- b.** Size or area shall be as specified in the respective Specification Section.
- c.** Fabricate each Sample and mock-up complete and finished.
- d.** Remove mock-ups at conclusion of Work or when acceptable to the Engineer if not a permanent part of construction.

1.4 Information Submittals

- A.** Informational Submittals are comprised of technical reports, administrative Submittals, and guarantees, which relate to the Work, but do not require Engineer approval prior to proceeding with the Work. Informational Submittals include:
- 1.** Welder qualification tests.
 - 2.** Welding procedure qualification tests.
 - 3.** X-ray and radiographic reports.
 - 4.** Hydrostatic testing of pipes.
 - 5.** Field test reports.
 - 6.** Concrete cylinder test reports.
 - 7.** ASME pressure vessel test reports.
 - 8.** Certification on Materials:
 - a.** Steel mill tests.
 - b.** Brick and concrete masonry unit lab tests.
 - 9.** Soil test reports.

10. Piping stress analysis.

11. Warranties and guarantees.

B. Transmittal of Informational Submittals

1. All informational Submittals furnished by Subcontractors, manufacturers, and Suppliers shall be submitted to Engineer by Contractor unless otherwise specified.

a. Identify each informational Submittal by Project name and number, Contract title and number, and the Specification Section and Article number marked thereon or in the letter of transmittal. Unidentifiable Submittals will be returned for proper identification.

b. At the time of each submission, call to the attention of Engineer in the letter of transmittal any deviations from the requirements of the Contract Documents.

2. Quantity Requirements:

a. Technical reports and administrative Submittals except as otherwise specified:

(1) Engineer: Two copies.

b. Written Certificates and Guarantees:

(1) Engineer: Two copies.

3. Test Reports:

a. Responsibilities of Contractor, Owner, and Engineer regarding tests and inspections of Equipment and Materials and completed Work are set forth elsewhere in these Contract Documents.

b. The party specified responsible for testing or inspection shall in each case, unless otherwise specified, arrange for the testing laboratory or reporting agency to distribute test reports as follows:

- (1) Owner: Two copies.
- (2) Engineer: One copy.
- (3) Resident Project Representative: One copy.
- (4) Contractor: Two copies.
- (5) Manufacturer or Supplier: One copy.

C. Engineer's Review

- 1. Engineer will review informational Submittals for indications of Work or Material deficiencies.
- 2. Engineer will respond to Contractor on those informational Submittals, which indicate Work or Material deficiency.

PART 2 - PRODUCTS - Not Applicable.

PART 3 - EXECUTION – Not Applicable.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable

**** END OF SECTION 01330 ****

SECTION 01420

DEFINITIONS AND STANDARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Definitions

1. Basic contract definitions used in the Contract Documents are defined in the GENERAL CONDITIONS. Definitions and explanations are not necessarily either complete or exclusive, but are general for the Work.
2. General Requirements are the provisions or requirements of DIVISION 1 Sections, and which apply to the entire Work of the Contract.

B. Related Information Specified Elsewhere: Specification standards and associations applicable to the Work are specified in each Section.

1.2 Specification Format and Content Explanations

A. Specification Format: The Specifications are organized into Divisions and Sections based on the Construction Specifications Institute's (CSI) Section Format and MasterFormat numbering system. Some portions may not fully comply and no particular significance will be attached to such compliance or noncompliance.

1. **Divisions and Sections:** For convenience, a basic unit of Specification text is a "Section," each unit of which is numbered and named. These are organized with related Sections, into "Divisions," which are recognized as the present industry consensus on uniform organization and sequencing of Specifications. The Section title is not intended to limit meaning or content of Section, nor to be fully descriptive of requirements specified therein, nor to be an integral part of text.
2. **Section Numbering:** Used for identification and to facilitate cross-references in Contract Documents. Sections are placed

in numeric sequence; however, numbering sequence is not complete, and listing of Sections in Table of Contents at beginning of the Project Manual must be consulted to determine numbers and names of Specification Sections in these Contract Documents.

3. **Page Numbering:** Numbered independently for each Section. Section number is shown with page number at bottom of each page, to facilitate location of text.
4. **Parts:** Each Section of Specifications generally has been subdivided into three basic "parts" for uniformity and convenience (PART 1 - GENERAL, PART 2 - PRODUCTS, and PART 3 - EXECUTION). These "Parts" do not limit the meaning of text within. Some Sections may not contain all three "Parts" when not applicable, or may contain more than three "Parts" to add clarity to organization of Section.
5. **Underscoring of Titles:** Used strictly to assist reader of Specification in scanning text for key words in content. No emphasis on or relative importance is intended except where underscoring may be used in body of text to emphasize a duty, critical requirement, or similar situation.
6. **Project Identification:** Project file number and identification are recorded at bottom of each page of Specifications to minimize possible misuse of Specifications, or confusion with other Project Specifications.

B. Specification Content

1. These Specifications apply certain conventions in the use of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:
 - a. **Imperative and Streamlined Language:** These Specifications are written in imperative and abbreviated form. This imperative language of the technical Sections is directed at the Contractor, unless specifically noted otherwise. Incomplete sentences shall be completed by inserting "shall," "the Contractor shall," and "shall be," and similar mandatory phrases by inference in the same manner as they are applied

to notes on the Drawings. The words "shall be" shall be supplied by inference where a colon (:) is used within sentences or phrases. Except as worded to the contrary, fulfill (perform) all indicated requirements whether stated imperatively or otherwise.

- b. Specifying Methods:** The techniques or methods of specifying requirements varies throughout text, and may include "prescriptive," "compliance with standards," "performance," "proprietary," or a combination of these. The method used for specifying one unit of Work has no bearing on requirements for another unit of Work.
 - c. Overlapping and Conflicting Requirements:** Where compliance with two or more industry standards or sets of requirements is specified, and overlapping of those different standards or requirements establishes different or conflicting minimums or levels of quality, notify Engineer for a decision as specified in GENERAL CONDITIONS.
 - d. Abbreviations:** Throughout the Contract Documents are abbreviations implying words and meanings which shall be appropriately interpreted. Specific abbreviations have been established, principally for lengthy technical terminology and in conjunction with coordination of Specification requirements with notations on Drawings and in schedules. These are normally defined at first instance of use. Organizational and association names and titles of general standards are also abbreviated.
- C. Assignment of Specialists:** In certain instances, Specification text requires that specific Work be assigned to specialists in the operations to be performed. These specialists shall be engaged for performance of those units of Work, and assignments are requirements over which Contractor has no choice or option. These assignments shall not be confused with, and are not intended to interfere with, enforcement of building codes and similar regulations governing the Work, local trade and union jurisdictions, and similar conventions. Nevertheless, final responsibility for fulfillment of Contract requirements remains with Contractor.

- D. **Trades:** Except as otherwise specified or indicated, the use of titles such as "carpentry" in Specification text, implies neither that the Work must be performed by an accredited or unionized tradesperson of corresponding generic name (such as "carpenter"), nor that specified requirements apply exclusively to work by tradespersons of that corresponding generic name.

1.3 Drawing Symbols

- A. Except as otherwise indicated, graphic symbols used on Drawings are those symbols recognized in the construction industry for purposes indicated. Refer instances of uncertainty to Engineer for clarification.

1.4 Industry Standards

- A. **Applicability of Standards:** Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents. Such standards are made a part of the Contract Documents by reference and are stated in each Section.
 1. Referenced standards, referenced directly in Contract Documents or by governing regulations, have precedence over nonreferenced standards which are recognized in industry for applicability to the Work.
 2. Where compliance with an industry standard is required, standard in effect shall be as stated in GENERAL CONDITIONS.
 3. Where an applicable code or standard has been revised and reissued after the date of the Contract Documents and before performance of Work affected, the Engineer will decide whether to issue a Change Order to proceed with the updated standard.
 4. In every instance the quantity or quality level shown or specified shall be the minimum to be provided or performed. The actual installation may comply exactly, within specified tolerances, with the minimum quantity or quality specified, or it may exceed that minimum within reasonable limits. In complying with these requirements, indicated

numeric values are minimum or maximum values, as noted, or appropriate for the context of the requirements. Refer instances of uncertainty to the Engineer for a decision before proceeding.

5. Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - a. Where copies of standards are needed for performance of a required construction activity, Contractor shall obtain copies directly from the publication source.

- B. Abbreviations and Names:** Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards generating organization, authority having jurisdiction, or other entity applicable to the context of the text provision.

PART 2 - PRODUCTS - Not Applicable.

PART 3 - EXECUTION - Not Applicable.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable.

**** END OF SECTION 01420 ****

SECTION 01520

FIELD OFFICES AND SHEDS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes requirements for temporary field offices and other structures required for office and storage space required by Contractor.

B. Related Work Specified Elsewhere

Equipment and Materials.....Section 01600
Temporary Utilities and FacilitiesSection 01560

PART 2 - PRODUCTS

2.1 Field Offices

A. General

1. Provide trailers, mobile buildings, or buildings constructed with floors raised aboveground, with steps, landings, and railings at entrance doors.
2. Buildings shall be structurally sound, secure, and weathertight.
3. Provide appropriate type fire extinguishers at each office and storage area.
4. Maintain offices during progress of the Work.
5. Install office spaces ready for occupancy 15 days after date stated in Notice to Proceed.

B. Contractor's Office

1. Provide a field office for Contractor's superintendent on the Site.

2. It shall be of size required for general use, with lights, heat, furnishings, telephone service, and other necessary facilities and utilities required by Contractor's operations.

2.2 Storage Sheds and Trailers

A. On Site

1. Provide temporary buildings or trailers needed for storage of Equipment and Materials installed under this Contract (and those furnished by Owner or others under separate contract).
2. Provide ventilation and heating as required by Equipment and Material stored.

B. Off Site

1. Advise Engineer of any arrangements made for storage of Equipment and Materials in a place other than Owner's Site. Furnish evidence of insurance coverage with Application for Payment in conformance with the GENERAL CONDITIONS.

PART 3 - EXECUTION

3.1 Location, Installation and Maintenance

A. General

1. Place temporary buildings, trailers, and stored materials in locations acceptable to Owner or Engineer.
2. Install field offices and sheds to resist winds and elements of the locality where installed.
3. Remove when no longer needed at the Site or when Work is completed.
4. Keep approach walks free of leaves, mud, water, ice, or snow.
5. At completion of Work, remove temporary buildings and trailers, foundations (if any), utility services, and debris.

6. Prepare ground or paved areas as specified in applicable Sections.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable

**** END OF SECTION 01520 ****

SECTION 01530

TEMPORARY BARRIERS AND CONTROLS

PART 1 - GENERAL

1.1 Summary

A. This Section includes General Requirements for:

1. Safety and protection of Work.
2. Safety and protection of existing property.
3. Barriers.
4. Environmental controls.
5. Traffic control and use of roadways.

B. Related Work Specified Elsewhere

Temporary Utilities and FacilitiesSection 01560

PART 2 - PRODUCTS – Not Applicable

PART 3 - EXECUTION

3.1 Safety and Protection of Work and Property

A. General

1. Provide for the safety and protection of the Work as set forth in GENERAL CONDITIONS. Provide protection at all times against rain, wind, storms, frost, freezing, condensation, or heat so as to maintain all Work and Equipment and Materials free from injury or damage. At the end of each day, all new Work likely to be damaged shall be appropriately protected.
2. Notify Engineer immediately at any time operations are stopped due to conditions, which make it impossible to continue operations safely or to obtain proper results.

3. Construct and maintain all necessary temporary drainage and do all pumping necessary to keep excavations, floors, pits, trenches, manholes, and ducts free of water.
4. Protect floors from damage by proper covering and care when handling heavy equipment, painting, or handling mortar or other such materials. Use proper cribbing and shoring to prevent overloading of floors while moving heavy equipment. Provide metal pans under pipe-threading machines and clean such pans daily, keeping oil off floors. Restore floors to former condition where damaged or stained.
5. Concrete floors less than 28 days old shall not be loaded without written permission from Engineer.
6. Restrict access to roofs except as required by the Work. Where access is required, provide protection with plywood, boards, or other suitable materials.

B. Property Other than Owner's

1. Provide for the safety and protection of property as set forth in the GENERAL CONDITIONS. Report immediately to the owners thereof and promptly repair damage to existing facilities resulting from construction operations.
2. Names and telephone numbers of representatives of agencies and utilities having jurisdiction over streets and utilities in the Work area can be obtained from Engineer for the agencies listed below. Concerned agencies or utilities shall be contacted a minimum of 24 hours prior to performing Work, closing streets and other traffic areas, or excavating near underground utilities or pole lines.
 - a. Water.
 - b. Gas.
 - c. Sanitary sewers.
 - d. Storm drains.
 - e. Pipeline companies.

- f. Telephone.
 - g. Electric.
 - h. Municipal streets.
 - i. State highways.
 - j. City engineer.
 - k. Fire.
 - l. Police.
3. Operation of valves or other appurtenances on existing utilities, when required, shall be by or under the direct supervision of the owning utility.
 4. Where fences are to be breached on private property, the owners thereof shall be contacted and arrangements made to ensure proper protection of any livestock or other property thus exposed.
 5. The applicable requirements specified for protection of the Work shall also apply to the protection of existing property of others.
 6. Before acceptance of the Work by Owner, restore all property affected by Contractor's operations to the original or better condition.

3.2 Barriers

A. General

1. Furnish, install, and maintain suitable barriers as required to prevent public entry, protect the public, and to protect the Work, existing facilities, trees, and plants from construction operations. Remove when no longer needed or at completion of Work.
2. Materials may be new or used, suitable for the intended purpose, but shall not violate requirements of applicable codes and standards or regulatory agencies.

3. Barriers shall be of a neat and reasonable uniform appearance, structurally adequate for the required purposes.
4. Maintain barriers in good repair and clean condition for adequate visibility. Relocate barriers as required by progress of Work.
5. Repair damage caused by installation and restore area to original or better condition. Clean the area.

B. Tree and Plant Protection

1. Preserve and protect existing trees and plants.
2. Provide temporary barriers around each, or around each group of trees and plants. Construct to a height of 6 feet around trees, and to a height to adequately protect plants.
3. Employ qualified tree surgeon to remove and to treat cuts.
4. Protect root zones of trees and plants as follows:
 - a. Do not allow vehicular traffic or parking.
 - b. Do not store materials or products.
 - c. Prevent dumping of refuse or chemically injurious materials or liquids.
 - d. Prevent puddling or continuous running water.
5. Carefully supervise excavating, grading and filling, and subsequent construction operations to prevent damage.
6. Remove and replace similar size & type (or agreed upon by homeowner), or suitably repair, trees and plants which are damaged or destroyed due to construction operations, and which were designated to remain.

3.3 Environmental Conditions

A. Dust Control

1. Provide proactive positive methods and apply dust control materials to minimize the raising of dust from construction operations; and to prevent airborne dust from dispersing into the atmosphere throughout the duration of the project day and night.
2. Clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished.
3. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.

B. Water and Erosion Control

1. Provide methods to control surface water to prevent damage to the Project, the Site, or adjoining properties.
2. Plan and execute construction and earthwork by methods to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.
 - a. Hold the areas of bare soil exposed at one time to a minimum.
 - b. Provide temporary control measures such as berms, dikes, and drains.
3. Control fill, grading, and ditching to direct surface drainage away from excavations, pits, tunnels, and other construction areas; and to direct drainage to proper runoff.
4. Provide, operate, and maintain hydraulic equipment of adequate capacity to control surface and groundwater.
5. Dispose of drainage water in a manner to prevent flooding, erosion, or other damage to any portion of the Site or to adjoining areas.
6. Provide temporary drainage where the roofing or similar waterproof deck construction is completed prior to the

connection and operation of the permanent drainage piping system.

C. Debris Control and Clean-Up

1. Keep the premises free at all times from accumulations of debris, waste materials, and rubbish caused by construction operations and employees. Responsibilities shall include:
 - a. Adequate trash receptacles about the Site, emptied promptly when filled.
 - b. Periodic cleanup to avoid hazards or interference with operations at the Site and to maintain the Site in a reasonably neat condition.
 - c. The keeping of construction materials such as forms and scaffolding neatly stacked.
 - d. Immediate cleanup to protect the Work by removing splattered concrete, asphalt, oil, paint, corrosive liquids, and cleaning solutions from walls, floors, and metal surfaces before surfaces are marred.
2. Prohibit overloading of trucks to prevent spillages on access and haul routes. Provide periodic inspection of traffic areas to enforce requirements.
3. Final cleanup is specified in Section 01780 - CONTRACT CLOSEOUT.

D. Pollution Control

1. Provide methods, means, and facilities required to prevent contamination of soil, water, or atmosphere by the discharge of hazardous or toxic substances from construction operations.
2. Provide equipment and personnel, perform emergency measures required to contain any spillages, and remove contaminated soils or liquids. Excavate and dispose of any contaminated earth off-Site in approved locations, and replace with suitable compacted fill and topsoil.

3. Take special measures to prevent harmful substances from entering public waters, sanitary, or storm sewers.

3.4 Traffic Control and Use of Roadways

A. Traffic Control:

1. Provide, operate, and maintain equipment, services, and personnel, with traffic control and protective devices, as required to expedite vehicular traffic flow on haul routes, at Site entrances, on-Site access roads, and parking areas. This includes traffic signals and signs, flagmen, flares, lights, barricades, and other devices or personnel as necessary to adequately protect the public. Any traffic control devices used during nighttime hours shall have functioning flashing lights.
2. Remove temporary equipment and facilities when no longer required. Restore grounds to original, better, or specified condition when no longer required.
3. Provide and maintain suitable detours or other temporary expedients if necessary.
4. Bridge over open trenches where necessary to maintain traffic.
5. Consult with governing authorities to establish public thoroughfares, which will be used as haul routes and Site access. All operations shall meet the approval of owners or agencies having jurisdiction.

B. Maintenance of Roadways

1. Repair roads, walkways, and other traffic areas damaged by operations. **Keep traffic areas as free as possible of excavated materials and maintain in a manner to eliminate dust, mud, and hazardous conditions.**
2. All operations and repairs shall meet the approval of owners or agencies having jurisdiction.
3. The CONTRACTOR will provide dust control, be required to grade, smooth-out, fill holes, and generally maintain the streets where the pavement has been removed. This

maintenance will be done daily, if necessary, to allow local traffic to travel through the area on an acceptable surface.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable.

**** END OF SECTION 01530 ****

SECTION 01560

TEMPORARY UTILITIES AND FACILITIES

PART 1 - GENERAL

1.1 Summary

A. This Section includes requirements of a temporary nature not normally incorporated into final Work. It includes the following:

1. Utility services.
2. Construction and support facilities.
3. Construction aids.
4. Safety and health.
5. Fire protection.

B. Related Work Specified Elsewhere

Temporary Barriers and ControlsSection 01530
Field Offices and Sheds.....Section 01520

1.2 Quality Assurance

A. Reference Standards and Specifications

1. American National Standards Association (ANSI)

A10 Series - Safety Requirements for Construction and Demolition.

2. National Electrical Contractors Association (NECA)

3. Electrical Design Library - Temporary Electrical Facilities.

4. National Fire Protection Association (NFPA)

10 - Portable Fire Extinguishers.

70 - National Electrical Code.

241 - Safeguarding Construction, Alterations, and Demolition Operations.

B. National Electrical Manufacturers Association (NEMA).

C. Underwriters Laboratories (UL).

D. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction, including but not limited to:

1. Building Code requirements.
2. Health and safety regulations.
3. Utility company regulations.
4. Police, Fire Department, and rescue squad rules.
5. Environmental Protection Regulations.

E. Standards

1. Comply with NFPA 10 and 241, and ANSI A10 Series standards "Temporary Electrical Facilities."
2. Comply with NEMA, NECA, and UL standards and regulations for temporary electric service. Install service in compliance with NFPA 70.

F. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.

1.3 Submittals

A. Temporary Utilities

Submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.

1.4 Project Conditions

- A. Conditions of Use:** Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not allow hazardous, dangerous, unsanitary conditions, or public nuisances to develop or persist on the Site.

PART 2 - PRODUCTS

2.1 Materials and Equipment

- A.** Provide new materials and equipment. If acceptable to Engineer, undamaged previously used materials and equipment in serviceable condition may be used. Provide materials and equipment suitable for the use intended, of capacity for required usage, and meeting applicable codes and standards. Comply with requirements of DIVISIONS 2 through 16.

PART 3 - EXECUTION

3.1 Temporary Utilities

A. General

- 1.** Furnish, install, and maintain temporary utilities required for adequate construction, safety, and security. Modify, relocate, and extend systems as Work progresses. Repair damage caused by installation or use of temporary facilities. Remove on completion of Work or until service or facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 Temporary Sanitary Facilities

A. Contractor-Furnished Facilities

- 1.** Furnish, install, and maintain temporary sanitary facilities for use through construction period. Remove on completion of Work.
- 2.** Provide for all construction workers under this Contract and representatives at the Site.

3. Toilet facilities shall be of the chemical, aerated recirculation, or combustion type, properly vented, and fully enclosed with a glass- fiber-reinforced polyester shell or similar nonabsorbent material.
4. Drinking Water Fixtures: Provide containerized tap dispenser type drinking water units.
5. Supply and maintain toilet tissue, paper towels, paper cups and similar disposable materials as appropriate for each facility. Provide appropriate covered waste containers for used material.

3.3 Temporary Safety and Health

- A. **General:** Contractor shall be responsible for development of safety and health programs for personnel at Project Site as specified in the GENERAL CONDITIONS.

3.4 Installation and Removal

- A. **Relocation:** Relocate construction aids as required by progress of construction, storage limitations, or Work requirements and to accommodate requirements of Owner and other contractors at the Site.
- B. **Removal:** Remove temporary materials, equipment, and services when construction needs can be met and allowed by use of permanent construction, or at completion of the Project.
- C. **Repair:** Clean and repair damage caused by installation or by use of temporary facilities.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable.

**** END OF SECTION 01560 ****

SECTION 01580

PROJECT IDENTIFICATION AND SIGNS

PART 1 - GENERAL

1.1 Summary

A. This Section includes basic requirements for temporary Project identification and informational signs required during construction.

B. Related Work Specified Elsewhere

SubmittalsSection 01330

1.2 Quality Assurance

A. Design sign and structure to withstand wind and environmental conditions of locality. Provide with finish adequate to withstand weathering, fading, chipping, and peeling for duration of construction.

1.3 Submittals

A. Submit as specified in Section 01330.

B. Includes, but not limited to, the following

1. Shop Drawings and product data as applicable.
2. Show content, layout, lettering, colors, structure, and foundation.

PART 2 - PRODUCTS

2.1 Identification Signs

A. Project Identification

1. Construct to design, size, and material indicated.
2. Construct structure and framing of wood, structurally adequate to resist design requirements of locality.

3. Construct sign surface of minimum 3/4-inch thickness exterior grade plywood with medium density overlay. Panels shall be of size to minimize joints. Overall size shall be 4' x 8'.
 4. Rough hardware shall be galvanized or aluminum.
 5. Coating: Paint as specified of colors selected by Engineer.
 6. Information Content:
 - a. Project title, logo, and name of Owner as shown on Contract Documents.
 - b. Names and titles of authorities.
 - c. Name and title of Engineer.
 - d. Name of prime Contractor and major Subcontractors.
- B. Contractor Identification:** If not part of Project identification sign, provide and install Contractor's standard sign.

2.2 INFORMATIONAL SIGNS

A. Construction

1. This includes signs for traffic, construction workers, and general public in regards to directions, warnings, hazards, locations of areas, facilities, equipment, and others of a similar nature.
2. Provide signs of design, size, color, and lettering as required by regulatory agencies. Signs shall be painted metal, wood, plastic, or fiberglass and of materials suitable for the conditions in which they are placed, such as weathering and fading.
3. Construct structure and framing of wood or metal, structurally adequate to resist design requirements of area of Project.

PART 3 - EXECUTION

3.1 Installation

A. Project and Contractor Identification Sign

1. Install in appropriate location so as not to obstruct traffic, pedestrians, or construction operations.
2. Erect on framing or foundation, and rigidly brace.
3. Maintain sign in good repair, in a clean and neat condition.
4. Remove upon completion of Project.

B. Informational Signs

1. Install at appropriate locations and in sufficient quantities to assure visibility. Relocate as required by progress of Work.
2. Maintain signs in good repair, in a neat, clean, readable condition.
3. Remove all signs, framing, supports, and foundations upon completion of Project.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable.

**** END OF SECTION 01580 ****

SECTION 01600

EQUIPMENT AND MATERIALS

PART 1 - GENERAL

1.1 Summary

- A. This Section includes administrative and procedural requirements governing Contractor's selection of products for use in the Project.
- B. **Related Work Specified Elsewhere**
 - 1. For the applicability of industry standards to products specified: DIVISIONS 2 through 16.
 - 2. For submittal of Contractor's construction progress schedule and the Submittal schedule: Section 01320 and Section 01330.
 - 3. For handling requests for substitutions made after award of the Contract: Section 01631.

1.2 Definitions

- A. Definitions used in this Article are not intended to change the meaning of other terms used in these Contract Documents, such as "specialties," "systems," "structures," "finishes," "accessories," and similar terms. Such terms are self-explanatory and have well-recognized meanings in the construction industry.
 - 1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "Material," "Equipment," "system," and terms of similar intent.
 - a. "Named Products" are items identified by the manufacturer's product name, including make or model number or other designation, shown or listed in the manufacturer's published product literature, that is current as of the date of the Contract Documents.
 - b. "Foreign Products," as distinguished from "domestic products," are items substantially manufactured (50% or more of value) outside the United States and its

possessions. Products produced or supplied by entities substantially owned (more than 50%) by persons who are not citizens of, nor living within, the United States and its possessions are also considered to be foreign products.

2. "Materials" are products substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.
3. "Equipment" is a product with operational or non-operational parts, whether motorized, or manually operated, that may require service connections, such as wiring or piping.

1.3 Submittals

- A. Submittal of preliminary procurement schedule is specified in Section 01320 - PROJECT MEETINGS, SCHEDULES, AND REPORTS.
- B. Submittals for products are specified in Section 01330 and in applicable Sections of DIVISIONS 2 through 16.

1.4 Quality Assurance

- A. **Source Limitations:** To the fullest extent possible, provide products of the same kind from a single source.
- B. **Nameplates:** Along with required labels and operating data, manufacturer or producer's nameplates, imprints, or trademarks may be placed on surfaces exposed to view.
 1. **Labels:** Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on accessible surfaces that are not conspicuous.
 2. **Equipment Nameplates:** Provide a permanent nameplate on each item of service-connected or power-operated Equipment. Locate on an easily accessible surface that is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:
 - a. Name of product and manufacturer including address (and telephone number).

- b. Model and serial number.
- c. Capacity.
- d. Speed.
- e. Ratings.

C. Electronic Equipment Compliance:

- 1. Contractor warrants that all equipment, devices, items, systems, software, hardware, or firmware provided shall properly, appropriately, and consistently function and accurately process date and time data (including without limitation: calculating, comparing, and sequencing). This warranty supercedes anything in the Specifications or other Contract Documents, which might be construed inconsistently. This warranty is applicable whether the equipment, device, item, system, software, hardware, or firmware is specified with or without reference to a manufacturer's name, make, or model number.

1.5 Transportation and Shipment

A. Shipment Preparation

- 1. Contractor shall require manufacturers and Suppliers to prepare products for shipment in a manner to facilitate unloading and handling, and to protect against damage, deterioration, or unnecessary exposure to the elements in transit and storage. Provisions for protection shall include the following:
 - a. Crates or other suitable packaging materials.
 - b. Covers and other means to prevent corrosion, moisture damage, mechanical injury, and accumulation of dirt in motors, electrical equipment, and machinery.
 - c. Suitable rust-preventive compound on exposed machined surfaces and unpainted iron and steel.
 - d. Grease packing or oil lubrication in all bearings and similar items.

- B. Marking:** Each product item shall be tagged or marked as identified in the delivery schedule or on Submittals. Complete packing lists and bills of material shall be included with each shipment. Each piece of every item need not be marked separately, provided that all pieces of each item are packed or bundled together and the packages or bundles are properly tagged or marked.

1.6 Product Delivery, Storage and Handling

- A.** Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.
 - 1.** Schedule delivery to minimize long-term storage at the Site and to prevent overcrowding of construction spaces. Allow ample time to avoid delay of the Work.
 - 2.** Coordinate delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3.** Deliver products to the Site in an undamaged condition in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4.** Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected. Inspect shipment to assure:
 - a.** Product complies with requirements of Contract Documents and reviewed Submittals.
 - b.** Quantities are correct.
 - c.** Containers and packages are intact and labels are legible.
 - d.** Products are properly protected and undamaged.

5. Store products at the Site in a manner that will facilitate inspection and measurement of quantity or counting of units. Mark deliveries of component parts of Equipment to identify the Equipment, to permit easy accumulation of parts, and to facilitate inspection and measurement of quantity or counting of units.
6. Store heavy Materials away from the Project structure in a manner that will not endanger the supporting construction.
7. Store products subject to damage by the elements above ground, under cover in a weather tight enclosure, and with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.
8. Protect motors, electrical Equipment, plumbing fixtures, and machinery of all kinds against corrosion, moisture deteriorations, mechanical injury, and accumulation of dirt or other foreign matter.
9. Protect exposed machined surfaces and unpainted iron and steel as necessary with suitable rust-preventive compounds.
10. Protect bearings and similar items with grease packing or oil lubrication.
11. Handle and store steel plate, sheet metal, and similar items in a manner to prevent deformation.
12. For storage of pipe and other products on easements and rights-of-way in residential and commercial areas, do not exceed the minimum required by scheduled laying operations, and conform to all requirements of public authorities. Store or place pipe along roads, set back from shoulder or curb, and at an angle tending to deflect vehicles if struck. Place or block pipe to preclude its accidental movement.

B. Handling

1. Provide equipment and personnel necessary to unload and handle products, by methods to prevent damage or soiling to products, or packaging.

2. Handle by methods to prevent bending or overstressing. Where lifting points are designated, lift components only at those points.
3. Provide additional protection to surrounding surfaces as necessary to prevent damage.

C. Maintenance of Storage

1. Inspect stored products on a scheduled basis.
2. Verify that storage facilities comply with manufacturer's product storage requirements, including environmental conditions continually maintained.
3. Verify that surfaces of products exposed to elements are not adversely affected; that any weathering of finishes is acceptable under requirements of Contract Documents.
4. For mechanical and electrical Equipment in long-term storage, provide manufacturer's service instructions to accompany each item, with notice of enclosed instructions on exterior of package. Service Equipment on a regularly scheduled basis.

D. Protection After Installation: Provide substantial coverings as necessary to protect installed products from damage from subsequent construction operations. Remove coverings when no longer needed or as specified.

PART 2 - PRODUCTS

2.1 Product Selection

- A. General Product Requirements:** Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise specified or indicated, new at the time of installation.
1. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and the intended use and effect.
 2. Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

3. Continued Availability: Where, because of the nature of its application, Owner is likely to need replacement parts or additional amounts of a product at a later date, either for maintenance and repair or replacement, provide standard products for which the manufacturer has published assurances that the products and its parts are likely to be available to Owner at a later date.
4. Conform to applicable Specifications, codes, standards, and regulatory agencies.
5. Comply with size, make, type, and quality specified, or as specifically approved in writing by Engineer.
6. Manufactured and Fabricated Products:
 - a. Design, fabricate, and assemble in accordance with the best engineering and shop practices.
 - b. Manufacture like parts of duplicate units to standard sizes and gages, to be interchangeable.
 - c. Equipment and Materials shall be suitable for service conditions intended.
 - d. Equipment capacities, sizes, and dimensions indicated or specified shall be adhered to unless variations are specifically approved in writing by Engineer.
 - e. Provide labels and nameplates where required by regulatory agencies or to state identification and essential operating data.
7. Do not use products for any purpose other than that for which designed.
8. To the fullest extent possible, provide products of the same kind from a single source.

PART 3 - EXECUTION

3.1 Installation of Products

- A.** Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place except as required for proper movement and performance, and accurately located and aligned with other Work.
- 1.** Obtain and distribute copies of manufacturer's printed instructions and recommendations if not a part of Submittals, containers, or packaging to parties involved in the installation, including a copy to Engineer (and Resident Project Representative).
 - 2.** Maintain one complete set of instructions at the Site during installation and until completion.
 - 3.** Handle, install, connect, clean, condition, and adjust products in accordance with such instructions and in conformance with specified requirements. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with Engineer for further instructions.
- B.** Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Completion.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable

**** END OF SECTION 01600 ****

SECTION 01631

SUBSTITUTIONS

PART 1 - GENERAL

1.1 Summary

- A. This Section includes administrative and procedural requirements for handling requests for substitutions made after award of the Contract.
- B. Related Work Specified Elsewhere:
 - 1. Requirements for submitting Contractor's Construction Schedule and the Submittal Schedule: SECTIONS 01320 and 01330.
 - 2. Requirements governing Contractor's selection of products: SECTION 01600.

1.2 Definitions

- A. Definitions in this Article do not change or modify the meaning of other terms used in the Contract Documents.
- B. **Substitutions:** Changes in products, Materials, Equipment, and methods of construction required by the Contract Documents proposed by the Contractor after award of the Contract are considered to be requests for substitutions. The following are not considered to be requests for substitutions:
 - 1. Revisions to the Contract Documents requested by Owner or Engineer.
 - 2. Specified options of products and construction methods included in the Contract Documents.

1.3 Submittals

- A. **Substitution Request Submittal:** Engineer will consider written requests for substitution if received within 14 calendar days of Notice to Proceed. Requests received more than 14 calendar days after Notice to Proceed may be considered or rejected solely at the discretion of the Owner.

- 1.** Submit 3 copies of each request for substitution for consideration. Submit requests in the form and according to procedures required for Change Order proposals. Requests for substitution shall not be submitted in the form of a Request for Information (RFI).
- 2.** Identify the Equipment or Material, the fabrication, or installation method to be replaced in each request. Include related Specification Section/Article and Drawing numbers.
- 3.** Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:
 - a.** Statement indicating why specified product or method of construction cannot be provided.
 - b.** Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate the proposed substitution.
 - c.** A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - d.** Product data, including drawings and descriptions of products and fabrication and installation procedures.
 - e.** Samples, where applicable or requested.
 - f.** Identification of available sales, maintenance, repair, and replacement services.
 - g.** A statement indicating the effect of the substitution on Contractor's construction progress schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on the overall Contract Times. If specified product cannot be provided within the Contract Times, provide letter from

manufacturer, on manufacturer's letterhead, stating lack of availability or delay in delivery.

- h.** An itemized estimate of costs that will result directly or indirectly from approval of the substitution, including:

 - (1)** A proposal of the net change, if any, in the Contract Price.
 - (2)** Costs of redesign required by the proposed change.
 - (3)** Costs of resulting claims as determined in coordination with other contractors having work on the Project affected by the substitution.
 - i.** Statement indicating whether or not incorporation or use of the substitute is subject to payment of any license fee or royalty.
 - j.** Contractor's certification that the proposed substitution conforms to requirements in the Contract Documents, will perform adequately the functions and achieve the results called for by the general design, is similar in substance to that specified, and is suitable for same use as that indicated and specified.
 - k.** Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
- 4. Engineer's Action:** If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a request for substitution. Engineer will notify Contractor of acceptance or rejection of the substitution within 14 calendar days of receipt of the request, or one week of receipt of additional information or documentation, whichever is later. Acceptance, if granted, will be in the form of a Change Order.

PART 2 - PRODUCTS

2.1 Substitutions

- A. Conditions:** Engineer will receive and consider Contractor's request for substitution when one or more of the following conditions are satisfied, as determined by Engineer. If the following conditions are not satisfied, Engineer will return the requests without action except to record noncompliance with these requirements.
1. Extensive revisions to the Contract Documents are not required.
 2. Proposed substitution is in keeping with the general intent of the Contract Documents and will produce indicated results.
 3. Substitution request is timely, fully documented, and properly submitted.
 4. The specified product or method of construction cannot be provided within the Contract Times. Engineer will not consider the request if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.
 5. The requested substitution offers Owner a substantial advantage, in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Engineer for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 6. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
 7. The specified product or method of construction cannot be provided in a manner that is compatible with other materials and where Contractor certifies that the substitution will overcome the incompatibility.
 8. The specified product or method of construction cannot be coordinated with other materials and where Contractor certifies that the proposed substitution can be coordinated.

9. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where Contractor certifies that the proposed substitution provides the required warranty.

B. Engineer's review and acceptance of Submittals shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents. Engineer's acceptance of Submittals not complying with the Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval of a substitution. Acceptance by Engineer shall not relieve Contractor from responsibility for errors or omissions in the Submittals.

PART 3 - EXECUTION - Not Applicable.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable.

**** END OF SECTION 01631 ****

SECTION 01780

CONTRACT CLOSEOUT

PART 1 - GENERAL

1.1 Summary

- A. This Section includes administrative and procedural requirements for Contract closeout including, but not limited to, the following:
 - 1. Inspection procedures.
 - 2. Project record document submittal.
 - 3. Instruction book and operating manual submittal.
 - 4. Submittal of warranties.
 - 5. Final cleaning.
- B. Closeout requirements for specific construction activities are included in the appropriate Sections of the Specifications.
- C. **Related Work Specified Elsewhere**
 - 1. Prerequisites to Contract Completion and Final Acceptance: GENERAL CONDITIONS.
 - 2. Submittals: SECTION 01330.

1.2 Contract Completion

- A. **Preliminary Procedures:** Before requesting inspection for Notice of Completion, complete the following. List exceptions in the request.
 - 1. In the Application for Payment that coincides with, or first follows, the date Final Acceptance is claimed, show 100% completion for the portion of the Work.
 - a. Include supporting documentation for completion as indicated in these Contract Documents and a

2. Results of the completed inspection will form the basis of requirements for Final Acceptance.

1.3 Final Acceptance

A. Preliminary Procedures: Before requesting final inspection for Notice of Completion of Final Acceptance and final payment, complete the following. List exceptions in the request.

1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include insurance certificates for products and completed operations where required.
2. Submit an updated final statement, accounting for final additional changes to the Contract Price.
3. Submit a certified copy of Engineer's final inspection list of items to be completed or corrected, endorsed and dated by Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance and shall be endorsed and dated by Engineer.
4. Submit final meter readings for utilities, a measured record of stored fuel, and similar data as of the Date of Contract Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
5. Submit consent of surety to final payment.
6. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
7. Submit a final liquidated damages settlement statement.

B. Reinspection Procedure: Engineer will re-inspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except for items whose completion is delayed under circumstances acceptable to Engineer.

1. Upon completion of re-inspection, Owner will prepare a Notice of Completion of Final Acceptance. If the Work is incomplete,

Engineer will advise Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for Final Acceptance.

2. If necessary, re-inspection will be repeated.

1.4 Record Document Submittals

- A. **General:** Do not use record documents for construction purposes. Protect record documents from deterioration and loss in a secure, fire-resistant location. Provide access to record documents for Engineer's reference during normal working hours.
- B. **Record Drawings:** Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation. This will require an "as constructed" elevation of the manhole top and invert elevations of all pipes entering and leaving the manhole.
 1. Record information concurrently with construction progress.
 2. Mark record sets with red erasable pencil. Use other colors to distinguish between variations in separate categories of the Work. Mark each document "PROJECT RECORD" in neat, large, printed letters.
 3. Mark new information that is important to Owner but was not shown on Contract Drawings or Shop Drawings.
 4. Note related Change Order numbers where applicable.
 5. Organize record drawing sheets into manageable sets. Bind sets with durable-paper cover sheets; print suitable titles, dates, and other identification on the cover of each set.
 6. Upon completion of the Work, submit record drawings to Engineer for Owner's records.
 7. Include the following:
 - a. Depths of various elements of foundation in relation to finish first floor datum.

- b. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - c. Location of internal utilities and appurtenances concealed in the construction, referenced to visible and accessible features of construction.
 - d. Where Submittals are used for mark-up, record a cross-reference at corresponding location on Drawings.
 - e. Field changes of dimension and detail.
 - f. Changes made by Change Order or other Modifications.
 - g. Details not on original Contract Drawings.
 - h. As constructed information shall include a GPS coordinate of the sanitary manhole including the invert elevation of the pipes entering and leaving the manhole. The GPS level of accuracy shall be to centimeters. A registered land surveyor of the state of Arizona shall conduct the survey. This information shall be recorded on the record information set submitted to the Engineer. The information shall also be provided in an electronic format compatible with AUTOCAD latest release.
 - i. Provide a record location of all service laterals where they connect to the main sewer. The separation distance between the service lateral at the crossing of a water line shall be recorded by the Contractor on his record documents.
- C. **Record Specifications:** Maintain one complete copy of the Project Manual including Addenda. Include with the Project Manual one copy of other written construction documents, such as Change Orders and Modifications issued in printed form during construction.

1. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications.
 2. Give particular attention to substitutions and selection of options and information on concealed construction that cannot otherwise be readily discerned later by direct observation.
 3. Note related record drawing information and product data.
 4. Upon completion of the Work, submit record Specifications to Engineer for Owner's records.
 5. Include the following:
 - a. Manufacturer, trade name, catalog number, and Supplier of each product and item of Equipment actually installed, particularly optional and substitute items.
 - b. Changes made by Addendum, Change Order, or other Modifications.
 - c. Related Submittals.
- D. Record Product Data:** Maintain one copy of each product data Submittal. Note related Change Orders and markup of record drawings and specifications.
1. Mark these documents to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to the Site and from the manufacturer's installation instructions and recommendations.
 2. Give particular attention to concealed products and portions of the Work that cannot otherwise be readily discerned later by direct observation.
 3. Upon completion of markup, submit complete set of record product data to Engineer for Owner's records.

- E. **Miscellaneous Record Submittals:** Refer to other Specification Sections for requirements of miscellaneous record keeping and Submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records and place in good order. Identify miscellaneous records properly and bind or file, ready for continued use and reference. Submit to Engineer for Owner's records.

- F. **Warranties and Bonds:** Specified in GENERAL CONDITIONS, Section 01330.

PART 2 - PRODUCTS - Not Applicable.

PART 3 - EXECUTION

3.1 Closeout Procedures

- A. **Operation and Maintenance Instructions:** Arrange for each installer of Equipment that requires regular maintenance to meet with Owner's personnel at Project Site to provide instruction in proper operation and maintenance. Provide instruction by manufacturer's representatives if installers are not experienced in operation and maintenance procedures. Include a detailed review of the following items:
 - 1. Instruction books and operating manuals.
 - 2. Record documents.
 - 3. Tools.
 - 4. Lubricants.
 - 5. Fuels.
 - 6. Identification systems.
 - 7. Control sequences.
 - 8. Hazards, hazardous chemicals data sheets.
 - 9. Cleaning.

10. Warranties and bonds.
 11. Maintenance agreements and similar continuing commitments.
- B. As part of instruction for operating Equipment, demonstrate the following procedures:**
1. Start-up.
 2. Shutdown.
 3. Emergency operations.
 4. Noise and vibration adjustments.
 5. Safety procedures.
 6. Economy and efficiency adjustments.
 7. Effective energy utilization.

3.2 Final Restoration

- A. General:** The GENERAL CONDITIONS requires general cleaning during construction.
1. Remove temporary structures, tools, equipment, supplies, and surplus materials.
 2. Remove temporary protection devices and facilities, which were installed, to protect previously completed Work.
 3. Restore the entire construction area to pre-construction condition.
- B. Removal of Protection:** Remove temporary protection and facilities installed for protection of the Work during construction.
- C. Compliance:** Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from the Site and dispose of lawfully.

PART 4 - MEASUREMENT AND PAYMENT - Not Applicable.

**** END OF SECTION 01780 ****

DIVISION III
TECHNICAL SPECIFICATIONS

SECTION 33 21 13.03
VADOSE WELL CONSTRUCTION

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. ASTM International (ASTM): D422, Standard Test Method for Particle-Size Analysis of Soils.
 2. International Association of Drilling Contractors (IADC): API-Approved Official Daily Drilling Report Form.
 3. National Pollutant Discharge Elimination System (NPDES).
 4. NSF International (NSF): 61, Drinking Water System Components—Health Effects.

1.02 SUBMITTALS

- A. Action Submittals:
1. Drill cutting samples.
 2. Description of drilling equipment and proposed methods.
 3. Well Casing and all downhole pipe and fittings.
 4. Diagram of all equipment positioned within the Construction area that will be used onsite.
 5. Proposed Gravel
 6. Daily Drilling Log.
 7. Diagram of development equipment and test equipment proposed installation.
- B. Submittals shall be made in accordance with Section 01330, Submittal Procedures.

1.03 QUALITY ASSURANCE

- A. Regulatory Requirements:
1. Comply with applicable permits, laws, and regulations in disposing of drilling fluids, drill cuttings, and water generated during drilling and well construction. Permits, laws and regulations shall include, but not be limited to, the following:
 2. The requirements specified in NPDES Permit. The requirements of the current NPDES (De Minimis) permit are as follows.

3. Ensure all discharges meet all applicable Surface Water Quality Standards (SWQS). ADEQ can request to see any and all data to verify that the discharge meets SWQS.
4. Daily sampling, monitoring, and recording of E. Coli, Flow Rate, Oil and Grease, pH, Total Residual Chlorine (Max), Turbidity, and Duration of Discharge.
5. Coordinate and assist the Engineer with the required water sampling. The Owner will analyze the water samples for the above parameters and will do the required reporting to ADEQ.
6. Other Federal, state, and local laws, regulations, and ordinances related to disposing of materials generated in constructing wells.

PART 2 PRODUCTS

2.01 CLEAN GRAVEL

1. ¾-inch Clean Gravel
2. Crushed granite or similar
3. Free of fines

2.02 STEEL AND STAINLESS STEEL BLANK CASING AND PIPE

1. Carbon Steel Conductor Casing
 1. ASTM A139/A139M, Grade B as manufactured by Roscoe Moss Company and approved by the Engineer.
 2. 0.500-inch wall, 54-inch
 3. Material shall be new and unused.
 4. Plain ends fitted for welding collars.
 5. 20 foot length or as recommended by the CONTRACTOR and approved by the ENGINEER.
- B. 12-inch Stainless Steel Blank Casing
 1. Type 304L stainless steel, ASTM A312/A312M, 12-inch, 0.375-inch wall, 16-foot length, as approved by the ENGINEER.
 2. Material shall be new and unused.
 3. Ends shall be flush threaded, ASTM F480 threads to match Johnson Shur-Grip PVC blank casing.
- C. 3-Inch Stainless Steel Injection and Vent Pipes
 1. 3-inch diameter, Schedule 40 stainless steel, Type 304L, ASTM A312 pipe. Provide with flush thread ends, ASTM F480.
 2. 16-foot length, as approved by the ENGINEER.
- D. 4-Inch Stainless Steel Injection Pipe

1. 4-inch diameter, Schedule 40 stainless steel, Type 304L, ASTM A312 pipe. Provide with flush thread ASTM F480 to fit Shur-Grip PVC flush threads.
2. 16-foot length, as approved by the ENGINEER.

2.03 PVC BLANK CASING AND PIPE

A. 12-inch PVC Well Casing

2. Johnson 12-inch Shur-Grip® or equal, conforming to ASTM F 480, D1785, or D2241 as applicable, and shall be specifically designed for use as well casing. The casing shall be new and unused. 0.750-inch wall, SDR 17. Ends shall be flush threaded, ASTM F480 threads to match the 12-inch blank stainless steel casing.
2. Material shall be new and unused.
3. Ends shall be flush threaded, ASTM F480 threads.
4. Section Ends: Machined flat perpendicular to axis of casing, with a maximum variance of 0.010 inch at any point from a true plane at right angles to axis of casing.
5. Connect to 12-inch stainless casing using flush threaded Shur-Grip Hybrid Well Connection, or equal.

B 3-Inch PVC Blank Injection and Vent Pipes

1. Johnson Shur-Grip® 3-inch PVC or equal, conforming to ASTM F 480, D1785, or D2241 as applicable, and shall be specifically designed for use as well screen.
2. Material shall be new and unused.
3. Ends shall be flush threaded, ASTM F480 threads.
4. Section Ends: Machined flat perpendicular to axis of casing, with a maximum variance of 0.010 inch at any point from a true plane at right angles to axis of casing.
5. Connect to 3-inch stainless casing using flush threaded Shur-Grip Hybrid Well Connection, or equal.

C. 4-Inch PVC Blank Injection Pipe

1. Johnson Shur-Grip® 4-inch PVC or equal, conforming to ASTM F 480, D1785, or D2241 as applicable. SCH 80.
2. Material shall be new and unused.

3. Ends shall be flush threaded, ASTM F480 threads.
4. Section Ends: Machined flat perpendicular to axis of casing, with a maximum variance of 0.010 inch at any point from a true plane at right angles to axis of casing.
5. Connect to 4-inch stainless casing using flush threaded Shur-Grip Hybrid Well Connection, or equal.

2.04 WELL SCREENS

A. 12-Inch PVC Well Screen

1. Johnson Shur-Grip® 12-inch slotted PVC screen or equal, conforming to ASTM F 480, D1785, or D2241 as applicable, and shall be specifically designed for use as well screen. The casing shall be new and unused. 100-slot. SDR 17.
2. Material shall be new and unused.
3. Ends shall be flush threaded, ASTM F480 threads.
4. Section Ends: Machined flat perpendicular to axis of casing, with a maximum variance of 0.010 inch at any point from a true plane at right angles to axis of casing.

B. 3-Inch PVC Injection and Vent Screens

1. Johnson Shur-Grip® 3-inch slotted PVC screen or equal, conforming to ASTM F 480, D1785, or D2241 as applicable, and shall be specifically designed for use as well screen. The casing shall be new and unused. Injection screen 0.100 slot. and vent screen 0.050 slot. SCH 80.
2. Material shall be new and unused.
3. Ends shall be flush threaded, ASTM F480 threads.
4. Section Ends: Machined flat perpendicular to axis of casing, with a maximum variance of 0.010 inch at any point from a true plane at right angles to axis of casing.

C. 4-Inch PVC Injection Screen

1. Johnson Shur-Grip® 4-inch slotted PVC screen or equal, conforming to ASTM F 480, D1785, or D2241 as applicable, and shall be specifically designed for use as well screen. The casing shall be new and unused. 100-slot. SCH 80.
2. Material shall be new and unused.
3. Ends shall be flush threaded, ASTM F480 threads.
4. Section Ends: Machined flat perpendicular to axis of casing, with a maximum variance of 0.010 inch at any point from a true plane at right angles to axis of casing.

PART 3 EXECUTION

3.01 GENERAL

- A. Notify Engineer at least 5 working days before drilling begins.
- B. Notify Engineer of anticipated delays whenever they become apparent.
- C. Excavation of fluid pits will not be allowed unless approved by Engineer.

3.02 DRILLING EQUIPMENT

- A. Provide auger rotary drilling equipment, or equal and accessories required to complete well as specified.

3.03 DRILLING FLUIDS

- A. Use potable water for any fluid required at each well site. Muds, clays, will not be allowed.
- B. Water:
 - 3. Use potable water, with a minimum chlorine residual of 0.5 mg/L, for any drilling fluids required.

3.04 BOREHOLE DRILLING

- A. Before drilling, install permanent conductor casing needed to stabilize surface material. Conductor casing must be fully cemented in place with a minimum cement thickness of 3-inches.
- B. Drill wells by bucket auger rotary, air-rotary with casing advance, or method proposed by Contractor and approved by Engineer. Drill inside of a 48-inch blank steel casing, advance the 48-inch blank steel casing to 180-feet and construct the vadose zone well inside the 48-inch blank casing. Remove the blank 48-inch casing after construction of the well.
- C. Drill boreholes to dimensions and depth as shown and as determined by Engineer.
- 4. Drill boreholes sufficiently straight and plumb to permit installation of casing and screen.
- D. Use of bentonite, clay, mud, or other foreign matter that has a tendency to build a mud cake on the walls of the hole and clog or seal up water-bearing stratum will not be permitted without prior approval of Engineer.

3.05 DAILY LOG

A. General:

1. Keep driller's log of borehole which carefully and accurately describes the materials penetrated.
2. Drilling log shall be available for inspection at Site at all times.

B. Utilize the IADC, API-approved official Daily Drilling Report Form, or equivalent, as approved by Engineer.

1. Submit legible forms covering the previous day suitable for photocopying to the Engineer on a daily basis.
2. Daily log shall be signed daily by Contractor and Engineer to represent their agreement of the included data.

C. Data:

1. Formations encountered from surface to total depth, indicating the depth of each change in formation and including difficulties and unusual conditions met during drilling.
2. Drilling rate.
3. Depth at which water is first encountered.
4. Other pertinent phenomena observed.
5. Record of variations in the addition and amount of approved clays or chemical products or water required.
6. Properties of drilling fluids as described in Article Drilling Fluids and depth at which changes were required.

3.06 SAMPLE COLLECTION

A. Every 5 feet and at each change in the strata, collect a large, representative sample of the interval or new strata in accordance with procedures approved by Engineer.

B. Storage:

1. Store each sample in a suitable gallon-sized, waterproof container and label each sample.
2. Label shall include well number, date, time, and depth interval.
3. Sample containers shall be stored in a manner to prevent breakage or loss.
4. Furnish containers approved by Engineer.

3.07 SIEVE ANALYSIS

- A. The grain size distribution of at least 10 cutting samples shall be determined by sieve analysis. Samples selected shall be approved by Engineer.
- B. Perform sieve analysis in accordance with ASTM D422 and include a table and plot of the cumulative percent of particles retained by each sieve versus particle size.
- C. Obtain Engineer's approval prior to ordering screen materials.
- D. Provide sieve analysis results within 48 hours of completion of borehole.

3.08 DRILL CUTTINGS AND DRILL FLUIDS DISPOSAL

- A. Separate drill cuttings and drill fluids generated during borehole drilling using appropriate equipment.
- B. Contain drill cuttings while onsite in roll-off bins, and ultimately disposed of by the Contractor.
- C. Upon completion of drilling, remove and dispose of drilling fluids and cuttings from well from Site in accordance with State and Local regulations.
- D. Restore ground surface to its original condition.

3.09 WELL DEVELOPMENT AND TESTING

- A. Set up equipment to allow:
 - 1. Blowing out the dry well with compressed air.
 - 2. Conducting a short injection test for 3 hours. Injection test piping must include a source of potable water and appropriate tankage. 6-inch temporary piping, a properly installed flowmeter, an air release valve, and a throttling valve.
- B. Develop well by first blowing out well thoroughly with compressed air.
- C. Add potable water to well rapidly using a tremie pipe to create a column of water that can be rapidly air lifted or pumped out.
- D. Repeat Step B up to 3 times to flush out the well screen.
- E. Inject potable water into the well at a rate of 200 gpm through the 4-inch injection tube. Measure and record water levels in the 3-inch transducer/vent tube. Obtain water level measurements before the start of the test and every 10 minutes for 3 hours. Simultaneously measure and record pressure upstream and downstream of the throttling valve on the injection piping. Stop the injection testing after 3 hours.

END OF SECTION

SECTION 02100

CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 Description

A. Description of Work

The work to be performed in accordance with this section includes clearing, grubbing, and disposal of materials, for all ground surfaces within the limits designated on the plans. The work shall include the furnishing of all labor, tools, equipment, materials and the performing of all operations required to provide a complete item in accordance with the project plans and these specifications.

Clearing and grubbing includes the removal of all brush, undergrowth, heavy growth of grass or weeds, debris, rubbish of any nature, obstructions or material which is unsuitable for the foundation of fills, pavements, or other required structures and the disposal of all spoil materials resulting from clearing and grubbing in an approved landfill.

B. Related Work Specified Elsewhere

Removal of Existing Improvements.....Section 02110
Earthwork.....Section 02200

1.2 Protection of Property

Protect existing improvements, adjacent property, utilities, trees, plants, or any other existing items which are not specifically intended to be removed.

1.3 Submittals

A. Disposal Area

Describe the location of the disposal area and provide written approval for the use of the area for disposing of waste from the operation. Work performed at the disposal area shall meet all local codes and ordinances.

PART 2 - MATERIALS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 Limits of Work

Clearing and grubbing operations are to remain within the limits of construction and/or the right-of-way as shown on the plans. Clear and grub only in areas that are affected by excavation or other earthwork operations.

3.2 Construction Methods

Remove all stumps, roots, buried logs, brush, grass, and other unsuitable materials. Grub roots and other projections over 1-1/2 inches in diameter to a depth of at least 18 inches below the finished subgrade or slope elevation.

Backfill all holes remaining after the grubbing operation in accordance with Section 2200, Earthwork.

3.3 Disposal

Dispose of all debris at an approved landfill.

3.4 Burning

No burning shall be permitted.

3.5 Existing Vegetation to Remain

Save all trees and shrubs which will not interfere with excavation or embankment or cause disintegration of the improvements. Coordinate removal of vegetation with the **OWNER**. Protect trees, shrubbery, vines, plants, grasses and other vegetation growing outside of the limits of construction.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

No measurement will be made for this item.

4.2 Payment

No payment will be made for **Clearing and Grubbing**. Clearing and grubbing shall be considered incidental to other items.

****END OF SECTION****

SECTION 2200

EARTHWORK

PART 1 - GENERAL

1.1 Description

A. Description of Work

The work to be performed in accordance with this section includes excavation, fill, borrow, spoil and compaction for roadways, structures, channels and embankments. The work shall include the furnishing of all labor, tools, equipment, materials and the performing of all operations required to provide a complete item in accordance with the project plans and these specifications.

B. Related Work Specified Elsewhere

Clearing and Grubbing.....	Section 2100
Removal of Existing Improvements	Section 2110
Trench Excavation and Backfill.....	Section 2300
Subgrade Preparation.....	Section 2600

1.2 Quality Assurance

A. Reference Test Standards and Specifications

ASTM D698, Test Methods for Moisture Density of Soils and Soil-Aggregate Mixtures Using 5.5 lb. Rammer and 12-inch Drop.

ASTM D1556, Density of Soil in Place by the Sand-Cone Method.

ASTM D6938-08a, Density of Soil and Soil-Aggregate in Place by Nuclear Methods.

ASTM D6938-08a, Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods.

Rock Correction Procedure for Maximum Density Determination, ARIZ 227.

B. Frequency of Testing

- 1.** Maximum Dry Density and Optimum Moisture Content, ASTM D698.
 - a.** One test for each different class or type of material shall be provided by the **CONTRACTOR** prior to any earthwork operations.
 - b.** **CONTRACTOR** shall provide additional test when previous test is suspect, due to subtle changes in the material, as determined by the **OWNER**.
- 2.** Density of Soil In-Place by the Sand Cone or by Nuclear Methods, ASTM D1556 or D6938-08a.
 - a.** **OWNER** will perform a minimum of one test per lift per 5,000 square yards per each type of material.
 - b.** **OWNER** will perform additional tests as required to ensure proper compaction.

C. Testing Tolerances

1. Relative Percent Compaction

Not less than as specified on plans or in these specifications.

2. In-Place Moisture Content

As required to achieve minimum relative compaction.

3. Soft or Yielding Surfaces

Regardless of the percent compaction obtained by test, areas which are soft and yield under the load of construction equipment are to be removed and replaced at no additional cost.

1.3 Submittals

A. Materials Test Reports

Report on maximum dry density and optimum moisture content of soils proposed for use in the work prior to beginning of construction.

B. Disposal Area

Provide the location of the disposal area(s) and provide written approval for the use of the area(s) for disposing of excess soils from the operation. Work performed at the disposal areas shall meet all local codes and ordinances.

PART 2 - MATERIALS

2.1 Soil and Soil Aggregate Materials

A. Unsuitable materials not to be incorporated in the work.

1. Organic matter such as peat, mulch, organic silt or sod.
2. Soils containing expansive clays.
3. Material containing excessive moisture.
4. Poorly graded coarse material.
5. Material with particle sizes in excess of 12 inches.
6. Material which will not achieve density and/or bearing requirements.
7. Asphalt concrete or Portland cement concrete that does not conform to 3.5 Engineered Fill under Section 2200, Earthwork.

2.2 Earthwork Balance

No attempt has been made to estimate cut and fill earthwork quantities. The **CONTRACTOR** is solely responsible for the estimation of the earthwork quantities required to construct the project as indicated on the plans and described herein.

PART 3 - EXECUTION

3.1 Preliminary Investigation of the Work

Verify that all preliminary work including clearing, grubbing and staking has been performed in accordance with these specifications prior to earthwork operations.

3.2 Blasting

No blasting will be permitted unless approved by the **OWNER**. All permits shall be obtained by the **CONTRACTOR** at his own expense.

3.3 Spoil Disposal Area

Disposal of surplus excavated material shall be in an approved spoil area, outside of the project right-of-way. Make all arrangements necessary for disposal of material at an off-site location. The disposal of surplus materials in the designated area shall meet all local codes and ordinances.

3.4 Excavation

A. Unsuitable Material

Overexcavate existing unsuitable material below the lower limit of excavation to a depth that will provide adequate bearing, as determined by the **OWNER**. Remove unsuitable material from the site and dispose of the material at approved spoil area. Replace the overexcavated material with suitable material in accordance with Subsection 3.5 Engineered Fill.

B. Slides and Slipouts

Excavate and grade material outside the finished work which is unstable, or which has slipped out, to the slope and elevation determined by the **OWNER**. Dispose of excess material at approved spoil disposal area.

C. Slopes

Finish excavation slopes to the lines and grades shown on the plans. Remove all debris and loose materials. Round all grade breaks and slope transitions. Finish elevations on slopes shall not deviate from the plan elevation by more than ".25 feet. Variations from the plan grade and cross section shall be compensating so that the average

grade and cross section are obtained.

D. Foundation Excavation

1. Cast in Place Concrete on Rock

Remove sufficient depth of rock surface to expose sound rock. Cut rock to approximate horizontal and vertical steps to provide minimum dimensions. Grout seams and faults in rock surfaces as directed by the **OWNER**.

2. Cast in Place Concrete on In-Situ Soil

Excavate to the lines shown such that the surface on which the concrete is to rest is undisturbed native material with no loose materials or debris. Replace overexcavation with concrete as specified for the structure.

E. Roadway Excavation

Remove the existing pavement and excavate the existing base course and subgrade materials to the new subgrade elevation. Excavate to the cross section as shown on the plan. Prepare the existing soil at the new subgrade elevation in accordance with Section 2600, Subgrade Preparation.

F. Shoring and Sheeting

Provide such bracing, sheeting or shoring necessary to perform and protect the excavation as required for safety. Shore, sheet and brace excavations as set forth in the rules, orders and regulations of the United States Department of Labor Occupational Health and Safety Administration (OSHA). Provide detailed plan and calculations as prepared by a registered professional engineer for excavations 20 feet in depth or greater or when shoring, sheeting or bracing deviates from OSHA standards. Place and remove shoring, sheeting and bracing so as not to damage adjacent improvements, utilities or utility being placed. Costs for shoring, sheeting and bracing to be incidental to the other items.

3.5 Engineered Fill

A. Subgrade Preparation

Prior to fill placement, plow or scarify the surface to a minimum depth of 6 inches. Moisture condition and compact surface to 95 percent of the maximum density in accordance with Section 2600, Subgrade Preparation.

B. Moisture Conditioning

Condition the soil by aerating or wetting to obtain the moisture content required to achieve the relative percent compaction. Mix the soil such that the moisture content is uniform throughout the lift.

C. Fill Placement

1. Lift Thickness

The uncompacted lift thickness shall not exceed eight (8) inches. When material contains more than 25 percent of rock larger than six (6) inches, the uncompacted lift thickness shall not exceed the maximum particle size dimension.

2. Rock Fill

Rock, broken portland cement concrete and crushed asphalt concrete is permitted in fill areas when conforming to the following:

- a.** Place earth or other fine material around the interstices of the pieces to form a dense fill layer. Nesting is not permitted.
- b.** Do not place pieces larger than 4 inches closer than 12 inches from any structure.
- c.** Do not place pieces larger than 2-1/2 inches closer than 12 inches from the finish subgrade.
- d.** Existing asphalt concrete conforming to these requirements for rock fill may be used as fill material only in areas to receive pavement.

3. Benching

When fill is to be placed and compacted on slopes steeper than 5:1 or where new fill is to be compacted against existing fill or where embankment is built 1/2 width at a time, the slopes of original and old or new fills shall be benched as the fill is placed. A new bench shall be started wherever the vertical cut of the next lower bench intersects the existing ground. Material thus cut out shall be recompacted along with the new embankment material by the **CONTRACTOR** at no additional cost. The vertical bench cut shall not exceed three (3) feet.

D. Compaction

1. Compaction Methods

Water consolidation will not be permitted.

2. Percent Relative Compaction

Compact fill and backfill as indicated on the plan. When not indicated on the plan, compact as specified herein.

a. 95% of maximum dry density

1. Areas to receive fill
2. Areas to receive structures, including pavement, upper two feet of fill
3. Structural backfill

b. 90% of maximum dry density

1. All other areas

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for the item, Earthwork.

B. Overexcavation

Overexcavation shall be measured by the cubic yard. The quantity

will be computed by the average end area method. The end area is that bound by the original ground line established by field cross sections and the final theoretical pay line established by cross sections shown on the plans subject to verification by the **OWNER**. After completion of all operations and prior to the placing of base or subbase material, the final embankment shall be verified by the **OWNER** by means of field cross sections taken randomly at intervals not exceeding 500 linear feet.

Final field cross sections shall be employed if the following changes have been made:

1. Plan width of embankments or excavations are changed by more than plus or minus 1.0 foot; or
2. Plan elevations of embankments or excavations are changed by more than plus or minus 0.5 foot.

4.2 Payment

A. Earthwork

Payment for earthwork will be made at the contract lump sum price. The lump sum payment shall be full compensation for excavation of existing materials to the new subgrade elevation, subgrade preparation, fill placement, waste, borrow, hauling, and testing required to complete the item. The item shall be full compensation for all materials; for all preparation, hauling, and placing of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

B. Overexcavation

Payment for overexcavation will be made at the contract cubic yard price. The payment shall be full compensation for excavating the existing material to the depth and section required, hauling and wasting the overexcavated material and backfilling with suitable material. This item shall be full compensation for all work including furnishing all materials; for all preparation, hauling, and placing of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

The quantity of this item listed in the bid schedule represents no actual estimate, is nominal only, and may be greatly increased or decreased or reduced to zero. The increase or reduction of this quantity as compared with that set forth in the bid schedule shall not constitute a basis for claim by the **CONTRACTOR** for extra payment or damages.

See Section 00310 Bid Schedule for Bid Items.

SECTION 02254

SHEETING AND SHORED EXCAVATIONS

PART 1 - GENERAL

1.1 Summary

- A.** Work under this Section consists of furnishing, placing, maintaining and subsequently removing, to the extent required, a positive system of temporary supports for cut and cover, open cut, and trench excavations, including bracing, dewatering, and associated items to support the sides and ends of the excavations. The support system shall prevent lateral and vertical ground movements which will cause damage to buildings, structures, pavements, utilities, and any other adjacent improvements.

- B.** The excavations for the structures shall be made vertical and shored according to this Section. The Contractor shall construct sheeting and shoring to construct all structures and protect all existing structures, improvements, aboveground utilities, and below-ground utilities.

- C.** Contractor shall make his own assessment of existing conditions including adjacent property, the possible effects of his proposed temporary works and construction methods, and shall select and design such support systems, methods, and details as will assure safety to the public, adjacent property, and the completed Work.

- D.** The positive system of support may consist of soldier piles and lagging, sheet piling, or other methods as may be approved by Engineer; secured in place by means of bracing members which may include wales, struts, tieback anchors, or similar members. A trench box is not considered a positive means of support and will not be permitted.

- E.** Utility modification or relocation shall be performed by Contractor at no additional cost to Owner or Engineer, if existing utilities interfere with Contractor's proposed method of support.

- F. Related Work Specified Elsewhere:**

EarthworkSection 2200
Trench Excavation and BackfillSection 2300
Excavation, Filling, and Backfilling for StructuresSection 2321

1.2 Quality Assurance

A. Reference Standards and Specifications:

1. American Society for Testing and Materials (ASTM):

ASTM A36/A36M - Carbon Structural Steel.

ASTM A328/A328M - Steel Sheet Piling.

2. American Welding Society (AWS):

D1.1 - Structural Welding Code, Steel.

3. American Institute of Steel Construction (AISC):

Manual of Steel Construction.

1.3 Submittals and Construction Records

A. Submittals:

1. Submit as specified in Section 1330.

2. Preliminary Shoring Report:

a. A Preliminary Shoring Report outlining the entire scope of the Contract shoring to the specified requirements shall be prepared by or under supervision of Contractor's shoring engineer. The Preliminary Shoring Report shall be submitted for Owner and Engineer review in accordance with Section 1330 prior to the commencement of any shoring work.

3. Working Drawings:

a. Working drawings, by a licensed professional engineer, shall be submitted for Owner and Engineer review in accordance with Section 1330 prior to the commencement of work on each individual item of shoring.

b. The following shall be included on the working drawings:

- (1) Details, arrangement, and method of assembly of the proposed system.
 - (2) The method of bracing and preloading.
 - (3) The full excavation depth.
 - (4) Loads for various stages of bracing removal during concrete placement and backfilling.
 - (5) The anticipated lateral earth pressure, hydrostatic pressure, utility, rail, traffic, and equipment loads.
 - (6) The maximum design load to be carried by the various members of the support system and a tabulation of the required preloads.
 - (7) The depth to which the support system will be installed.
 - (8) The proposed sequence of strut and shore removal as applicable and as related to concrete placement and backfilling operations.
 - (9) Proposed monitoring plan, including location of monitoring points, inclinometers, and seismographs.
- c. Complete design calculations and the maximum theoretical deflections of the support members shall be included.
 - d. Existing utility facilities shall be included and, after checking their locations by field investigations, the working drawings shall be revised to show the actual locations of facilities, location of excavation supports, interference with the proposed Work, and how Contractor proposes to overcome these interferences.
 - e. Documents provided with evidence of an Arizona State registered Professional Engineer's seal, signature, and date.

f. Welder certificates signed by Contractor certifying that welders comply with requirements under "Quality Assurance" Article.

g. Qualifications of vibration monitoring firm.

B. Construction Records:

1. The summary of monitoring data prepared by Contractor's shoring engineer shall be submitted for Owner and Engineer review on a weekly basis.

2. Results of pre-excavation survey prior to any excavation.

1.4 Qualifications

A. Contractor and his subcontracted shoring engineer shall furnish evidence of having successfully completed one project that meets the following criteria:

1. Equal or larger total linear footage of sheeting or shoring for one project of similar scope and conditions.

2. Complete within the specified contract time.

1.5 Dewatering

A. Dewatering plan shall be based on the criteria specified in Section 2300.

1.6 Protection

A. **Sheeting and Shoring:** Provide shoring, sheeting, and bracing as indicated or required. Meet the following requirements:

1. Prevent undermining of pavements and slabs. Remove and replace all undermined pavements, either concrete or asphalt, at Contractor's expense.

2. Excavations shall be accomplished with vertical banks wherever possible. All excavations shall remain within the property lines of the pump station as shown on the Drawings.

3. Except as otherwise specified herein, shoring and sheeting materials may be extracted and reused at Contractor's option; however, Contractor shall remove and replace any existing structure or utility damaged during shoring and sheeting. Where shoring and sheeting materials must be left in place in the completed Work to prevent settlements or damage to adjacent structures or as directed, backfill the excavation to 1 meter (3 feet) below the finished grade and remove the remaining exposed portion of the shoring before completing the backfill. If H-piles and wood lagging are used for shoring, remove wood lagging to within 1 meter (3 feet) of finished grade in incremental steps of approximately 150 mm (6 inches) as the backfill is constructed. The location of all shoring and sheeting left in place shall be documented on drawings and given to Engineer and Owner.

1.7 Quality Assurance

A. Design Criteria:

1. The design and construction of the support system, and the adequacy thereof, shall be the responsibility of Contractor. Contractor's shoring engineer shall be a professional engineer, legally authorized to practice in the jurisdiction where the Project is located, experienced in the design of earth support systems, and required to visit the Site prior to development of any sheeting and shoring system designs in order to become familiar with existing Site conditions.
2. During installation and removal of the any shoring, Contractor's shoring engineer shall visit the Site to observe the Work and to verify the compatibility of the Work with design assumptions. Contractor's shoring engineer shall prepare a status report with each visit to the Site. This report shall be submitted to Engineer within three days of each Site visit. This status report shall contain certification that the Work is in concurrence with design assumptions. If deficiencies are observed, these must be noted and the corrective action outlined in the report. In the event that deficiencies are noted in Contractor's shoring engineer's report, Contractor's shoring engineer shall return to the Site within three days after the corrective action has begun to verify that the deficiencies are adequately being corrected. A corrective action status report shall be prepared by the

Contractor's shoring engineer. The above outlined procedures shall be repeated until the corrective action status report confirms that all deficiencies have adequately been corrected.

3. Design the excavation support in accordance with the design criteria specified herein and in the Contract Documents. The criteria are intended for guidance and are the minimum acceptable.
4. Where applicable, the design and construction of the support system shall conform to the requirements of the AISC Manual of Steel Construction, unless otherwise stated.
5. Design the excavation support system and components to support lateral earth pressures, unrelieved hydrostatic pressures, utility loads, rail loads, traffic and construction loads, and building and other surcharge loads to allow the safe and expeditious construction of the permanent structures without movement or settlement of the ground, and to prevent damage to or movement of adjacent buildings, structures, utilities, and other improvements. The minimum lateral design earth pressure in all cases shall be determined by the Contractor's Shoring Engineer. All of the other above loadings shall be determined by Contractor's shoring engineer and added to the minimum design criteria. The design shall account for staged removal of bracing to suit the sequence of concrete placement for permanent structures and of backfill.
6. Design members to support the maximum loads that can occur during construction. For the purpose of this Section, the design load is the maximum load the support member will have to carry in actual practice, and the proof load is a specified test load greater than the design load.
7. Employ wales, struts, rakers, and tieback anchors for horizontal support for excavation faces retained by soldier piles and lagging, sheet piling, or other methods as may be approved by Engineer. Provide struts with intermediate vertical and horizontal supports if necessary to prevent buckling. Bracing members shall be structural steel. Tiebacks shall be high strength tendons or rods.

8. Take into account stresses due to temperature variations in the design of the struts. Make provisions to protect struts against deformations and stress variations induced by temperature fluctuations.
9. The splicing of an element of the support system will not be permitted.
10. Analyze elements supporting vertical loads and lateral pressures for combined axial load and bending.
11. Lateral loads due to soil and surcharges shall not be transmitted to the permanent structures, or portions thereof, until the concrete has reached sufficient strength to resist said loads, and then, not until the section to be loaded has been checked for strength and deflection and the method of load transmittal accepted by Engineer. The removal of struts shall not increase the design loading on the permanent structures.
12. In a bracing system where wales are not used and a direct strut to soldier pile connection is used, consider an additional provision for bending stress due to the eccentricity of lateral loading of 10% of the depth of the member in each direction in the design of the strut member.
13. Design compression member connections for their compressive loads and for a tensile and shearing load equal to 10% of the design compressive load unless tensile or shearing loads are greater.
14. Driven soldier piles may be assumed as fully braced against buckling in the plane of lagging. In the plane perpendicular to the lagging, the column length shall be taken as the distance between braced points.
15. Backfill soldier piles installed in predrilled holes with lean concrete and allow to set up prior to the start of excavation.
16. Vertical members of flexible wall systems may be designed under the assumption that they are hinged at the bottom of the pile supported excavation and at all bracing levels except the topmost level.

- 17.** In order to satisfy a hinge condition at the bottom of excavation in soil, the vertical wall members shall have at least the minimum penetration necessary to develop the passive resistance of ground material in which piles are embedded, or cantilever action shall be assumed about the lowest installed brace.
- 18.** The calculated deflection of any element of the support system shall not exceed 13 mm (1/2-inch) during excavation or brace removal.
- 19.** Apply active pressure above the pile subgrade elevation to the full panel width between soldier pile centers and to the width of the soldier pile or encasement below pile subgrade. Passive pressure for calculation of embedment required shall be taken as acting on 1.5 times diameter for soldier piles circular in plan and 2.0 times width for soldier piles rectangular in plan.
- 20.** To account for the concentration of soil pressures at struts and tieback locations, the bending moments taken from pressure diagrams (hydrostatic and surcharge pressures excluded) may be reduced by 20 percent when calculating flexure requirements for vertical members and wales of flexible wall systems.
- 21.** Where the loading conditions on opposite sides of an excavation are not equal, analyze the stability of the temporary retaining structure and design structural members so as to take this condition into account.
- 22.** In design of vertical members and wales of flexible wall systems, basic allowable unit stresses may be increased 20%. Design bracing members and connections using basic allowable unit stresses.
- 23.** For calculation of brace loads, vertical wall members may be assumed as several independent simple beams supported at brace levels and their continuity effects ignored. The sum of reactions at each support is used as the design brace load. The full loading on cantilevered portions shall be considered as acting directly upon the supporting brace level. An assumed strut shall be considered to exist at the bottom of the excavation when the minimum pile penetration below subgrade, or deeper, is satisfied. Where wales are a part of the support system, they shall be designed according to the principles of statics.

B. Tieback Analysis and Design:

1. Investigate loading and use the most critical case for design.
2. Make a check of the overall stability (sliding, rotational, etc.) of the zone forming the anchoring mass of earth. The width of resisting surface shall be taken not greater than the distance from the support wall back to the vertical plane passing through the end of the shortest anchor. For a rotational analysis using the slip circle method the design shall yield a factor of safety of at least 1.5, based on loading and the physical properties tabulated.
3. For purposes of determining the effective length of anchors, take the failure plane of the soil mass behind the wall at a minimum angle of 45 degrees measured from the vertical. Anchors shall be considered as receiving resistance from only the soil mass acting beyond the indicated failure plane. Consideration shall be given to increased extent of the failure zone due to high surcharge loads.
4. For loading combinations found, determine the allowable value of adhesion between the soil and the anchor for design of effective embedded length of each individual anchor in various strata. The effective length thus found shall be increased by at least 10% to make allowance for unforeseen field variables.
5. The angle between the direction of the anchor and the horizontal line perpendicular to the support of excavation wall shall be chosen by the Contractor within a range of 0 degrees to 30 degrees. Account shall be taken of the effects of resulting vertical components and associated structural implications arising therefrom, particularly regarding toe penetration requirements.
6. Install anchors in predrilled holes and pressure grout to ensure firm contact with the surrounding soil.
7. For drilled-in anchors, the total anchor load shall be developed in bond between steel and grout acting within effective length of the anchorage.

8. The final working stress shall not exceed 60% of the ultimate tensile strength of the steel nor 70% of its yield strength loads where high-strength tie rod steel is used.
9. For tieback anchors of high strength steel, a pretest load of at least 140% of working load shall be applied. The load shall then be relaxed to not less than 100% of the working load. Final pretest stress in the steel is not to exceed 80% of the ultimate strength nor the manufacturer's recommendations as shown in his catalog or otherwise stated by him in writing.
10. Spacing of the tiebacks shall ensure no overlap of resisting soil stress bulbs in assuming full value of anchorage for each tieback. In the event of overlap, then a reduction factor shall be used for ties effected. In any one plane the anchors shall have a minimum clear distance between them of 1.5 meters (5 feet). Tiebacks having overlapping soil stress bulbs shall be pretested simultaneously.
11. Use good engineering practice, a knowledge of the local or regional subsurface conditions, available geotechnical or subsurface information, and studies performed by the Contractor to investigate the subsurface conditions at the Site in the analysis and design of tieback systems.
12. The value of overburden pressure, if used for adhesion calculations, shall not include surcharge loads.
13. Tiebacks shall not be placed closer than 3 meters (10 feet) to foundation structures of existing buildings.

C. Monitoring:

1. Pre-excavation Survey:
 - a. Contractor shall document all existing damage to adjacent facilities and submit the information to the Owner prior to performing any excavation. Documentation shall include a written description, diagrams, measurements, and photographs as appropriate.
 - b. Establish lines of monitoring points, perpendicular to the excavation face, for at least two sides of each excavation where monitoring is required. Space the lines of monitoring points no more than 6 meters (20 feet) apart, and a minimum of three lines shall be established for each

excavation side to be monitored. Each monitoring line shall consist of a minimum of four monitoring points spaced no more than 3 meters (10 feet) apart. Locate the first monitoring point in each line at the top of the braced excavation. The monitoring lines shall extend from the excavation face to a distance equivalent to twice the total excavation depth. The base of each monitoring point monument shall extend to a depth of at least 1.5 meters (5 feet) below the ground surface. Establish surface monitoring points prior to beginning an excavation.

- c. Each survey reading shall consist of measuring the vertical and horizontal location of each monitoring point. Make the initial set of readings prior to the start of the excavation. Make each additional set of readings at each 1.5-meter (5-foot) increment of vertical excavation depth, immediately before and immediately after internal bracing or tiebacks are installed. After the excavation has been completed, take readings at 7-day intervals thereafter and until movements have been determined by Contractor's shoring engineer to have ceased. If portions of the bracing system are removed at any time, make readings immediately prior to removal and immediately after removal.
- d. Contractor's shoring engineer shall reduce and review the monitoring data and submit a summary of the data to Engineer on a weekly basis. As a minimum, this summary shall include graphical plots of the monitoring data and Contractor's shoring engineer's interpretation thereof.

D. Work Site Conditions:

- 1. Provision for Contingencies:
 - a. Monitor the performance of the components of the support system for both vertical and horizontal movement at regular intervals not to exceed three days.
 - b. Provide a contingency plan or alternative procedure for implementation if unfavorable performance is evident.
 - c. Keep the materials and equipment necessary to implement the contingency plan on hand.

2. Employ caution in the areas of utility facilities, which shall be exposed by hand or other excavation methods acceptable to Owner.

E. Welding Standards:

1. Comply with applicable provisions of AWS D1.1.
2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved, and if pertinent, has undergone recertification.

PART 2 - MATERIALS

- 2.1 Structural Steel:** Steel H-piles, WF shapes, bracing members, fabricated connections, and all other accessories shall conform to the requirements of ASTM A36.

2.2 Structural Steel Sheet Piles

- A. Steel sheet piling shall conform to the requirements of ASTM A328.
- B. Steel sheet piling and interlocks shall not have excessive kinks, camber, or twists that would prevent the pile from free sliding.

- 2.3 Reinforcing Steel:** Shall conform to the requirements of Section 3200.

- 2.4 Field Welding:** Shall be performed by certified welders and be in accordance with AWS D1.1.

- 2.5 Tiebacks:** Shall be high strength steel tendons or rods encased in concrete grout. Use of helical screw anchors is strictly prohibited.

2.6 Concrete

- A. Lean grout shall be a mixture of Type V cement, sand, and fly ash in the proportions of one bag cement, 5 cubic feet fly ash, and sufficient aggregate and mix water to yield 27 cubic feet and shall be placed in such a manner as to present a firm, stable mass capable of retaining shape and position during excavation operations, yet allow relative ease in chipping out for placement of lagging.

- B. All other concrete shall conform to the requirements of Section 03300.

2.7 Timber Lagging: Shall be of a structural grade providing a minimum allowable working stress of 7.6 MPa (1,100 psi) where a system of timber lagging is to be used to support earth excavation.

2.8 Other Materials: Shall be of the size, shape and properties best fitted for their intended use.

2.9 Materials: Whether new or used, shall be sound and free of defects that might impair strength or function.

PART 3 - EXECUTION

3.1 Soldier Piles Installation

A. In the initial positioning of soldier piles at the ground surface, make allowances for installation deviations, and the probable inward movements of the support wall during excavation. Intrusion of wall members into the neat lines of the structures will not be permitted. Where sheeting systems are located contiguous to the neat lines of the structure, provide a reasonable percentage of the depth of excavation to subgrade for initial installation offset.

B. Install soldier piles by preboring or other preexcavating methods to tip elevation shown on the approved working drawings.

C. Case or fill the prebored holes with drill mud, as required, to prevent caving of the sides of the hole prior to placement of the soldier pile and encasement.

D. Pile Embedment:

1. Carry the bottom of the support system to a depth below the main excavation to provide sufficient lateral support to limit the maximum pile deflection to 13 mm (0.5-inch).

E. After seating the soldier piles, encase the piles with lean grout, completely encasing the pile.

F. Design of soldier piles shall conform to the criteria specified in PART 1 - QUALITY ASSURANCE, this Section.

G. Vertical Support System with Tiebacks:

1. Install piles or other vertical support system members incorporated in a system using tieback anchors so that

vertical support members are capable of resisting vertical components of tieback loads without significant settlement during excavation and construction.

2. Install the vertical support members so that settlements will not be caused by construction. In general, install the members to be end bearing in a stratum below the maximum depth of excavation and capable of carrying the total vertical loads without assistance of skin friction in the depth of the excavation.

3.2 Lagging and Sheeting Installation:

- A. Use timber lagging or contact sheeting, steel sheeting, or precast reinforced concrete members secured in place for sheeting of excavations.
- B. Install sheeting and lagging with no gap between the boards. Carefully perform excavation for the installation of sheeting and lagging to minimize or eliminate the formation of voids behind the lagging. As installation progresses, backfill voids between the excavation face and the lagging or sheeting with sand or soil compacted in place. Pack gaps in lagging with materials such as hay or burlap to allow drainage of groundwater without substantial loss of soil.
- C. If unstable material is encountered, take measures to retain the material in place or to otherwise prevent soil displacement.
- D. Sheeting and lagging placement shall follow the excavation. The maximum height of the unsheeted or unlagged face of excavation shall be determined by the job conditions, but in no case shall it exceed at anytime 1.2 meters (4 feet) in predominately clayey soils or 1 meter (3 feet) in sandy soils. If water flows from the face of the excavation, or soil in the face moves toward the excavated area, the maximum height of the unlagged face shall not exceed 375 mm (15 inches), or as directed by Resident Project Representative.
- E. Sheet piling not cut to length shall be cut off after driving at elevations as indicated, if applicable.
- F. Drive sheet piling by recognized methods of good practice in soil conditions present using a hammer with sufficient energy to penetrate overburden material without damaging the sheet piling or adjacent existing facilities. Avoid splicing of sheet piling when

possible. Z-pile sections shall be driven with ball edge "ahead."

- G.** Provide protection to sheet pile ends, as required, to ease driving, assure penetration and prevent tearing or splitting in hard driving conditions.
- H.** In running sand or silt, provide a positive means of securing the lagging to the soldier piles to avoid shifting or falling off of the lagging. Also provide a positive means of securing the material behind the lagging or sheeting.
- I.** A sufficient quantity of material shall be on hand at all times (for sheeting, shoring, bracing and other purposes) for the safe execution of the work and for use in case of accident or other emergency.
- J.** Place wales, when used, on the inside face of the support wall. Make provisions to wedge, pack, shim, or otherwise assure tight bearing between wales and soldier piles, with ample bearing area to assure transfer of the load.
- K.** Remove lean grout only to the extent that is required for installation of the lagging.

3.3 Internal Bracing Support Systems Installation

- A.** The internal bracing support system includes lagging and sheeting, soldier piles, wales, struts, and shores.
- B.** Brace as soon as possible after reaching prescribed excavation levels.
- C.** Provide struts with intermediate bracing if necessary, to enable them to carry the maximum design load without distortion or buckling.
- D.** Provide diagonal bracing where needed to maintain the stability of the system.
- E.** Include web stiffeners, plates, or angles to prevent rotation, crippling, or buckling of connections and points of bearing between structural steel members. Allow for eccentricities due to field fabrication and assembly.
- F.** Install bracing support members and maintain in tight contact with

each other and with the surface being supported. Install support system instrumentation if directed by Owner or Engineer.

- G.** Coordinate excavation work with installation of bracing and preloading.
- H.** Design primary support members to support the maximum loads occurring during the excavation or removal stages, and as required by design criteria specified under PART 1 - QUALITY ASSURANCE, this Section, and on the Contract Drawings.
- I. Preloading:**
 - 1.** Primary bracing members including struts, shores, and similar members shall be preloaded at installation. The amount of the preload shall be determined by Contractor's shoring engineer. Tiebacks shall be preloaded as specified for those installations.
 - 2.** Use procedures that produce uniform loading of the bracing member without appreciable eccentricities, or overstressing and distortion of the members of the wall system.
 - 3.** Make provisions for permanently fixing the required load in the member using steel shims or wedges welded into place.
 - 4.** Wooden wedges shall not be used to preload a bracing member.
 - 5.** The preloading system shall include a means to determine within 5% the amount of preload induced into the bracing members.
- J.** Excavation shall not go deeper than 1 meter (3 feet) below the point of support about to be placed. Install the support and preload immediately after installation of bracing and prior to continuing excavation.

3.4 Tieback Support Systems Installation

- A.** If Contractor elects to use a support system which includes tieback anchors, he shall submit full details of his proposed system to the Engineer for review prior to commencement of the work. The submittal shall be in accordance with instructions specified under PART 1 - SUBMITTALS, this Section. Design shall be in accordance with tieback criteria specified under PART 1 - QUALITY

ASSURANCE, this Section.

- B.** Install tieback systems in accordance with the working drawings. Install the anchorage in soil no closer than a plane extending upward at an angle of 45 degrees to the horizontal from the limit of the lowest depth of excavation.
- C.** Stress all the tiebacks to proof loads equal to 120% of the maximum design load. Maintain the proof load for 30 minutes prior to reducing it to the design load. Anchors which lose more than 5% of the proof load during the 30-minute period will not be acceptable.
- D.** During proof testing, load in increments of 4.5 metric tons (5 tons) at one-minute intervals providing means to measure the load application within an accuracy of plus or minus 5%. Record axial movement corresponding to incremental applications of load to an accuracy of 0.25 mm (0.01-inch).
- E.** After reducing the tieback load to the design load, encase tiebacks in grout. Maintain the design load until the tiebacks are fixed in place.
- F.** Use a method of fixation which will limit the load loss to no more than 5% of the design load in the transfer of the loads from the jacks to the support system.
- G.** Provide and maintain convenient access and appropriate means so that these observations may be made.
- H.** Grease and wrap drilled-in anchors or otherwise treat to ensure the absence of bond on the portion of the tieback between the face of wall and the anchorage.
- I. Performance Tests on Tiebacks:**
 - 1.** Conduct performance tests on at least three selected tiebacks prior to installing any of the remaining tiebacks, which will all be proof loaded. Test tiebacks at each level of support in the excavation. A minimum of 10% of the tiebacks installed shall be performance tested. All performance tests shall be measured with a load cell accurate to within 1% of the design load.
 - 2.** Performance tests for tiebacks in cohesionless soils shall consist of the following cyclic loadings: 0 tons to 0.25 DL

(Design Load); 0.25 DL to 2 tons; 2 tons to 0.50 DL; 0.50 DL to 2 tons; 2 tons to 0.75 DL; 0.75 DL to 2 tons; 2 tons to 1.0 DL; 1.0 DL to 2 tons; 2 tons to 1.2 DL; 1.2 DL to 2 tons; 2 tons to 1.33 DL. The load shall then be reduced to 100% of the design load and locked off. Record axial movement corresponding to incremental applications of 25% of the design load for each individual cycle of loading to an accuracy of 0.025 mm (0.001-inch).

3. Performance tests for tiebacks in cohesive soils shall consist of the following cyclic loadings: 0 tons to 0.25 DL (Design Load); 0.25 DL to 1.8 m tons (2 tons); 1.8 m tons (2 tons) to 0.50 DL; 0.50 DL to 1.8 m tons (2 tons); 1.8 m tons (2 tons) to 0.75 DL; 0.75 DL to 1.8 m tons (2 tons); 1.8 m tons (2 tons) to 1.0 DL; 1.0 DL to 1.8 m tons (2 tons); 1.8 m tons (2 tons) to 1.2 DL; 1.2 DL to 1.8 m tons (2 tons); 1.8 m tons (2 tons) to 1.33 DL. The load shall then be reduced to 100% of the design load and maintained continuously for a minimum of 10 hours. Measure axial movements to an accuracy of 0.025 mm (0.001 inch) and record on 5-minute intervals for the first 100 minutes and 10-minute intervals thereafter.
4. The data from all performance tests shall be interpreted by Contractor's shoring engineer. This interpretation will constitute an evaluation of anchor allowable load-carrying capacities and shall be used by Contractor's shoring engineer to set a criteria for allowable movement of the proof tests.

3.5 Trench Excavation

- A. Perform sheeting, shoring, and bracing for trench excavation for utility facilities and other purposes in accordance with the safety requirements of the General Conditions.
- B. Provide sheeting, shoring, and bracing for trench excavation in the subgrade of the excavation to prevent movement of the main excavation support system.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

No measurement will be made for this item.

4.2 Payment

A. Sheeting and Shored Excavations

Payment for Sheeting and Shored Excavations is included in the lump sum price for the appropriate precast concrete structure(s) included in this project.

**** END OF SECTION 2254 ****

SECTION 02300

TRENCH EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.1 Description

A. Description of Work

The work to be performed in accordance with this section includes the excavation, trenching, backfilling, and surface repair for all pipelines, pipe culverts, box culverts, accessories and lines connected thereto, complete including sheeting and shoring, dewatering, grading and cleanup.

Excavation for appurtenant structures such as manholes, inlets, transition structures, junction structures, vaults, valve boxes, catch basins, etc. shall be included in this section.

The work shall include the furnishing of all labor, tools, equipment, materials and performing all operations to provide a complete item in accordance with the project plans and these specifications.

B. Related Work Specified Elsewhere

Earthwork.....	Section 02200
Ductile Iron Pipe	Section 02648
Cement-Mortar Lined and Coated Steel Pipe and Fittings	Section 02651
General Piping Systems and Appurtenances.....	Section 15000
Valves and Appurtenances.....	Section 15020

C. Definitions

1. Trench

An excavation in which the depth is greater than the width of the bottom of the excavation.

2. Foundation

Material on which bedding is to be directly placed.

3. Bedding

Granular material on which pipe or structure is to be directly placed. The bedding extends from 6 inches below the pipe to 12 inches above the top of the pipe.

4. Select Backfill

Material placed from top of the bedding to finished subgrade.

1.2 Quality Assurance

A. Reference Test Standards and Specifications

ASTM C94, Standard Specification for Ready Mix Concrete.

ASTM C117, Standard Test Method for Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing.

ASTM C131, Standard Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

ASTM C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregate.

ASTM D1556, Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.

ASTM D698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³).

ASTM D6938, Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

ASTM D4215, Standard Specification for Cold Mixed, Cold Laid Bituminous Paving Mixture.

ASTM D4318, Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

Rock Correction Procedure for Maximum Density Determination, ARIZ 227.

Moisture – Density Relationship Using Typical Moisture – Density Curves (One Point Proctor) Method A, ARIZ 232

B. Frequency of Testing

1. Maximum Dry Density and Optimum Moisture Content, ASTM D698.

- a. One test for each different class or type of material shall be provided by the **CONTRACTOR**.
- b. **CONTRACTOR** shall provide additional test when previous test is suspect, as determined by the **ENGINEER**.
- c. **The ENGINEER at the discretion of the OWNER may perform quality assurance testing for compaction, gradation and plasticity index of bedding sand and select backfill. If any test results show non-compliance with the project specifications, the non-complying materials shall be removed and replaced or reworked by the CONTRACTOR. The CONTRACTOR shall perform additional tests at his cost to verify an acceptable condition prior to acceptance by the ENGINEER.**

2. Density of Soil In-Place by Sand Cone or by Nuclear Methods

- a. **CONTRACTOR** shall perform a minimum of one test per lift per 500 linear feet of trench for each type of material.
- b. **CONTRACTOR** shall perform additional tests as required to ensure proper compaction.

3. Sieve Analysis of Aggregate, ASTM C136

- a. **CONTRACTOR** shall perform one test per 1,000 cy per material type of Bedding Sand Material incorporated into the **WORK**.
- b. **CONTRACTOR** shall perform one test per 1,000 cy per material type of Select Backfill Material incorporated into the **WORK**.

4. Plasticity Index of Soils, ASTM D4318

- a. CONTRACTOR shall perform one test per 1,000 cy per material type of Bedding Sand material incorporated into the WORK.
- b. CONTRACTOR shall perform one test per 1,000 cy per material type of Select Backfill material incorporated into the WORK.

5. Moisture – Density Relationship Using Typical Moisture – Density Curves (One Point Proctor) Method A, ARIZ 232

- a. CONTRACTOR shall perform this test any time the fill material appears to have changed or as directed by the ENGINEER or DESIGNEE to verify the appropriate proctor is being utilized.

C. Testing Tolerances

1. Percent Relative Compaction

Not less than as specified on plans or in these specifications.

2. In-Place Moisture Content

As required to achieve specified percent relative compaction.

3. Soft or Yielding Surfaces

Regardless of percent relative compaction obtained by test, areas which are soft and yield under the load of construction equipment are to be removed and replaced at no additional cost.

1.3 Submittals

A. Materials Test Reports

1. Report on maximum dry density and optimum moisture content prior to beginning of construction.
2. Report on bedding and backfill materials compliance tests as required. Compaction test reports shall be submitted to the ENGINEER within two (2) business days of completion of each test.

B. Spoil Disposal Area

Provide location and written approval for area to dispose of spoil from operation, as approved by ENGINEER.

C. Shoring Plan

Provide plans, details, and calculations by a professional **ENGINEER** registered in the State of Arizona if shoring or sheeting is required. See Section 02254

D. Dewatering Plan

Provide plans, details and calculations by a professional Engineer registered in the State of Arizona if dewatering is required.

1.4 Job Conditions

A. Dewatering

It is the **CONTRACTOR'S** responsibility to dewater if groundwater is encountered.

B. Protection of Existing Utilities

Maintain all utilities both underground and overhead in continuous service throughout the contract period. Liability for damages to, or interruption of services caused by the construction shall be borne by the **CONTRACTOR**.

PART 2 - MATERIALS

2.1 Soil and Soil Aggregate Materials

A. Unsuitable materials not to be incorporated in the work include:

1. Organic matter such as peat, mulch, organic silt or sod.
2. Soils containing expansive clays.
3. Material containing excessive moisture.
4. Poorly graded coarse material.
5. Particle size in excess of 6-inches.
6. Material which will not achieve density and/or bearing requirements.
7. Material containing asphalt concrete or Portland cement concrete.

B. Bedding

Bedding for all water, sewer, storm drain lines, and manholes specified in Sections 2500, 2551, 2550, 2560, and 2570 shall be bedded in bedding sand. Culverts, specified in Section 2520, shall be bedded on aggregate base course per subsection 2.1.E unless otherwise specified.

1. Bedding Sand

Bedding sand shall consist of non-plastic sandy material conforming to the following requirements:

Sand Equivalent (SE), 30 Minimum
PH 6.5 – 8.5
Resistivity 2,000 – 50,000 ohm-cm
Sulfate (optional) 1500 PPM or less

SIEVE SIZES	PERCENTAGE BY WEIGHT
3/8"	100
No. 4	90-100
No. 50	10-40
No. 100	3-20
No. 200	0-15

C. Granular Backfill

Native excavated or approved import granular material, free draining and free of unsuitable materials defined herein. Granular backfill shall be non-plastic, well graded and meet the following requirements:

Sieve Size	Percent by Weight Passing
4 inches	100
No. 4	30-75
No. 8	20-60
No. 30	10-40
No. 200	0-12

D. Aggregate Base Course

Crushed aggregate or processed natural material, clean, hard, sound, and free of any detrimental quantity of soft, friable, elongated, or laminated pieces, organic matter or other deleterious substances. Properties of which shall meet the following requirement:

- a. Grading, ASTM C136 and ASTM C117.

Sieve Size	Percent by Weight
1 1/2"	100
No. 4	30-70
No. 8	20-60
No. 30	10-40
No. 200	0-12

- b. Percentage of Wear, ASTM C131, maximum percentage of wear of 40 after 500 revolutions.

- c. Plasticity Index and Liquid Limit, ASTM D4318, maximum plasticity index of 5, maximum liquid limit of 25 percent.

2.2 Portland Cement Concrete

ASTM C94 and Specification Section 3300.

2.3 Asphalt Cement Concrete

As required in Specification Section 2630.

2.4 Cold Mix, Cold Laid Bituminous Paving Mixture

ASTM D4215.

2.5 Buried Warning and Identification Tape

Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for locating, warning, and identification of buried utility lines. Provide tape on rolls, 3-inch minimum width, color coded as stated below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing is to be permanent, unaffected by moisture or soil.

WARNING TAPE COLOR CODES	
RED	ELECTRIC
YELLOW	GAS, OIL, DANGEROUS MATERIALS
ORANGE	TELEPHONE AND OTHER COMMUNICATIONS
BLUE	WATER
GREEN	SEWER
WHITE	STEAM, AIR
PURPLE	REUSE

A. Warning Tape for Metallic Piping

Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements indicated above. Minimum thickness of the tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise with a maximum 350 percent elongation.

B. Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape to the width, color, and printing requirements indicated above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise.

PART 3 - EXECUTION

3.1 Preliminary Investigation of the Work

Verify that all of the preliminary work including construction staking has been performed in accordance with the plans and specifications prior to trenching and backfill operations.

3.2 Trenching in Fill Areas

Grade fill areas to within 1 foot of the finish grade prior to trenching and placement of the pipeline.

3.3 Excavation

A. General

Perform all excavations of every description and of whatever substances encountered to the depths indicated on the plans and including excavation ordered by the **ENGINEER** of compacted fill for the purpose of performing tests. Use open cut excavation methods unless otherwise indicated on the plans or approved by the **ENGINEER**.

B. Trench Widths

Trenches shall be excavated per LHC Standard Detail 200A

Maintain trench walls as vertical as possible except as required by safety standards and as required for sheeting and shoring.

If the maximum trench width is exceeded at the top of the pipe, the **CONTRACTOR** shall provide necessary additional load bearing capacity by means approved by the **ENGINEER** at no additional cost to the **OWNER**.

C. Over excavation

1. Unauthorized

Fill and compact unauthorized excavation beyond the specified grade line, at the **CONTRACTOR'S** expense, with bedding material, compact to 95 percent of the maximum density. No payment will be made for unauthorized over excavation.

2. Rock

Over excavate rock encountered in the trench to provide a minimum of six inches of bedding below the pipe and the minimum width at the springline.

3. Unsuitable Material

Over excavate unsuitable material to the depth necessary to provide the required support as determined by the **ENGINEER**. Backfill the over excavation with bedding material and compact to at least 95 percent of the maximum density.

D. Excavation for Manholes, Valves, Inlets, Catch Basins and Other Accessories

Provided the excavated surfaces are firm and unyielding, the **CONTRACTOR** may elect to cast concrete for the structure directly against excavated surfaces. Over excavate to provide bedding where shown on the plans.

E. Pavement and Concrete Cutting and Removal

Sawcut, remove and dispose of existing pavements and concrete per Specification Section 2110.

F. Grading and Stockpiling

1. Grading

Grade in the vicinity of the trench to prevent surface water from flowing into the trench. Remove any water accumulated in the trench by pumping or by other approved methods. Stockpile excavated material in an orderly manner a sufficient distance back from the edges of the trench to avoid overloading and to prevent slides or cave-ins.

2. Topsoil

Excavate topsoil and stockpile separately. Replace topsoil upon completion of backfill and grade to the elevations indicated on the plans.

G. Shoring and Sheeting

Shore, sheet and brace excavations as set forth in the rules, orders and regulations of the United States Department of Labor Occupational Health and Safety Administration (OSHA), and as specified in section 02254 of these specifications. Provide detailed plan and calculations as prepared by a registered professional **ENGINEER** for excavations 20 feet in depth or greater or when shoring, sheeting or bracing deviates from OSHA standards. Place and remove shoring, sheeting and bracing so as not to damage adjacent improvements, utilities or utility being placed. Costs for shoring, sheeting, and bracing is considered incidental.

H. Open Trench

1. Maximum Length

The maximum length of open trench within developed, dedicated right of way is not to exceed 500 feet per trench and pipeline crew, provided that all proper barricades and safety procedures have been addressed. The trench is considered to be open until backfill is completed to adjacent finish grade elevation.

2. Street Crossing

Complete backfill of trench across streets at the end of each work day. Use temporary patch material (cold mix asphalt concrete) or steel plates as required.

3. Temporary Provisions

Furnish and install trench bracing and steel plating required to provide safe and convenient vehicular and pedestrian passage across trenches where required. Maintain access to and from emergency facilities at all times.

3.4 Foundation, Bedding, Backfilling and Compaction

A. Foundation

Excavate trench bottom to the depth and width as shown. Remove all loose, disturbed material from the bottom of the trench such that the bedding shall rest on firm, undisturbed soil.

B. Bedding

Moisture condition and place bedding material to required thickness. Compact bedding material to the specified density.

C. Fine Grading

Accurately grade the bottom of the trench to provide uniform bearing and support for each section of pipe at every point along its entire length, except where it is necessary to excavate for joints.

D. Moisture Conditioning

Moisture condition all bedding and backfill materials by aerating or wetting to obtain the moisture content required to achieve specified percent relative compaction. Completely mix the material until the moisture content is uniform throughout the lift.

E. Lift Thickness

1. The following table applies when using mechanical compaction:

LIFT DESCRIPTION	MAXIMUM LOOSE LIFT THICKNESS, INCHES
Bedding	8-Inches in all cases
Backfill	
Aggregate Base Course	

Lift thickness may be increased if **CONTRACTOR** can prove, through a series of density tests, to be approved by the Engineer, that minimum density is achieved throughout the lift thickness.

F. Compaction

1. Compaction Methods

Construction shall be accomplished by mechanical methods. Rubber tire wheel rolling will not be allowed.

2. Pipe Haunch

When using mechanical methods, hand compact initial backfill in pipe haunch with a pipe haunch compactor (J-bar) or mechanical vibrator sized to fit the narrow width between the pipe and the trench. Give special attention to provide proper compactive effort in the pipe haunch zone.

3. Compaction Densities

Thoroughly compact trench bedding and backfill to not less than the percent relative compaction as presented in the following table, unless more stringent requirements are called for on the plans.

PERCENT RELATIVE COMPACTION MINIMUM DENSITY REQUIRED				
Backfill Type	Location	From Subgrade Surface To 2' Below Surface	From 2' Below Surface To 1' Above Top of Pipe	From 1' Above Top of Pipe To Bottom of Trench
I	Under any existing or proposed pavement, curb, gutter, sidewalk, or such construction included in the contract or when any part of the trench excavation is within 2' of the above.	95%	95%	95%
II	On any utility easement, street, road or alley right-of-way outside of (I).	95%	95%	95%
III	Around any structures or exposed utilities.	95% in all cases		
IV	Outside of right-of-way and not below any curb, gutter sidewalk or other structures.	90% in all cases		

3.5 Buried Warning and Identification Tape

Place warning and identification tape to the depth indicated on the plan. Center tape over pipeline.

3.6 Backfill for Manholes, Valves, Inlets, Catch Basins and Other Accessories

Backfill appurtenances and structures including bedding, backfill, lift thicknesses and compaction as indicated.

3.7 Pavement Replacement and Surface Restoration

A. Grading

Perform all grading adjacent to backfilled trenches and structures necessary to leave the area in a neat and satisfactory condition as approved by the **Engineer**.

B. Surface Restoration

Restore all streets, alleys, driveways, sidewalks, curbs or other surfaces which were broken or damaged by the installation of the new work, to a condition as good as or better than originally encountered in accordance with these specifications, accepted standards and as acceptable to the **ENGINEER**.

1. Landscape

Replace landscape rock, sod, shrubs, trees, grass, sprinkler systems as required to a condition as good as or better than originally encountered in accordance with these specifications, accepted standards and as acceptable to the Engineer.

2. Temporary Pavement

Place cold mix, cold laid bituminous paving mixture in accordance with ASTM D4215 immediately following backfilling and compaction of trenches through existing pavement. Maintain pavement in safe and smooth condition until final pavement can be placed.

3. Pavement Replacement

Replace permanent asphalt cement, concrete pavement per the requirements of Specification Section 2630, Asphalt Concrete Pavement.

4. Clean Up

Remove all excess soil, concrete, etc. from the premises. Leave job site in a neat and clean condition.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

A. Trench Excavation and Backfill

No measurement will be made for trench excavation and backfill.

B. Over excavation

Over excavation of unsuitable material will be measured by the average end area method per Section 2200, Earthwork.

C. Surface Repair

Measure surface repair along the centerline of utility over which it occurs from junction center to center.

4.2 Payment

A. Trench Excavation and Backfill

No payment will be made for trench excavation and backfill. All trench excavation and backfill work including but not limited to excavation, material testing, disposal, backfill grading is incidental to the pipelines and appurtenant bid items.

B. Over excavation

Payment for over excavation will be made per Specification Section 2200, Earthwork.

****END OF SECTION 02300****

SECTION 02510

ROCK RIP-RAP CONSTRUCTION

PART 1 - GENERAL

1.1 Description

A. Description of Work

The work to be performed in accordance with this section includes furnishing and installing stone, with or without grout as indicated on the plans and specified herein. The work shall include the furnishing of all labor, tools, equipment, materials and the performing of all operations required to provide with the project plans and these specifications.

B. Related Work Specified Elsewhere

Earthwork.....Section 02200
Storm Drain Construction.....Section 02500

1.2 Quality Assurance

A. Reference Test Standards and Specifications

ASTM C131, Standard Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

ASTM C144, Standard Specification for Masonry Mortar

ASTM C404, Standard Specification for Aggregate for Masonry Grout

1.3 Submittals

A. Materials Test Reports

1. Report on Rip-Rap Gradation and Abrasion Loss.
2. Report on Portland Cement Grout Including Mix Design and Aggregate Properties.

B. Frequency for Testing

1. One test for each source of stone and grout.

PART 2 - MATERIALS

2.1 Stone

Sound and durable, free from seams and coatings. Loss by abrasion not to exceed 10 percent by weight after 100 revolutions nor 40 percent after 500 revolutions when tested in accordance with ASTM C131.

A. Shape

Do not use rounded boulders or cobbles on slopes steeper than 2 to 1 unless grouted. The thickness of each stone shall be more than 1/3 the length.

B. Size

Stone shall be as large as can be conveniently placed in a layer of the required depth. Except for small stones used to chink interstices, stone shall not be less than 10 pounds and at least 50 percent of the stone shall not be less than 100 pounds.

C. Type

Waste concrete is not to be used unless specifically approved by the **OWNER**.

2.2 Portland Cement Grout

One part Type V portland cement, three parts aggregate by volume. The aggregate shall be two parts sand and one part 3/8 inch aggregate. The sand shall meet the requirements of ASTM C144. The aggregate shall meet the requirements of ASTM C404, Size No. 1.

PART 3 - EXECUTION

3.1 Preliminary Investigation of the Work

Verify all preliminary work has been performed in accordance with these specifications prior to placement of rock rip-rap.

3.2 Preparation of Ground Surfaces

Trim and shape bed to provide even surfaces to the plan elevation. Excavate, backfill and compact bed for rip-rap in accordance with Specification Section 2200, Earthwork.

3.3 Rock Rip-Rap

A. Depth Less Than 20 Inches

Place stone by hand to provide a minimum of voids. Place larger stone in the trench at the slope toe; as foundation course and on the perimeter. Place stones with longitudinal axis normal to the face of the embankment and arranged so that each stone has at least 3 point bearing on underlying stones. Chink interstices with small stones. The finished surface shall be even and tight and shall not vary from the planned surface by more than 3 inches per foot of depth.

B. Depth Greater Than 20 Inches

Stone may be placed by dumping and spreading in layers with suitable equipment. Arrange with equipment to produce stable and dense layer.

3.4 Grouted Rock Rip-Rap

Place rip-rap as specified above and grout with portland cement grout. Mix grout in an appropriate machine mixer. Place grout to the depth as shown on the plan but in no case less than 70 percent of the depth of rip-rap. Place and consolidate grout so as to provide a dense stone and mortar layer with all voids and interstices filled.

The stone face surface shall be exposed. If required, use water pressure to clean stone faces after the mortar has achieved sufficient strength. Cure grouted rip-rap in accordance with Specification Section 3300, Concrete.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

The surface area of rock rip-rap construction to be paid for will be that of the completed bid item, in place, within the limits of dimensions shown on the plans. The **OWNER** will compute the quantities of rip-rap by a method which, in his opinion, is best suited to obtain an accurate determination.

4.2 Payment

Payment for rock rip-rap will be made at the contract unit price for the number of square yards of rock rip-rap in place for each depth required on the basis of unit prices stipulated in the proposal and shall include preparation of ground surfaces and trenching.

Payment will be made under Item Number:

NOT USED - "X" Rock Rip-Rap, S.Y.

****END OF SECTION****

SECTION 02515

UTILITY VALVES AND ACCESSORIES

PART 1 - GENERAL

1.1 Summary

A. Description of the Work

The work to be performed in accordance with this Section includes all work associated with the installation and testing of all valves, hangers and supports, gauges, and other accessories associated with the project piping.

The work shall include the furnishing of all labor, tools, equipment, materials and performing all operations to install all valves hangers and supports, gauges, and other accessories.

B. Related Work Specified Elsewhere

Water Piping Systems..... Section 2550
Electrical.....Section 16000 thru 16950

1.2 Quality Assurance

A. Reference Standards and Specifications

1. American National Standards Institute (ANSI)

ANSI B16.1 - Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800.

2. American Society for Testing and Materials (ASTM)

ASTM A126 - Gray Iron Castings for Valves, Flanges and Pipe Fittings.

ASTM A276 - Stainless and Heat Resisting Steel Bars and Shapes.

ASTM A536 - Ductile Iron Castings.

3. American Water Works Association (AWWA)

AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

AWWA C207 - Steel Pipe Flanges for Waterworks Service, Sizes 4 Inch through 144 Inch.

AWWA C504 - Rubber Seated Butterfly Valves.

AWWA C507 - Ball Valves, 6 Inch through 48 Inch.

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

AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.

AWWA C512 - Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.

AWWA C550 - Protective Epoxy Interior Coatings for Valves and Hydrants.

AWWA C600 - Installation of Ductile-Iron Water Mains and their Appurtenances.

B. Manufacturer Quality Assurance

Manufacturers shall be experienced in the design and manufacture of specific valves and accessories for a minimum period of 5 years and all valves and fittings shall be manufactured in U.S.

C. Field Testing

- 1.** Perform on piping and valves as specified including:
 - a.** Check valves.
 - b.** Gate valves.
 - c.** Butterfly valves
 - d.** Ball valves.

- e. Air and air/vacuum valves.
 - f. Control valves.
 - g. Gauges.
2. Valves may be either tested while testing pipelines, or as a separate step.
 3. Test that valves open and close smoothly under operating pressure conditions. Test that two-way valves open and close smoothly under operating pressure conditions from both directions.
 4. Inspect air and vacuum valves as pipe is being filled to verify venting and seating is fully functional.
 5. Count and record number of turns to open and close valve; account for discrepancies with manufacturer's data.
 6. Set, verify, and record set pressures for relief and regulating valves.
 7. Automatic valves to be tested in conjunction with control system testing. Set opening and closing speeds, limit switches, as required or recommended by Engineer.

1.3 Submittals

- A. Submit as specified in Section 1330.
- B. Include, but not limited to, the following:
 1. Catalog data or illustrations showing principal dimensions, parts, and materials.
 2. Spare parts list referenced to illustration of parts.
 3. Assembly and disassembly or repair instructions.
 4. Dimensions of the clearance required for butterfly valve discs, handwheels, actuators or any other moving part.

5. Manufacturers published operation and maintenance instructions.

C. Certificates and Affidavits: Furnish prior to shipment. Include the following:

1. Test certificates.

2. Affidavit of compliance with applicable AWWA Standard.

1.4 Delivery, Storage, and Handling

A. Ship all valves with suitable end covers to prevent entrance of foreign material into valve body.

B. Protect valve threads, flanges, stems, and operators from damage.

C. Ship valves 2-1/2-inch and larger to the Project Site tagged with the valve number shown on the Drawings and valve schedule. Tag smaller valves to show the piping system in which it is to be used.

1.5 Responsibility

Actuators, their controls, and accessories shall be the responsibility of the valve manufacturer for sizing, assembly, certification, field testing, and any adjustments necessary to operate the valve as specified.

PART 2 - MATERIALS

2.1 Gate Valves

A. General:

1. AWWA gate valves to be in full compliance with stated AWWA standard and the following requirements:

2. Provide 2-inch operating nut and handwheel for AWWA gate valves 12 inches and smaller.

3. Provide Affidavit of Compliance per the applicable AWWA standard for AWWA gate valves.

4. Mark AWWA gate valves with manufacturer's name or mark, year of valve casting, valve size, and working water pressure.

5. Repaired AWWA gate valves shall not be submitted or supplied.

2.2 Exposed Gate Valves

- A. AWWA C509, iron body, bronze mounted, flanged ends, double-disc gate, non-rising bronze stem, resilient seated. working water pressure 200 psi for 3 inches through 12 inches and 150 psi for 14 inches through 48 inches.
- B. Manufacturers and Products:
 1. Mueller Valve Company.

2.3 Buried Gate Valves

- A. AWWA C509, iron body, bronze mounted, mechanical joint ends, double-disc gate, non-rising bronze stem, resilient seated, 2-inch operating nut, and O-ring sealed stuffing box, working water pressure of 200 psi for 3 inches through 12 inches and 150 psi for 14 inches through 48 inches.
- B. Manufacturers and Products:
 1. Mueller Valve Company.

2.4 Exposed Ball Valves

- A. Ball Valve 3 Inches and Smaller for General Water and Air Service:
 1. Two-piece, standard port, NPT threaded ends, bronze body and end piece, hard chrome-plated solid bronze or brass ball, RTFE seats and packing, blowout-proof stem, adjustable packing gland, zinc-coated steel hand lever operator with vinyl grip, rated 600 pound WOG, 150 pound SWP, complies with MSS SP 110.
- B. Manufacturers and Products:
 1. Conbraco Apollo; 70-100.
 2. Nibco; T-580-70.

2.5 Exposed Butterfly Valves, flanged

A. Butterfly valves, AWWA C504, Class 150B, 3-inch and 4-inch, short body type, flanged ends. Cast-iron body, cast or ductile iron disc, Type 304 stainless steel shafts, EPDM rubber seat, and stainless steel seating surface Provide with gear driven 90 degree handwheel operator.

B. Manufacturers and Products:

1. Pratt; Model 2FII or Triton XR-70
2. DeZurik; AWWA Valve

2.6 Buried Butterfly Valves

A. AWWA C504, Class 150B, Mechanical joint ends, Cast-iron body, cast or ductile iron disc, Type 304 stainless steel shafts, rubber seat bonded or molded in body only, and stainless steel seating surface. Provide epoxy lining and coating in compliance with AWWA C550.

B. Manufacturers and Products:

1. Pratt.
2. DeZurik.

2.7 Cushioned Swing Check Valves

A. Acceptable Manufacturers

1. APCO, Valve and Primer Corporation, CVS type.
2. GA Industries, Inc.

B. Operational Requirements

1. Prevent reverse flow without shock or hammer.
2. Drip Tight Seat with internal pipeline forces.
3. Cushioned with air cylinder controls in manner permitting adjustment of speed of closure.

C. Design: Conform to AWWA C508 and as specified.

1. Swing disc type with single shaft and flanged body. Flanges shall be ANSI B16.1, Class 125.
2. Cushion chamber shall be mounted externally on valve body.
3. Valve disc shall have external lever and counterweight to initiate closure.
4. Suitable for 250 psi operating pressure.

D. Materials and Construction

1. Valve body shall be cast iron, ductile iron, or steel.
2. Valve disc shall be cast iron, ductile iron, or stainless steel.
3. Seats and seat ring shall be renewable. Seats shall be bronze or stainless steel. Seat rings shall be Buna-N or bronze.

2.9 Bronze Swing Check Valves

A. Acceptable Manufacturers

1. Crane
2. Nibco
3. Approved equal.

B. Design

1. "Y" Pattern check swing type.
2. Rated for 200 psi cold working pressure.

C. Operation

1. Prevent reverse flow without shock or hammer.

2. Seat tightly with internal pipeline forces.
3. For use on service water lines 2" and less.

D. Materials and Construction

1. Valve body shall be bronze ASTM B62.
2. Valve disc shall be composition or PTFE.
3. Seats and seat ring shall be renewable. Seats shall be bronze.
4. Bonnet to be screwed cap type.

E. Connections

1. Connections to be threaded.

2.10 Air/Vacuum Release Valves

A. Acceptable Manufacturers

1. A.R.I.
 - a. K-060 HF
2. or Approved Equal.

B. Design: Conform to the following:

1. Valve shall be a water service air/vacuum valve.
2. Body shall be ductile iron.
3. Float shall be SAE 316 stainless steel. Orifice seats shall be SAE 316 stainless steel. Seal assembly shall be of reinforced nylon and E.P.D.M. rubber.
4. All other internal parts shall be 316 stainless steel.
5. Single body construction built for 3 - 250 psi service.

C. Operation

1. Discharge air when filling line and at water column return.
2. Admit air when draining the line and at water column separation.

D. Connection

1. Connect air valves using threaded connection as shown on the Drawings.
3. Connecting fittings and pipe shall be bronze, brass, or copper rated for 250 psi service.
5. Couplings or unions indicated between pipeline and air valve piping shall be insulated style.

2.11 Pressure Reducing Valves

A. Pressure reducing valves 3" and larger

1. Hydraulically operated, diaphragm actuated, pilot-controlled globe valve with reduced port, ductile iron body, ASME B16.1 Class 150 flanged ends, rated 250 psi, bronze or stainless steel trim, stainless steel stem, externally mounted strainers with cocks, maintains a constant downstream pressure while maintaining a minimum upstream pressure.
2. Provide Operation and Maintenance data and manufacturer's certificate of proper installation.
3. A factory trained representative of the manufacturer shall visit the site and provide field services during functional and performance testing to set up or tune the valve to the application, and train Owner's personal in the operation and maintenance of the valve as required.

B. Manufacturers and Products:

1. Cla-Val; 690-01
2. Singer; Model 206PR-R

2.12 Isolation Valves

- A. Isolation valves shall be provided for all air/vacuum valves and pressure switches and shall be bronze gate valve, Crane No. 424 or Engineer-approved equal for sizes 3 inches and smaller unless otherwise noted. Isolation valves 4 inches and larger shall be flanged AWWA C504 butterfly valves.

2.13 Pipe Supports

- A. Pipe supports shall meet the requirements of Section 5, Chapter II of ANSI B31.1 and shall be types as given for MSS Standard Practice SP-58 and SP-69.
- B. Constant Support: Bergen, Blaw Knox, Fee and Mason, Grinnell, or NAVCO.
- C. Pipe supports shall be of the types listed in Table 1 "Hanger and Support Selection," MSS Standard Practice SP-69 except that the following figure types given in Fig. 1 will not be acceptable: Types 5, 6, 11, 12, 7, 9, 10, and 25.

2.14 Meters and Gauges

A. General

- 1. Provide all instruments, meters, gauges, and thermometers, complete with interconnecting stainless steel tubing, piping, valves, as specified and as indicated.
- 2. Provide gauge stainless steel cock in the piping for all instruments, meters, and gauges, both at point of takeoff and at the instruments, meters and gauges. Gauge cock shall be of the same design requirements as the lines they serve.

B. Indicating Pressure Gauges

- 1. Ashcroft "Duragauge," Crosby or Marsh.
- 2. **Bourdon Tube**
 - a. **160-psi maximum graduation:** Stainless steel Grade A phosphor bronze, brazed joints stress relieved.

3. Mueller Company.
 4. Neenah Foundry Company.
 5. Tyler Company.
- B.** Provide for all buried valves.
- C. Design**
1. Boxes shall be three-piece cast-iron screw type with 5-1/4-inch shaft.
 2. Provide extension stem to bring operating nut within 2 feet of valve box top.

2.16 Shop Painting

- A.** Prepare surfaces and paint or coat all valves, corporation stops, and all related accessories to the standard of the manufacturer unless otherwise specified herein.
- B.** Paint and coatings shall be suitable for the service intended.
- C.** Submit type of paint or coating proposed with drawings and data for Engineer approval prior to fabrication.

PART 3 - EXECUTION

3.1 Installation

- A.** Comply with provisions of AWWA C600 and as specified.
- B.** Thoroughly clean and remove all shipping materials prior to setting. Operate all valves from fully opened to totally closed.
- C.** Equip with anchorage where indicated.
- D.** In accordance with Section 2550 Water Line Construction.

3.2 Field Painting

- A. Manufacturer shall provide adequate coating system equal to shop coating for field touch-up.

3.3 Hangers, Supports and Anchors

A. General

1. The design, selection, spacing, and application of pipe supports shall be in accordance with the codes and standards specified except the ANSI B31.1 - Code for Power Piping shall take precedence over the MSS SP-69 standard.
4. Furnish and install for all pipe installed under this Contract.
5. Include all necessary structural aluminum or 316 stainless steel, brackets, concrete inserts, and similar items which are not a part of the building, or specified but required to properly support the piping systems.
6. Include necessary temporary supports, pins, and related items for the hydrostatic testing of any lines that are spring supported.
7. Install piping and provide necessary supports and anchors to prevent the forces and mounting imposed on Equipment from exceeding the limits specified by the Equipment manufacturer.

B. Adjustment

1. Prior to putting the piping systems into service, adjust all solid hangers to correct position and remove all temporary hangers used in erection and testing.
2. After and during the time the piping systems are being put into service, align all hanger rods to the vertical position.

- C. **Hangers, and Related Items Not on Drawings:** Pipe hanger assemblies, anchors, and sway braces other than those indicated on the Drawings shall be designed, selected, and located by Contractor or hanger manufacturer in accordance with the following:

1. Make accurate weight balance calculations to determine the required supporting force on each hanger and to show the

reaction and forces on Equipment on the Shop Drawings. Calculate expansion and movement of all pipe installed under this Contract and select hanger type and components to allow for pipe expansion and movement.

2. Submit detail Shop Drawings of each hanger assembly for review and comments.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

- A. No measurement will be made for this item.

4.2 Payment

- A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

**** END OF SECTION 02515 ****

SECTION 02535
PIPE INSTALLATION

PART 1 - GENERAL

1.1 Summary

A. Description of Work

This Section includes handling, installation and testing of pipe, fittings, specials, and appurtenances as indicated or specified.

B. Related Work Specified Elsewhere

Excavation, Filling, and Backfilling for Structures.....Section 02321
Utility StructuresSection 02532
Sewer Line ConstructionSection 02560

1.2 Quality Assurance

A. Applicable Standards and Specifications

1. American Society for Testing and Materials (ASTM):

ASTM D2321 - Underground Installation of Flexible Thermoplastic Sewer Pipe.

ASTM F1417 - Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air.

2. Federal Specifications (FS):

SS-S-00210 - Sealing Compound, Preformed Plastic, For Expansion Joints and Pipe Joints.

1.3 Delivery, Storage and Handling

A. Handle in a manner to ensure installation in sound and undamaged condition.

1. Do not drop or bump.

2. Use slings, lifting lugs, hooks, and other devices designed to protect pipe, joint elements, linings, and coatings.
- B. Ship, move, and store with provisions to prevent movement or shock contact with adjacent units.
 - C. Handle with equipment capable of work with adequate factor of safety against overturning or other unsafe procedures.

PART 2 - MATERIALS

Specified in Section 02560.

PART 3 - EXECUTION

3.1 Installation

- A. Verify all preliminary work has been completed prior to any sewer line construction.
- B. Use equipment, methods, and materials ensuring installation to lines and grades indicated.
 1. Maintain within tolerances specified or acceptable laying schedule.
 - a. **Alignment:** +1 inch per 100 feet in open cut or tunnel.
 - b. **Grade:** +1 inch per 100 feet.
 2. Do not lay on blocks unless pipe is to receive total concrete encasement.
 3. Obtain acceptance of method proposed for transfer of line and grade from control to the Work.
- C. Install pipe of size, materials, strength class, and joint type with embedment indicated.
- D. Install pipe with spigot or tongue ends in direction of flow. Obtain Engineer approval for deviations there from.

- E.** Clean interior of all pipe, fittings, and joints prior to installation. Exclude entrance of foreign matter during installation and at discontinuance of installation.
 - 1.** Close open ends of pipe with snug-fitting closures.
 - 2.** Do not let water fill trench. Include provisions to prevent flotation should water control measures prove inadequate.
 - 3.** Remove water, sand, mud, and other undesirable materials from trench before removal of end cap.
- F.** Brace or anchor as required to prevent displacement after establishing final position.
- G.** Perform only when weather and trench conditions are suitable. Do not lay in water.
- H.** Observe extra precaution when hazardous atmospheres might be encountered.

3.2 Jointing

A. General Requirements

- 1.** Locate joint to provide for differential movement at changes in type of pipe embedment, impervious trench checks, and structures.
 - a.** Not more than 8 inches from structure wall, or
 - b.** Support pipe from wall to first joint with concrete cradle structurally continuous with base slab or pipe bedding material.
 - c.** As indicated.
- 2.** Perform conforming to manufacturer's recommendations.
- 3.** Clean and lubricate all joint and gasket surfaces with lubricant recommended.

4. Use methods and equipment capable of fully seating or making up joints without damage.
5. Check joint opening and deflection for specification limits.

3.3 Temporary Plugs:

- A. Furnish and install temporary plugs. Temporary plugs are to be installed
In the pipe at the end of each workday and the trench is to be completely backfilled.

3.4 Field Testing:

1. Acceptance Tests for Gravity and Low-Pressure Pipelines:

a. Alignment:

- (1) Sewer shall be inspected by flashing a light between manholes or by physical passage where space permits.
- (2) Sewer shall be inspected by videotaping entire line, from first to last manhole. During entire video recording, water must be flowing in the invert at a rate of at least one gallon per minute. The footage from the starting manhole must be recorded on the video screen, as well as the pipe run identification.
- (3) Contractor shall clean pipe of excess mortar, joint sealant, and other dirt and debris prior to inspection.
- (4) Determine from Videotaping or Physical Inspection:
Presence of any misaligned, displaced, or broken pipe.
Presence of visible infiltration or other defects.
- (5) Correct defects as required prior to conducting leakage tests.

b. Air Testing: Perform air tests per ASTM C828 for clay or F1417 for plastic pipe at Contractor's option in lieu of exfiltration test for pipe sizes up to and including 42 inches in diameter and will include all lateral pipes to the property lines where applicable.

(1) Furnish all facilities required including:

Necessary piping connections.
Test pumping equipment.
Pressure gauges or manometers.
Bulkheads.
All miscellaneous items required.

(2) Obtain approval of equipment and acceptance of methods proposed for use.

(3) Conduct initial test on first run of pipe laid by each crew.

(a) Include a minimum of 10 lengths of pipe but not to exceed 500 feet.

(b) Perform before backfilling.

(c) Satisfactorily complete test before crew is permitted to continue pipe installation.

(4) Test remaining pipe in sections determined by Contractor and approved by Engineer.

(5) A wetted interior pipe surface on clay pipe is desirable and will produce more consistent test results.

(6) Plug ends of line and cap or plug all connections to withstand internal test pressures. Test plugs must be securely braced within the manholes.

(7) Introduce low-pressure air until internal air pressure is 4.0 psi greater than the average back pressure of ground water above the pipe invert.

- (8) Allow two to five minutes for internal air pressure and temperature to stabilize. Adjust pressure to 3.5 psi and start test.
- (9) Time required for pressure to decrease 1.0 psi from 3.5 to 2.5 psig greater than the average back pressure of any ground water above the pipe invert shall not be less than the minimum test time in the following table for the given diameters:

Minimum Test Times (Minutes) in Plastic Pipe			
<u>Nominal Pipe Diameter</u>	<u>Minimum Time (min.)*</u>	<u>Length for Min. Time</u>	<u>Time for Longer Length(s)*</u>
4 in.	3:46	597 ft.	0.380 L
6 in.	5:40	398 ft.	0.854 L
8 in.	7:34	298 ft.	1.520 L
10 in.	9:26	239 ft.	2.374 L
12 in.	11:20	199 ft.	3.418 L
15 in.	14:10	159 ft.	5.342 L
18 in.	17:00	133 ft.	7.692 L
21 in.	19:50	114 ft.	10.470 L
24 in.	22:40	99 ft.	13.674 L
27 in.	25:30	88 ft.	17.306 L
30 in.	28:20	80 ft.	21.366 L
33 in.	31:10	72 ft.	25.852 L
36 in.	34:00	66 ft.	30.768 L

* For 3.5 kPa (0.5 psi) pressure test drop, required test times shall be exactly one-half the values shown.

- (10) If the section of line to be tested includes more than one pipe size, calculate the test duration for the length of each size and add the test durations to arrive at the total duration of the testing period for the section.
- (11) Repeat test as necessary after all leaks and defects have been repaired.

2. Acceptance Tests for Pressure Pipelines:

- a. Perform hydrostatic pressure and leakage tests.
 - (1) Conform to AWWA C600 procedures. As modified herein.
 - (2) Perform after backfilling.
- b. Test separately in segments between sectionalizing valves, between a sectionalizing valve and a test plug, or between test plugs.
 - (1) Select test segments such that adjustable seated valves are isolated for individual checking.
 - (2) Contractor shall furnish and install test plugs.
 - (a) Including all anchors, braces, and other devices to withstand hydrostatic pressure on plugs.
 - (b) Be responsible for any damage to public or private property caused by failure of plugs
- c. Limit fill rate of line to available venting capacity. Fill rate shall be regulated to limit velocity in lines when flowing full to not more than 0.05 to 1 fps.
- d. Owner shall make water for testing available to Contractor at nearest source.
- e. Pressure and Leakage Test:
 - (1) Test pressure shall not exceed 1.25 times the working pressure at the highest point along the test section.
 - (2) Test shall be at least 2-hour duration. Maintain pressure throughout test within 5 PSI of the test pressure.
 - (3) Leakage test shall be conducted concurrently with the pressure test.
 - (4) Acceptable when leakage does not exceed that determined by the following formula (in English Units):
 - L = 0.0000075SD(P)^{1/2}, in which
 - L = allowable leakage, in gallons per hour
 - S = length of pipe tested, in feet
 - D = nominal diameter of the pipe, in inches
 - P = average actual leakage test pressure in psig.

- (5) These formulas are based on an allowable leakage of 11.65 gpd/mile/in of nominal diameter at a pressure of 150 psi.
- (6) When testing against a closed metal-seated valve, an additional leakage per closed valve of 0.0078 gal/hr/in of nominal valve size shall be allowed.
- (7) Repeat test as necessary.
 - (a) After location of leaks and repair or replacement of defective joints, pipe, fittings, valves or hydrants. All visible leaks are to be repaired regardless of the amount of leakage.
 - (b) Until satisfactory performance of test.
- (8) Engineer will witness pressure and leakage test.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

Measurement and payment will be made in accordance with Section 01210 - Measurement and Payment.

**** END OF SECTION 02535 ****

SECTION 02550

WATER PIPING SYSTEMS

PART 1 GENERAL

A. Description of Work:

This work consists of furnishing and installing water mains, service lines, and appurtenances. This includes all equipment, tools, materials, labor, and other incidentals to provide water mains and service lines complete and ready for immediate and continuous use. The work includes, but is not limited to, all necessary excavation, backfilling, compaction, testing, clean up, and restoration required for a complete installation of water mains, service lines, and appurtenances.

B. Related Work:

Section 02300 - Trench Excavation and Backfill

C. Definitions:

1. Distribution main means a water main that supplies one or more branch mains.
2. Fire Service Line means pipe and appurtenances delivering water from the City water distribution system to a building fire extinguishing system. Fire service lines may be located on private property or in public ROW and are owned, operated, and maintained by the property being served.
3. Fire hydrant assembly means the materials located from the city main to the fire hydrant including the tee or tap, piping, auxiliary valve hydrant and all other equipment constructed for the purpose of providing the fire hydrant.

4. "L" length for Joint restraining devices means the length of pipe from a fitting, valve, or feature that needs to have each pipe joint within that length restrained.
5. Private Fire Protection System means hydrants, valves, water pipes, and appurtenances, sprinkler systems, hose connections, and other equipment constructed for the purpose of providing fire protection for a building or group of buildings and supplied with water from a public water supply system. Private Fire Protection Systems are located on private property, although some components may be located in public ROW, and are owned, operated, and maintained by the property being served.
6. Transmission Main means a water main that supplies many tributary branches, serves a large area, and has few taps.
7. Water mains are those pipes of at least four (4) inches in diameter, which will be installed in public right-of-way or easements and will become a part of the City water distribution system and which will be owned, operated, and maintained by Lake Havasu City.
8. Water service line shall mean the line from the main to the meter box which is normally entirely located within the right-of-way and is owned and maintained by the City. The water meter is then connected to the property water distributing system and which the property owner is responsible for repair and maintenance.

D. Submittals:

1. Submittals shall be required per Section 01330 unless otherwise specified in the Plan Notes or Special Provisions. The term "Submittals" includes, but is not necessarily limited to, manufacturer's product data sheets of pipe, appurtenances, and fittings. Submittals shall be submitted for, but not limited to, the following items:
2. Fire hydrants, pipe, pipe fittings and their appurtenances including T- bolts, joint restraints, polyethylene encasement, and any other pertinent information concerning construction materials that the Engineer deems necessary for the review of the materials used on the project in accordance with the specifications and drawings.
3. Resubmittals shall be made in the same manner as submittals, with

changes clearly shown.

PART 2 MATERIALS

2.1 Pipe:

General: Pipe for water mains shall be Polyvinyl Chloride (PVC) or ductile iron with push on joints as specified on the plans or in the Special Provisions.

A. PVC

PVC pipe shall have bell ends with elastometric gaskets. Pipe joints shall use the Rieber joining system, which has the gasket formed into the pipe during the pipe manufacturing process. Installation procedures shall conform to AWWA C-605 Standards.

1. PVC pressure pipe, 4 inches through 12 inches, shall conform to the requirements of AWWA Specification C-900, Pressure Class 305 DR-14.
2. PVC pressure pipe, 14 inches through 36 inches, shall conform to the requirements of AWWA Specification C-905, Pressure Class 305 DR-14.

B. Ductile Iron Pipe

Ductile iron pipe shall conform to the requirements of AWWA Specifications C-150 and C-151, Pressure Class 350 unless specified otherwise on the plans or Detailed Specifications. Ductile iron pipe shall be coated on the outside with a bituminous coating 1-mil thick, minimum, and shall be cement-mortar lined in accordance with AWWA Specification C-104. Linings shall be full thickness to the end of the spigot and to the seat of the bell, or shall be tapered for a length of not more than two inches.

Rubber gasket joints for all Ductile Iron pipe shall meet the requirements of AWWA C-111. Installation procedures shall conform to AWWA C-600 Standards.

C. Water Service

1. 1" diameter service pipe shall be Type "K" soft copper tubing.
Type "K" soft copper tubing shall be US Government Type K

Soft Tubing. Tubing shall be supplied in 100 ft single or double pancake coils. The minimum center coil diameter shall be 16".

2. 1½" and 2" diameter service pipe shall be Polyethylene Plastic tubing. Polyethylene Tubing shall conform to AWWA C901 and have a pressure class of 200 psi.
3. Water service pipe with a diameter greater than 2" shall meet the above listed specifications for PVC or Ductile Iron pipe.

D. Water service at Injection Well Head (above grade)

1. 3" and smaller shall be schedule 40 carbon steel with threaded fittings.
2. Threaded fittings shall be 150-pound malleable iron, ASTM A197/A197M or ASTM A47/A47M, dimensions in accordance with ASME B16.3.
3. 4" and larger shall be schedule 40 carbon steel with ANSI 150# flanges or but-welded fittings.
4. Flanges shall be flat faced, ASTM A105/A105M, Class 150 with full face Garlock gaskets.
5. Flange bolts and studs shall be ASTM A193/A193M Grade B7 with ASTM A194/A194M Grade 2H heavy hex nuts.
6. Gaskets shall be inorganic aramid fiber with nitrile binder, CL150, 1/8-inch thick.

E. Insulating Flanges, Couplings, and Unions at injection well head:

1. Materials

In accordance with applicable piping material specified herein. Complete assembly shall have ASME B31.3 working pressure rating equal to or higher than that of joint and pipeline; galvanically compatible with piping.; resistant for intended exposure, operating temperatures, and products in pipeline.

2. Union Type, 2 Inches and Smaller
 - a. Screwed.

2.2 Fittings:

A. Water Main Fittings

1. All bolts and nuts shall be low-alloy, corrosion-resistant, high-strength steel in conformance with AWWA C111.
2. Fitting types applicable to this specification consist of bends, crosses, tees, reducers/increasers, plugs, caps, couplings, and sleeves.
3. Unless specified otherwise on the plans or Detailed Specifications the following fitting joint shall be provided:
4. Fittings 8 inches and smaller shall be push-on joint.
5. Fittings 10 inch and 12 inch shall be push-on joint or mechanical joint. If the fitting is going to be restrained then it shall be a mechanical joint.
6. Fittings 14 inches and larger shall be mechanical joint.
7. Push-on joint fittings shall be furnished with restraining lugs. The lug pattern for all sizes shall accommodate gripper-type restrainers.

B. Ductile Iron Water Main Fittings

1. Fittings shall be ductile-iron with 350-psi pressure rating and rubber gasket joints meeting all applicable requirements of the latest edition of AWWA C110, C111, and/or C153 Specifications. All fittings shall be coated on the outside with a bituminous coating 1-mil thick, minimum, and shall be cement-mortar lined in accordance with AWWA Specification C-104.

C. PVC Water Main Fittings

1. PVC fittings may be used in-lieu of ductile iron fittings for PVC pipe installations 12 inches and smaller. PVC fittings shall meet all applicable requirements of the latest edition of AWWA C900 Pressure Class 305 and AWWA C907. The

PVC fitting bell ends shall have elastometric gaskets. Installation procedures shall conform to AWWA C-605 Standards.

D. Couplings

1. Straight and transition couplings shall be as manufactured by Ford, Romac Industries, Inc., or approved equal and shall have ductile iron center rings and end rings meeting ASTM A536-80, Grade 65-45-12. Center rings shall be epoxy coated. Gaskets shall be SBR compounded for water service. Couplings for 12 inch and larger pipe shall be a minimum 12 inches in length.

E. Tapping Sleeves

1. Shall be ductile iron or stainless steel, flanged branch ends, with test plugs for pressure testing. The Sleeve shall be approved for use at pressures equaling or exceeding those of the pipe classification being installed. Ductile iron tapping sleeves shall be mechanical joint with totally confined end gaskets. Stainless steel tapping sleeves shall have a 304 stainless steel shell with SBR gaskets compounded for water service, a stainless steel flange, and shall have 304 stainless steel nuts, bolts, and washers.

2.3 Valve Boxes:

A. Gate Valves and Butterfly Valves:

1. Valve Boxes shall be Tyler Union 6850/60 series 2-piece screw-type construction, or East Jordan (EJIW) Series 8550 3-piece screw type or approved equal. Drop lids shall be marked "Water" and are to be of all-metal construction.

B. Valve Box Adaptor:

1. A valve box adaptor shall be installed on the valve bonnet prior to installing the valve box. The valve box adaptor eliminates shifting of the valve box, protects the coatings, centers the valve box, and seals the valve box with a resilient material. The adaptor shall be incidental to the valve

box installation. The valve box adaptor shall be installed per the manufacturer's recommendations. The valve box adaptor shall be a "Valve Box Adaptor II" as manufactured by Adaptor Inc., a "Valve Box Self-Centering Alignment Ring" as manufactured by American Flow Control, or an approved equal.

2. Extension stems shall be included on any valve greater than 3' in depth.

2.4 Fire Hydrants:

- A. Fire hydrants shall meet AWWA Standard C-502 and shall be Mueller Centurian, Clow Medallion, East Jordan 5CD250, American AVK Series 2700, or Waterous Pacer.
- B. All hydrants shall be Traffic model with 6 ft. bury and 6-inches mechanical joint inlets. Hydrants shall have 5 ¼ inches minimum valve openings, having O-ring packings and oil chamber to hold soft oil for stem thread lubrication, and shall have all operating parts, including valve seat, removable through the barrel. Barrel and upper standpipe shall be ductile iron with breaker flange and operating stem at ground level. A steel breakaway coupling shall be installed on the operating stem so that in case of breakage, no damage will result to the fire hydrant other than safety breakers.
- C. All internal and external ferrous surfaces shall be coated with a minimum of 6 mils of epoxy coating and at a minimum shall meet the requirements of AWWA C550 and AWWA C116 as applicable.
- D. All external ferrous surfaces below the fire hydrant "bury line" including the fire hydrant riser (barrel) sections and adjoining 90 degree ells shall be coated with HB Fuller IF1947T Red Oxide Powder, Tnemec Series 140 Pota- Pox Epoxy, or equal meeting the requirements of AWWA C550 and AWWA C116 as applicable.
- E. Additionally, an exterior coating of Polyurea/Polyurethan Hybrid Resin per American AVK Company, or equal may be added to the epoxy coatings required above.
- F. All exposed nuts and bolts below the breakaway (direct bury) shall be 304 stainless steel.
- G. Hydrants shall have a minimum extension adjustment capability

of 10 inches, in 6-inch increments.

- H. Drain valves shall be bronze and shall be positively operated by the main operating rod. All threads shall be National Standard threads. Operating nuts shall be 1 ½ inches point-to-flat, pentagon (National Standard). Valve stem for hydrant outlets shall open in a counter-clockwise direction. Fire Hydrants shall have an internal travel stop nut.
- I. Hydrants are to have two (2), two and one-half (2 1/2) inches nozzles and one (1) four and one-half- (4 1/2) inches steamer nozzle, all with National Standard threads. The minimum distance from the hydrant breaker flange to the centerline of the lower nozzle shall be sixteen (16) inches. Caps shall be nut type and shall be provided with chains. Hydrants shall be enamel Caterpillar yellow.
- J. All Fire Hydrants are to be ordered with barrel lengths of five (5) to eight (8) feet to facilitate their installation per the grades and lines shown on the drawings. Adjustments greater than eight (8) feet shall be accomplished using vertical bends (45, 22½, or 11¼) along the hydrant lead. The use of a Fire Hydrant Extension will not be an acceptable method of adjustment for a new Fire Hydrant. If the hydrant requires adjustment for final grade, then the Contractor shall replace the Fire Hydrant with a new Fire Hydrant with the correct barrel length or install the appropriate vertical bends on the hydrant lead.
- K. In cases where a Fire Hydrant Extension will be installed, the Contractor shall furnish the appropriate extension.

2.5 Service Lines, Valves and Fittings:

A. General

- 1. All fittings used shall meet current safe drinking water guidelines for lead free fittings, solder and flux. All service lines, valves and fittings shall meet AWWA Standard C-800 (ASTM B62 and B-584, UNS No C83600-85-5-5 and NSF/ANSI 61 Annex F). Shall have a 300 psi min. working pressure. All fittings shall meet the specified manufacturer's minimum material specifications or approved equal.

B. 1-inch services

1. 1-inch services shall be assembled as shown on the 1-Inch Service Connection LHC Standard Detail.
2. Service connection: the connection to the main shall consist of using a service saddle, corporation stop and un-spliced copper tubing in order to provide water to the meter box per Lake Havasu City Standard Details.
3. Service Termination: the service termination consists of connections made to the copper tubing that is stubbed out at the property line at the proposed meter box location. At the end of the tubing a 1-inch ball valve shall be placed, a short piece of 1 inch tubing (10-12 inches in length) to a service tee (if dual meters are necessary), then a ball meter valve shall be placed at each end of the tee branch. If a single service is to be installed a 1-inch angle meter stop shall be installed after the short piece of tubing.
4. The one-inch angle meter stop shall be a Ford BA43-342W or equal, the one inch service tee shall be a Ford T884-334-9 or equal, the ball meter valve shall be a B13-332W or equal and the 1 inch ball valve shall be a Ford B44-444 or equal.

C. 1-½ and 2 inch services

1. 1-½ and 2-inch services shall be assembled as shown on the detail named "Service Connection and Termination Details". All fittings shown shall meet the specified manufacturer's minimum material specifications or equal.
2. Service connection: the connection to the main shall consist of using a brass saddle and corporation stop in order to provide water to the meter box. The brass saddle shall be a Ford 202B Double Band Brass Saddle or equal. The corporation stop shall be a (Ford FB-1100-6 for 1 ½ inch) (Ford FB 1100-7 for 2 inch) or equal. Polyethylene Tubing shall be used and is described in the previous section "Water Service Pipe".
3. Service Termination: the service termination consists of

connections made to the polyethylene tubing that is stubbed out at the property line at the proposed meter box location. At the end of the tubing a Pack Joint Coupling (Ford C84-66 for 1 ½ inch) (Ford C84-77 for 2 inch) or equal shall be attached, a 1 ½ or 2-inch brass 90 degree street elbow shall then be attached, then a Ball Valve (Ford # B44-666W for 1 ½ inch) (Ford # B44-777W for 2 inch) or equal shall be attached.

D. Meter Boxes

1. For 1 inch service lines plastic meter boxes shall be Carson/ Brooks or equal. In Traffic areas meter boxes shall be Christy Fiberlite or equal.
2. For 1 ½ inch service lines the meter box shall be a Christy Fiberlite box # FL-36T Box 12 w/ lid # FL-36D01.
3. For 2-inch service lines (with no bypass) the meter box shall be a Christy Fiberlite box # FL 36T Box 18 w/ lid # FL36D01. For 2-inch service with a bypass the box shall be a NDS Pro Series Box # 126B with a Pro Series Lid with Reader Cover part # 126BCDMCIFB

E. Tapping Sleeves and Valves

1. Shall be used for service lines larger than 2 inches.

F. Concrete Thrust Blocks:

1. Thrust blocks shall be 4000 psi concrete as specified in Section 03300 of these specifications.

G. Joint Restraining Devices

1. **Joint Restraint Devices at Fittings shall meet the following requirements:**
 - a. In general, solid ring restraints shall be used whenever possible. Split restraints may be used when connecting to existing systems, for special cases, and when a solid ring restraint is not available for the application. All joint restraint devices shall be epoxy coated or poly-wrapped.

- 2. For DI pipe to DI push-on fittings:**
 - a. Fitting Joint Restraints shall be EBAA Series 1100HD, or equal.
- 3. For DI pipe to DI MJ fittings:**
 - a. Fitting Joint Restraints shall be EBAA MEGALUG Series 1100, Series 1100SD, or equal.
- 4. For PVC pipe to DI push-on fittings:**
 - a. Fitting Joint Restraints shall be EBAA Series 15PF00, or equal.
- 5. For PVC pipe to DI MJ fittings:**
 - a. Fitting Joint Restraints shall be EBAA Series 2000PV, Series 2000SV, Series 15PF00, or equal.
- 6. For PVC pipe to PVC push-on fittings:**
 - a. Fitting Joint Restraints shall be EBAA Series 2500, or equal.
 - b. Joint Restraint Devices at pipe bells shall meet the following requirements:
 - c. In general, solid ring restraints shall be used whenever possible. Split restraints may be used when connecting to existing systems, for special cases, and when a solid ring restraint is not available for the application. All joint restraint devices shall be epoxy coated or poly-wrapped.
- 7. For ductile iron pipe:**
 - a. The bell restraint shall be EBAA Series 1700, or equal.
 - b. In lieu of bell restraint devices, push on joints with the American Fastite Joint system with Fast Grip Gasket, or equal may be used when approved by the Engineer.
- 8. For PVC C-900 pipe:**

- a. The bell restraint shall be EBAA Series 1600, or equal.

9. For PVC C-905 pipe:

- a. The bell restraint shall be EBAA Series 2800, or equal.

H. Polyethylene Encasement:

1. Polyethylene Encasement (poly-wrap) shall meet AWWA C-105.
2. For ductile iron pipe, the encasement shall be 8-mil thickness, seamless tube, black ASTM D-1248, Type 1, Class C, Grade G-1. Joint tape for encasement shall be 3M Scotch-Wrap 50, or equal.

I. Combination Air Release Valves:

1. Air Release Valves shall be constructed in accordance with the LHC Standard Details. Air release valves shall be the size and style indicated on the drawings.

J. Tracer Wire System:

1. Tracer Wire shall be a direct bury wire that meets or exceeds the following requirements:
 - a. Conductor: 12 AWG 20 AMP solid strand soft drawn copper per ASTM B-3 soft annealed copper, or B-8 stranded/concentric lay 14 g (15 AMP). The breaking pounds of the wire shall be a minimum of 124 with an O.D. of 0.154". All wire shall be spark tested at 7500 VAC.
 - b. Insulation: Conductor shall be insulated with low density high molecular weight polyethylene insulation suitable for direct bury applications per ASTM D-1248. The minimum insulation thickness shall be 0.045". The color of the insulation shall be blue with a print line saying "WATER".
 - c. Splices and or Connectors: Splices and or Connectors should be capable of handling from 2 to 4 wires per connector and designated as "water- proof". PVC adhesives or sealing compounds are not acceptable.

d. Tracer Wire Access Box: Tracer wires shall be terminated using a small terminal box suitable for flush burial with a 2½ inches lockable cast iron top, integral stainless terminals and a minimum 12 in. ABS bottom section or as indicated on the plans.

e. Tracer Wire System Manufactures:

Tracing Wire – Kris Tech Wire Co. Inc., Paige Electric Corporation, or equal.

Splice Kit/Connectors -3M epoxy type compounds, fusible heat shrink tubing, 3M DBY connectors, or Snaploc LV 9000 direct bury wire connectors, or equals.

Tracer Wire Access Box – Valvco Pipe Tracer Wire Terminal Box or equal.

PART 3 EXECUTION

3.1 Materials Handling and Storage:

- A.** The Contractor shall be responsible for the safe handling and storage of all materials furnished by them and shall replace, at their expense, all such materials found defective in manufacture or damaged in transportation, handling, or storage.
- B.** Pipe, fittings, and accessories shall be loaded and unloaded by lifting with hoists or skidding to avoid shock or damage. Under no circumstances shall such materials be dropped. All material shall be stored in a neat and orderly manner. Pipe shall be stored, to the greatest extent possible, in unit packages or bundles and shall be handled to prevent stress to bell joints and prevent damage to bevel ends. In addition, materials shall be handled and stored in accordance with manufactures' recommendations.
- C.** If in the opinion of the Engineer damage or defects to the factory applied external coatings on steel or ductile iron pipe and fittings (including fire hydrants) can not be repaired, the Contractor shall replace the damaged items with new materials.
- D.** If approved by the Engineer, the Contractor may make repairs when

damage or defects occur in the factory applied external epoxy or "MEGABOND" coatings supplied on steel or ductile iron pipe and fittings (including fire hydrant risers and joint restraint devices). Coating repairs shall be made using a high build, low temperature applicable, fast cure, liquid epoxy coating. This epoxy coating material shall be DENSO Protal 7125 Repair Cartridge in packaged two component tubes with dispensing gun as manufactured by DENSO North America Inc.

- E. When high ambient temperatures (i.e., > 85 degrees F) occur or when metal surface skin temperatures are high (i.e., > 100 degrees F) such that use of the DENSO Protal 7125 Repair Cartridge may be difficult due to the very short handling time of the material, an alternate coating TC 7010 FS-Gray fast setting epoxy coating as manufactured by Tapecoat Co, shall be used.

3.2 Alignment and Grade:

- A. Pipe shall be laid true to the line and grade established on the Drawings. Where the Drawings indicate that the finished ground surface elevations are to be modified from the existing elevations by this or future construction, the Contractor shall exercise care to ensure that pipe, and appurtenances are placed to the elevations indicated on the drawings.

3.3 Underground Obstructions:

- A. The Contractor shall expose existing underground obstructions shown on the plans or located in the field and shall determine their elevations far enough in advance of pipe laying that the proposed water main can be installed without the use of fittings at or near the points of crossing. Wherever obstructions are encountered during the progress of the work and interfere with the proposed horizontal or vertical alignment of the pipeline, the contractor shall consult with the Engineer who may change the plans and order a deviation in the line and/or grade, or may arrange for the removal or relocation of the obstructions. The Contractor shall not deviate from plan line or grade without the Engineer's approval.

3.4 Water Main and Sewer Main/Storm Sewer Separation:

- A. Vertical Separation at Crossings:**

1. Water mains may cross above sanitary and storm sewers with a minimum vertical distance of twenty four (24) inches between the invert of the water main and the top of the sewer. In these cases where the water main is above the sewer and there is at least 24 in. of separation, then at the crossing no extra protection is required.
2. At all other crossings the sewer shall be encased in concrete a minimum of 6 inches thick per LHC standard details.

B. Water Main and Sewer Main/Storm Sewer Horizontal Separation:

1. Water mains shall be constructed with a minimum of 6 feet of horizontal separation from any existing sanitary or storm sewer or proposed sanitary or storm sewer. The 6 feet horizontal separation shall be the clear distance (water pipe sidewall to sewer pipe sidewall) and not the centerline distance between the utilities.

C. Unusual Conditions:

1. Where conditions prevent a minimum horizontal and vertical separation as set forth above, both water and sewer shall be protected 10' in both directions. Where a water main must cross under a sewer, a vertical separation of at least 18 inches between the bottom of the sewer and the top of the water main shall be maintained, under all conditions, with adequate support provided for the sewer lines to prevent them from settling on and breaking the water main.

D. Sewer Manholes:

1. No water pipe shall pass through, or come in contact with any part of the sewer manhole.

3.5 Installation:

- A. Trenching shall comply with the requirements of Section 02300 Trench Excavation and Backfill.
- B. Minimum Cover depth from top of pipe to finished grade shall be 3 ft.
- C. Cleaning shall be done as necessary so that the interior of all water

pipe and fittings are free from all dirt, cement, or other foreign material before installation. Contact surfaces shall be wire brushed immediately prior to jointing.

- D.** Pipe Cutting shall be done without damage to the pipe with saw or abrasive wheel and shall be smooth, straight, and at right angles to the pipe axis. Ends of pipe shall be dressed and beveled to remove roughness and sharp corners.
- E.** Laying and Joining of PVC pipe shall be in accordance with AWWA C-900, AWWA C905, and AWWA C605, and with the pipe manufacturer's instructions. Laying and joining of ductile iron pipe shall be in accordance with AWWA C-600, Installation of Ductile-Iron Water Mains and their Appurtenances, and with the pipe manufacturer's instructions, unless specifically required otherwise by these Specifications. All Ductile Iron Water Mains shall be constructed with a Polyethylene Encasement tube as specified herein. The polyethylene encasement tube shall be secured circumferentially at 2 feet horizontal intervals with tape during installation.
- F.** Pipe shall be laid with bell ends facing in the direction of laying. Each pipe length shall be inspected for defects prior to being lowered into the trench. All pipe and fittings shall be carefully lowered into the trench piece by piece by means of pipe slings to prevent damage to the pipe and/or coating. Full lengths of pipe shall be installed except where connecting to appurtenances and fittings. The Contractor shall leave an appurtenance or fitting with a full length of pipe whenever possible.
- G.** During construction, prior to filling and testing, no water shall be allowed to run into or through the pipe.
- H.** During the course of construction, a suitable stopper shall be kept in the end of the pipe so as to prevent any dirt and or water from entering during the progress of the work at all times. Any dirt, loose material or cement mortar, which may accumulate in the pipe, shall be removed prior to installation.
- I.** Push-on Joints: The spigot end of field cut piping shall be cut square and then beveled. Joint surfaces shall be cleaned and lubricated immediately before completing the joint.
- J.** Mechanical Joints: Joints shall not be over-tightened; if an effective seal is not obtained the joint shall be disassembled,

cleaned thoroughly and reassembled. Where joint restraint devices are used with a mechanical joint, the holes shall be carefully aligned to permit installation of harness bolts. At mechanical joints, a beveled PVC spigot may not be used. Rather a non-beveled spigot shall be used for insertion into mechanical joint.

- K.** Protection of the Work: Once in place, the pipe shall have its open end plugged to prevent soil, water, or other matter from entering the pipe.
- L.** Pipe Deflection: Deflection or bending of the pipe or deflection of the pipe joint (bell and spigot) shall not be permitted except as approved by the Engineer.
- M.** Fittings: Bends and tees shall be placed on a stable foundation, which may require the use of concrete pads of equal size or larger than specified for valves. Fittings may require thrust blocks and/or joint restraining devices. All fittings not epoxy-coated shall be poly-wrapped.
- N.** Couplings: Couplings shall be placed on a stable foundation and shall be wrapped in polyethylene encasement as specified herein. Couplings shall be approved by the pipe manufacturer for the use with the pipe and shall be installed according to the coupling manufacturer's recommendations.
- O.** Thrust Blocks: concrete thrust blocks may be required in lieu of restraints as approved by the Engineer at tees, crosses, horizontal bends, plugs, caps, fire hydrants, and similar locations as indicated. Refer to the subsection "Joint Restraining Device Installations" for situations and fittings that require the use of joint restraints in-lieu of concrete thrust blocks.
 - 1. Concrete thrust blocks shall have a thickness at the fitting equal to at least half the diameter of the pipe being installed but shall not be less than six (6) inches thick under any circumstances. They shall extend from the fitting to the undisturbed wall of the excavation. The Contractor shall insure that the concrete does not cover or render inoperable nuts or bolts on the fittings. All metal fittings, valves, or appurtenances shall be wrapped in polyethylene prior to pouring thrust blocks.
 - 2. Concrete Thrust blocks shall be allowed to cure for 48

hours prior to activating the water main. If the water main needs to be activated prior to the concrete curing (48 hours) then the water main shall be restrained using joint restraining devices. Prior to backfilling, thrust blocks shall cure for a minimum of four hours.

3. Thrust Blocks shall be installed as shown on the drawings and shall meet or exceed the minimum volume or bearing area requirements as specified on the drawings or specifications for the water pressures and soil conditions.
- P.** In muck, peat, or similar weak soils, thrust loads shall be resisted by using joint restraining devices or by removal of the soil and replacement with a material of sufficient stability to resist thrust loads as determined by the Engineer.
- Q.** Where prior approval of the Engineer is obtained, the Contractor may be able to substitute acceptable joint restraining devices for concrete thrust blocking. A condition of approval will be to address the potential corrosion issues associated with the use of joint restraints. The approval to substitute joint restraints is the Engineer's decision and approval may or may not necessarily be granted even if the potential corrosion issues are addressed.
- R.** Joint Restraining Device Installations: Joint Restraining Devices are required for the following installations: Refer to the plans for the definition of "L" length for Joint restraining devices.
1. All Valves 12 inches and larger and pipe joints within their corresponding "L" lengths shall be restrained.
 2. All High Pressure Valves (working pressures greater than 110 psi) and pipe joints within their corresponding "L" lengths shall be restrained.
 3. All Reducers/Increases and their corresponding "L" lengths shall be restrained.
 4. All Vertical Bends and pipe joints within their corresponding "L" lengths shall be restrained.
 5. All Water Main Lowering and pipe joints shall be restrained. Water Main Lowering restraint shall include restraining all joints within the fitting's corresponding "L" length plus restraining all pipe joints which lie between the start of

the lowering and the end of the lowering, regardless whether or not the pipe joint is located within the fitting's "L" length.

6. All Joint Restraint Devices shall be double poly wrapped and taped per the specifications for polyethylene encasement. If cathodic protection anodes are used, double poly wrap shall not be required. The polyethylene encasement ends shall be taped around the entire pipe diameter.
7. Joint Restraining Devices shall be installed per the manufactures' recommendations and for the appropriate water pressures and soil conditions as shown on the drawings or specifications.

S. Tracer Wire: Tracer wire shall be installed along with all water pipes as described below:

1. The tracer wire shall be extended along with the water main. The wire shall be installed along the top of the pipe and shall be securely anchored to the pipe every 4 feet horizontally with an adhesive tape. The tracer wire shall be extended along all water main branches and hydrant leads as well. At fire hydrant leads two (2) tracer wires (the upstream tracer wire and the downstream tracer wire) shall be brought along the lead and brought to the surface at the fire hydrant. The upstream and downstream tracer wire at fire hydrants shall not be tied together as this is intended to allow independent tracing of the downstream and upstream main.
2. Tracer wire shall not be installed with copper water service lines.
3. Tracer wire shall be installed with PVC water services. Tracer wire installed with PVC service lines shall be installed in accordance with water main requirements except that the tracer wire shall be brought to the surface at a service line valve location. Do not connect the water service tracer wire to the tracer wire on the main. Tracer wire installed along service lines shall be independent of the tracer wire installed along the main. This allows for only tracing the service line.
4. At locations where the PVC water service is not being replaced entirely, the contractor shall splice the new tracer wire to the existing tracer wire at the point of reconnection.

In instances where a PVC water service is not being replaced entirely and an existing tracer wire is not encountered, the Contractor shall coil approximately five (5) feet of wire at the reconnection location(s) to facilitate a future splice.

5. All tracer wire connections shall be accomplished through the use of "pig- tails". All splices and "pig-tails" shall be accomplished by stripping the wires to be connected, twisting the wires together, securing the connection by using an appropriately sized wire nut, and then preserving the splice or "pig-tail by using a direct bury splice kit.
6. The main line tracer wire shall run continuous along the main(s) from fire hydrant to fire hydrant but shall not be continuous at fire hydrants. At fire hydrants two tracer wires shall be installed, one wire is the main line wire from downstream of the fire hydrant and the second wire is the main line wire going upstream of the fire hydrant. The main line tracer wire shall not be interconnected at the fire hydrant or at the main. This is intended to allow independent tracing of the downstream main from the upstream main and vice a versa. Service line tracer wire shall not be connected to the main line tracer wire.
7. As a condition of project acceptance, Water Division personnel shall be able to successfully electronically trace all newly installed tracer wire/water mains. Utility maintenance personnel should be able to connect to tracing wires at every Fire Hydrant location and energize all water mains between that fire hydrant and the surrounding fire hydrants. The contractor is responsible for coordinating conductivity testing with Water Division personnel prior to finish surfacing activities. If the tracer wire does not function as intended, the contractor shall repair the system to the satisfaction of the Engineer.
8. The Engineer shall inspect all underground splices and "pig tails" prior to backfilling.

T. Fire Hydrants and Auxiliary Valves:

1. Fire Hydrants shall stand plumb and shall have their nozzles parallel with or at right angles to the street, with the pumper nozzle facing the street. At intersections, the

pumper nozzle shall face the higher classification street. Hydrants shall be set with the bottom of the breaker flange 2 inches above the finished ground elevation as shown on the Standard Details, resulting in the centerline of the lowest nozzle being at least 18 inches above finished grade. In no case shall hydrants be set closer than 4 feet from curb or edge of pavement; measured from outside of hydrant barrel to back of curb or edge of pavement.

2. The Contractor shall set each fire hydrant on a 8 inch x 12 inch precast concrete pad with a 4 inch thickness and shall place a minimum of 1/3 cubic yard of Aggregate Base around the lower part of the hydrant to at least six (6) in. above the drain port to provide a drainage area for the hydrant barrel. The Contractor shall insure that the drain port at the base of the hydrant is open to allow for the hydrant to drain properly when closed. Cast in place concrete may be used in lieu of the pre-cast pad if the hydrant lead is not charged for at least 48 hours and the drainage ports are maintained.
3. The hydrant barrel shall be poly wrapped to the ground surface and the poly wrap shall not cover up the weep holes.
4. A thrust block shall be installed between the hydrant valve chamber and the undisturbed trench wall. The thrust block shall meet the thrust block specifications herein.
5. An auxiliary valve matching the size of the fire hydrant lead and a valve box shall be installed on the fire hydrant lead. Auxiliary valves shall be installed as shown on the standard detail and shall be placed on a precast concrete block, or shall be fitted with a joint restraining device as approved by the Engineer. Cast in place concrete may be used in lieu of the pre-cast block if the hydrant and hydrant lead are not charged for 48 hours, and 4 hours cure time is allowed before backfilling.
6. Tracer wire shall be attached to the fire hydrant barrel section prior to backfill per LHC Standard Details.

Q. Valves

1. Valve interiors and adjacent piping shall be cleaned of

foreign material prior to making valve to pipe connection. Pipe/valve joints shall be straight and without deflection. All valves shall be encased in polyethylene per AWWA Standard C105 and as specified herein. Valves shall be placed and centered on a precast concrete anchor block. The trench surrounding valves shall be backfilled with Bedding Sand to one (1) foot above the valve. The Contractor shall check all operating mechanisms for proper functioning; valves which do not operate easily or are otherwise defective, shall be replaced by the Contractor at their expense.

2. Valves placed on dead-ends of mains with less than the required "L" length of pipe extending beyond the valve shall be restrained using the appropriate "joint restraining devices".

R. Valve Boxes

1. Valve boxes shall be installed straight and plumb directly over the valve stem and shall not be placed in direct contact with the valve. The top of the valve box shall be placed flush to ¼ inch below flush with the surfacing in paved or graveled areas and 1 inch - 2 inches above finished grade in non-paved surfaced areas. Where the Drawings indicate that the future grade at the valve location will be higher or lower than the existing grade at the time of valve installation, the Contractor shall provide the correct combination of extension pieces so that the valve box can be adjusted to the future finished grade without replacing the valve box.
2. A Valve Box Adaptor shall be installed on the valve bonnet prior to installing the valve box.
3. When shown on the drawings or specified, tracer wire shall be secured to the valve box section prior to backfill.

S. Tapping Tees for taps 4 inches and larger:

1. Where new 4 inch or larger service lines or mains are to be connected to an existing main, the Contractor shall furnish all material necessary for connection to the water main, as specified herein. The tapping tee shall be assembled in accordance with the manufacturer's instructions. Tapping sleeves shall be supported independently from the pipe prior to tapping and shall be provided with thrust restraint as

specified for other fittings. All tapping tees shall be poly wrapped.

T. Polyethylene Encasement:

1. All buried metallic items including fittings, service lines, valves, valve boxes, fire hydrants, pipe, and accessories, shall be encased in 8-mil thickness sheet polyethylene per AWWA Standard C105. The polyethylene sheet shall be installed per AWWA C105 and taped using 3M Scotchwrap 50 or equal. The polyethylene shall fully encase the fitting and appurtenances. Excess material shall be neatly trimmed away and all seams shall be taped. The transition between Ductile Iron and PVC shall be accomplished by sealing the ends of the polyethylene sheet and taping the material fully around the circumference of the pipe twice.
2. Polyethylene encasement shall NOT be used when the metallic piping is cathodically protected by the use of an anode.

U. Dewatering

1. If necessary, dewatering shall be accomplished as identified in the special provisions.

3.6 Disinfection:

A. Disinfection shall comply with the requirements of AWWA Standard C651, C605, C600, and ADEQ Engineering Bulletin #8. All new water mains and appurtenances shall be disinfected before they are placed into service. All water mains taken out of service for inspecting, repairing, or other activity that might lead to contamination shall be disinfected before they are returned to service.

B. Preventative Methods

1. The Contractor shall take precautions to protect the interiors of pipes, fittings, and valves against contamination. Pipe delivered for construction shall be strung so as to minimize the entrance of foreign material.
2. If dirt enters the pipe, it shall be removed and the interior of the pipe surface swabbed with a 1%-5% hypochlorite

disinfecting solution. If, in the opinion of the Engineer, the dirt remaining in the pipe will not be removed by flushing, the Contractor shall clean the interior of the pipe by mechanical means, such as a hydraulically propelled foam pig. Following mechanical cleaning the Contractor shall flush the line achieving minimum flushing velocities of at least 30 ft/s and shall then disinfect the pipe using either the continuous-feed or the slug method. Flushing a completed main will not be allowed as a method of cleaning sediment allowed to enter the pipe during construction.

3. All openings in the pipeline shall be closed with watertight plugs when pipe laying is stopped for any length of time. If water accumulates in the trench, the plugs shall remain in place until the trench is dry. If, for any reason, the water main is flooded during construction, it shall be cleared of the floodwater by draining and flushing with potable water until the main is clean. The section exposed to floodwater shall then be filled with chlorinated potable water that, at the end of a 24-hour holding period, will have a free chlorine residual of not less than 25 mg/l. The chlorinated water shall then be flushed from the main and after construction is completed, the main shall be disinfected using the continuous-feed or slug method.

C. Disinfectant

1. Unless specified otherwise in the Detailed Specifications or on the Drawings, or required by other provisions of this specification, disinfection shall be accomplished by the tablet method. The Contractor shall obtain the Engineer's approval prior to using a method other than the tablet method.
2. This method requires that the pipes and appurtenances be kept clean and dry. This method may not be used if the pipes and appurtenances are not kept clean and dry and in the event this happens, the Engineer must be contacted.
3. Tablets shall be 5-gram calcium hypochlorite tablets conforming to AWWA Standard B300 and shall contain between 65 and 70 per cent available chlorine. Tablets shall be fresh and shall be stored in a cool, dry, and dark environment to prevent loss of strength, which occurs upon exposure to the atmosphere.

4. Do not use calcium hypochlorite intended for swimming pool disinfection, as this material has been sequestered and is extremely difficult to eliminate from the pipe after the desired contact time has been achieved.

5. **Dosage:**

Unless otherwise specified, the Contractor shall place hypochlorite tablets in each section of water pipe installed, including the hydrant branch, according to the Table 1 below.

Table 1

NUMBER OF 5-GRAM CALCIUM HYPOCHLORITE TABLETS REQUIRED

(25 mg/l Dose)

Length of Pipe Section (Ft.)	4	6	8	10	12	16
13 or less	1	1	1	2	3	4
13 - 18	1	1	2	3	4	6
18 - 20	1	1	2	3	4	7
20 - 30	1	2	3	4	6	10
30 - 40	1	2	4	5	7	13

For Pipes 18 inches and larger refer to drawings or detailed specifications for disinfection requirements. The Engineer of Record is responsible for establishing the disinfection requirements for pipes 18 inches and larger.

6. **Placing Tablets**

a. Tablets shall be adhered to the inside top section of each pipe length using a food-grade adhesive, such as Permatex Form-A-Gasket No. 2 or Permatex Clear RTV Silicon Adhesive Sealant as manufactured by Loctite Corporation. Adhesives shall meet the requirements of a food-grade adhesive per either NSF/ANSI 51-2005: Food Equipment Materials or NSF/ANSI 61-2005: Drinking Water System Components – Health Effects. NSF/ANSI 61 lists several

adhesives that are approved for drinking water contact. It is recommended to use an adhesive that sets quickly and isn't reactive with the water main's composition or with the disinfectant tablet. There shall be no adhesive on the tablet except on the broad side attached to the surface of the pipe. If the tablets are attached before the pipe section is placed in the trench, their position shall be marked on the pipe section to indicate the pipe has been installed with the tablets at the top.

7. Filling and Contact

- a. The water main shall be filled slowly so that the water velocity is no greater than **one foot per second**. Precautions shall be taken to assure that air pockets are eliminated. The water shall be allowed to stand in the pipe for at least 24 hours. Valves shall be positioned so that the strong chlorine solution in the treated main will not flow into water mains in active service. The chlorinated water shall remain in the pipe for at least 24 hours. The Contractor shall notify the Engineer at the end of the 24-hour retention period prior to flushing to allow the Engineer to check the chlorine residual in the pipe. If the chlorine residual is less than 25 mg/l, the Contractor shall, at his expense, disinfect the water main again by the continuous-feed method or the slug method, as approved by the Engineer.

8. Flushing

- a. Within 48 hours of the end of the 24-hour retention period, the Contractor shall flush the heavily-chlorinated water from the main until the chlorine concentration in the water leaving the main is no higher than that prevailing in the system or is less than 1 ppm as determined by the Engineer. In addition to the above requirements, a **minimum flushing velocity of 3 feet per second** and flushing duration of one minute per 100 feet of pipe being flushed shall be achieved per Table 2.
- b. Flushing shall be done in accordance with AWWA C651. Flushing shall be accomplished through use of

hydrants or temporary fittings installed for the purpose; flushing through corporation stops and/or water service lines is prohibited. The Contractor shall obtain the Engineer's approval prior to installing special fittings for flushing.

- c. Flushing shall be conducted in such a way as to prevent contamination of existing water mains and/or water service lines and to minimize traffic and pedestrian hazards and nuisance conditions. When possible, flushing shall be to the nearest storm sewer or drainage way. Flushing to the sanitary sewer is prohibited.
- d. The Contractor will be responsible for any damage to fish and/or aquatic life caused by the chlorine residual. If Chlorine reaches or is detected in a stream, river, or other waterway the Contractor will be in violation for that discharge. For more information, contact ADEQ (602) 771-2300. Refer to section below, "Disposal of Chlorinated Water" for additional information regarding neutralizing chlorine residual.

Table 2

REQUIRED FLOW AND MINIMUM FLOW DURATION TO FLUSH PIPELINES

Pipe Diameter (In.)	Flow required to Produce 2.5 fps Velocity in Main* (Gpm)	Fire Hydrants		Minimum Flushing Duration (minutes Per 100 Feet of Pipe)
		Number Of Fire Hydrants	Outlet Size (In.)	
4	100	1	2-1/2	1
6	200	1	2-1/2	1
8	400	1	2-1/2	1
10	600	1	2-1/2	1
12	900	2	2-1/2	1**
16	1600	2	2-1/2	1**

Table 2 shows the rates of flow required to produce a velocity of 3.0 fps in pipes of various sizes and the minimum flushing duration per 100 feet of pipe length

For pipes 18 inches and larger refer to drawings or detailed specifications for flushing requirements.

* Requires a minimum 40-psi pressure in the main and the hydrant flowing to atmosphere.

** Assumes that the corresponding flow rate is being met.

After the water lines have been flushed, the contractor shall sample the lines. Two consecutive samples of water from the end of the disinfected/flushed line must be collected at least 24 hours apart.

9. Bacteria Testing:

- a. Per AWWA C651, the Contractor shall coordinate with Engineering to schedule sampling for coliform bacteria contamination. The samples must show the absence of coliform bacteria contamination before any taps may be made to the main or the main is activated and placed into service. Copies of all sample results shall be submitted to the Engineer within 48 hours of receipt thereof.

10. Disposal of Chlorinated Water:

- a. When, in the opinion of the Engineer or Contractor, the potential exists for chlorinated water to reach a stream, river, or waterway, the Contractor shall apply a neutralizing chemical to the water to be wasted to neutralize thoroughly the chlorine residual remaining in the water as listed in Appendix B of AWWA Standard C651. The Contractor will be responsible for any damage to fish and/or aquatic life caused by the chlorine residual. If Chlorine reaches or is detected in a stream, river, or other waterway the Contractor will be in violation for that discharge. For more information, contact ADEQ (602) 771-2300

3.7 Pressure and Leakage Test for Mains and service lines 4 inches or larger:

A. General

1. Pressure and leakage tests shall be performed on all newly installed water mains. The "Simultaneous Pressure and

Leakage Tests" will be used unless otherwise specified. The testing methods specified in this section are specific for water pressure testing only; air pressure testing is prohibited due to the catastrophic nature of potential failure.

B. Test Restrictions:

1. Per AWWA C605 the pressure shall be a minimum of 150% of the working pressure at the point of test, but not less than 125% (or 150 psi, whichever is greater) of normal working pressure at the highest elevation, whichever is greater. Test pressure shall not exceed pipe, valve, or thrust-restraint design pressures and shall not vary by more than 5 percent (plus or minus) for the duration of the test. The duration of the hydrostatic test shall be a minimum of two (2) hours.
2. The Contractor shall anticipate the need to conduct multiple tests in areas of varying topography and shall conduct testing in such a manner and sequence that the pressure requirements indicated above are achieved.

C. Pressurization

1. Before applying the specified test pressure, each valved section of pipe to be tested shall be slowly filled with potable water and all air expelled from the pipe, valves, fittings, and hydrants. Where City water is not available, the Contractor shall furnish sufficient potable water to fill and test the pipe. The specified test pressure, based on the elevation of the lowest point of the section under test and corrected to the elevation of the test gauge, shall then be applied by means of a suitable pump connected to the pipe in a manner satisfactory to the Engineer and shall be sustained for the specified time.
2. The test pump shall be equipped **with two (2) accurate pressure gauges**, between the pump shut-off valve and water main being tested, both to show the line pressure reading during testing. Pressure gauges shall have graduation marks, at minimum, for every 2 psi, and be capable of interpreting pressure readings within 1 psi. The pressure reading deviation between the two pressure gauges shall not be greater than 2.0 psi. During the pressure test the pressure loss indicated between the two gauges shall not deviate more

than 0.5 psi between the two gauges.

- D. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within five (5) psi of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by the drop in pressure for a test section over a period of time.

1. Allowable Leakage for PVC Pipe and Ductile Iron Pipe:

The PVC pipe shall be pressure and leakage tested in accordance with AWWA C605. The Ductile Iron pipe shall be pressure and leakage tested in accordance with AWWA C600.

No pipe installation, PVC pipe or ductile iron pipe will be accepted if the leakage is greater than that indicated in Table 3.

**Table 3
ALLOWABLE LEAKAGE IN GALLONS
PER HOUR PER 1000 FT OF PIPE
(GPH)**

Pipe. Dia. (in.)	Average Test Pressure (PSI)					
	50 psi (gph)	100 psi (gph)	150 psi (gph)	200 psi (gph)	250 psi (gph)	300 psi (gph)
4	0.19	0.27	0.33	0.38	0.43	0.47
6	0.29	0.41	0.50	0.57	0.64	0.70
8	0.38	0.54	0.66	0.76	0.85	0.94
10	0.48	0.68	0.83	0.96	1.07	1.17
12	0.57	0.81	0.99	1.15	1.28	1.40
14	0.67	0.95	1.16	1.34	1.50	1.64
16	0.76	1.08	1.32	1.53	1.71	1.87
18	0.86	1.22	1.49	1.72	1.92	2.11
20	0.96	1.35	1.66	1.91	2.14	2.34
24	1.15	1.62	1.99	2.29	2.56	2.81

30	1.43	2.03	2.48	2.87	3.21	3.51
36	1.72	2.43	2.98	3.44	3.85	4.21

The above table is based on the equation $L = SD(P)^{.5} / 148,000$ where
L= allowable make up water in gallons
D= nominal diameter of pipe in inches
P= average mainline test pressure (lb/ sq in) during mainline hydrostatic test
S= length of pipe tested

2. Acceptance shall be determined on the basis of allowable leakage. If any test of installed pipe discloses leakage greater than that specified in Table 3, the Contractor shall, at his own expense, locate and make approved repairs as necessary until the leakage is within the specified allowance. All visible leaks shall be repaired, regardless of the amount of leakage.
3. Any damaged or defective pipe, or appurtenances discovered following the pressure test shall be repaired or replaced with approved material at the Contractor's expense, and the test shall be repeated until it is within the specified allowance.

Example - A pipe segment is required to be tested at 140 psi. At the start of the test, pressure gauge #1 indicates an initial pressure of 141 psi and pressure gauge #2 indicates an initial pressure of 143 psi. Both gauges are recording the test pressure within 2 psi and therefore the test may proceed. After completing the two-hour test duration, pressure gauge #1 indicates a pressure of 134 psi and pressure gauge #2 indicates a pressure of 136.5 psi. The pressure drop for pressure gauge #1 is 7 psi and the drop for pressure gauge #2 is 6.5 psi. The two gauges record a pressure drop within 0.5 psi of each other therefore the deviation of the pressure reading between the two gauges is acceptable.

If the pressure test had indicated a pressure loss of less than 5 psi then the "Pressure and Leakage Test" would have been considered as passing. Because in this example, the pressure loss is more than 5 psi, the Contractor may elect to re-pressurize the system and repeat the two-hour test or the Contractor may elect to measure the quantity of water required to pressurize the pipe segment so that the pressure loss is less than 5 psi. For this example if the quantity of water required to pressurize the pipe segment so that pressure gauge #1 indicates a pressure of 137 psi (loss of 4 psi) and pressure gauge #2 indicates a pressure of 137.5 psi (loss of 4.5 psi), is within the

quantity of water allowed per Table 3 then the test would be considered as passing without having to repeat pressure test for two-hours.

3.8 Water Main Closures and Temporary Service

- A.** Water Main Closures shall be scheduled to minimize the inconvenience to the public. Consequently, water main closures shall be scheduled, between 9:00 A.M. and 4:00 P.M. Monday through Friday, when possible. Water main closures scheduled to begin prior to or continue beyond those times listed above, will require approval from the Engineer. In any case, water main closures will not be allowed until the Engineer gives his approval.
- B.** The Contractor shall provide notification of a proposed closure to the Water Division and any affected residents at least 48 hours prior to closure of any water main, unless a shorter time of notice is approved by the Engineer.

3.9 Operation of Valves

- A.** Only City personnel shall operate valves on existing water mains. The Contractor may operate valves on newly installed water mains that are under his control or closed valves with permission from Water Division.

4.0 Temporary Water Service

- A.** Private residences affected shall be provided by the Contractor when the water main closure will exceed eight (8) hours. The Contractor shall provide temporary water service for businesses upon request, regardless of the length of closure. When temporary service is to be provided to businesses, the Contractor shall obtain the name and phone number of a responsible contact person at each affected business and submit the information to the Engineer at least 48 hours prior to closure.

4.1 Abandonment and/or Salvage of Water Main and Appurtenances:

A. Water Mains

The Contractor shall seal all open ends of water mains to be abandoned with a concrete plug having a length equal to the diameter of the pipe being plugged.

B. Fire Hydrants

Fire hydrants and auxiliary valves are to be removed and salvaged, unless indicated otherwise on the drawings or Detailed Specifications, and shall be delivered by the Contractor to the City Utility Maintenance Shop in good working condition. Any damage to the hydrant and/or appurtenances as a result of removing, salvaging, and delivering, shall be repaired by the Contractor at no cost to the City.

C. Valves

Unless indicated otherwise on the drawings or Detailed Specifications, valves are to be removed, salvaged, and delivered by the Contractor to the City Utility Maintenance Shop without further damage.

D. Valve Boxes

The Contractor shall close the valve, remove and salvage the top sections of those water main valve boxes marked on the plans to be abandoned and shall deliver them to the City Utility Maintenance Shop. The resulting holes shall be backfilled and compacted to meet the requirements of these specifications and shall be resurfaced with the appropriate material; i.e. seed, gravel, asphalt, concrete, etc.

E. Others

When the drawings indicate items are to be removed or salvaged, the Contractor shall deliver the items to the City Utility Maintenance Shop in good working condition. Any damage to the items as a result of removing, salvaging, and delivering, shall be repaired by the Contractor at no cost to the City.

Unless an item is indicated as salvaged, the item will be considered a Contractor obligation to remove and dispose of.

4.2 Service Lines and Fittings:

- A. Service pipe:** Copper pipe shall be laid with sufficient waving as to prevent rupture in settlement. A "goose-neck" shape shall be constructed in the copper pipe leading from the corporation stop. Polyethylene, PVC and ductile iron service pipe shall be laid as

specified herein for water mains. Minimum cover depth for water service lines shall be four (4) feet. A minimum six (6) foot horizontal separation (outside diameter to outside diameter) shall be maintained between water service and sewer service lines. Tracer Wire shall be installed along with all Polyethylene and PVC service lines, as described in the specification section relating to tracer wire. Tracer Wire shall not be installed with copper service lines.

- B. Service saddles shall be installed for all connections to water mains 2 inch and smaller. Unless specified otherwise on the Drawings or Detailed Specifications, the Contractor shall furnish and install all service saddles.
- C. Corporation stops shall be provided by the Contractor. Corporation stops that are used to connect metal water services to metallic water mains shall be the isolator style. If a Contractor is installing a copper water service on private property but is not replacing the service to the main and the copper water service connects to a metallic water main then an insulating union for copper water services shall be installed near the curb stop or at the location where the new copper connects to the existing copper. This is only required for copper water services connecting to metallic mains.
- D. Service lines larger than 2 inches diameter shall be connected to the main with either an appropriately sized tapping sleeve and valve or a ductile iron tee as specified for water main fittings elsewhere in these specifications.
- E. Meter boxes shall be installed on all service lines and shall be located entirely within the public Right of Way. The top of the box shall be placed flush to ¼ inch below flush with the surfacing in paved or graveled areas and 1 - 2 inches above finished grade in non-traffic areas.
- F. Water Services: Where service lines are to be installed for undeveloped property or future buildings or additional services added to an existing building, the Contractor shall furnish all materials necessary for connection of new service lines to the water main. The termination point shall be at a meter box.
- G. Water Service Reconnections: The Contractor shall furnish all materials necessary for reconnecting service lines existing prior to

construction of a water main. On City projects, all permits and tapping fees will be waived.

- H. Inspection: All water service installations shall be inspected by the City prior to the Contractor backfilling the trench. The Contractor shall notify the City a minimum of four (4) hours prior to the time he needs the inspection. Any trench backfilled without being inspected and approved by authorized City personnel shall be re-excavated by the Contractor to expose the work for the required inspection. Discrepancies shall be corrected by the Contractor and re-inspected by City personnel.

4.3 Acceptance of Meter Valves and Main Valves:

- A. As a condition for project acceptance, all meter valves and water main valves within the project boundaries shall be in proper operating condition. City personnel will inspect and operate each valve as part of the final inspection. The Contractor shall correct any deficiencies discovered during the inspection

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

- A. No measurement will be made for this item.

4.2 Payment

- A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

END OF SECTION

SECTION 02551

REUSE LINE CONSTRUCTION

PART 1 - GENERAL

1.1 Description

A. Description of the Work

The work to be performed in accordance with this section includes all work associated with reuse line construction including valves, tapping sleeves, fittings, ARV valves and other appurtenances.

The work shall include the furnishing of all labor, tools, equipment, materials and installation of tracer wire, as well as performing all operations required to provide a complete item in accordance with the project plans and these specifications. All materials incorporated into the work shall be new unless otherwise indicated on the project drawings and the Contract Documents.

B. Related Work Specified Elsewhere

Trench Excavation and Backfill Section 02300

1.2 Quality Assurance

A. Reference Test Standards and Specifications

ASTM A48, Specification for Gray-Iron Castings

ASTM A307, Specification for Carbon Steel Bolts and Studs

ASTM B88, Specification for Seamless Copper Water Tube

ASTM B766, Specification for Electro-Deposited Coatings of Cadmium

ASTM D2466, Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40

ASTM D1785, Polyvinyl Chloride (PVC) Plastic Pipe,
Schedules 40, 80, 120

ASTM D2467, Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80

AWWA C104, American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

AWWA C105, American National Standard for Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids

AWWA C110, American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. through 48 In., for Water and Other Liquids

AWWA C111, American National Standard for Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings

AWWA C115, American National Standard for Flanged Ductile-Iron Pipe with Threaded Flanges

AWWA C151, American National Standard for Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids

AWWA C203, Standard for Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied

AWWA C213, Standard for Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipeline

AWWA C303, Standard for Reinforced Concrete Pressure Pipe, Steel Cylinder Type, Pretensioned, for Water and Other Liquids

AWWA C500, Standard for Gate Valves, for Water and Sewerage Systems

AWWA C504, Standard for Rubber-Seated Butterfly Valves

AWWA C509, Standard for Resilient-Seated Gate Valves, for Water and Sewerage Systems

AWWA C550, Standard for Protective Epoxy Interior Coatings for Valves

AWWA C600, Standard for Installation of Ductile-Iron Water Mains and their Appurtenances

AWWA C800, Standard for Underground Serviced Line Valves and

Fittings

AWWA C901, Standard for Polyethylene (PE) Pressure Pipe and Tubing, 1/2 inch through 3 inches for Water

Other miscellaneous AWWA and ASTM Standards

B. Hydrostatic Tests

All testing shall be in accordance with AWWA Standards. Perform pressure and leakage tests on all pipe or any valved section of it or both as required. Furnish all necessary assistance, equipment, and material and make all taps in the pipe as required. Utilize a saddle and corporation stop on all taps. All tests shall be witnessed by the **ENGINEER**.

For short segments of mainline pipe repair or replacement, 100 feet in length or less, where it is imperative that water service be restored immediately, the **ENGINEER** will waive pressure test requirements. When so approved, the joints, valves and fittings will remain exposed for pressurization to allow visual inspection for leaks. Upon satisfactorily passing visual inspection, backfill remaining trench in accordance with these specifications.

Furnish the following equipment and materials for the tests:

- 1 - 55 gallon drum.
- 1 - 5 gallon graduated container.
- 2 - Pressure gauges, liquid filled, 1% accuracy, 2-1/2 inch dial min. complete with surge and vibration dampeners.
- 1 - Hydraulic pump with air chamber. Suitable hose and suction pipe as required Suitable check valves and shut-off valves.

Conduct tests after the trench has been backfilled or partially backfilled with the joints left exposed for inspection. Where any section of pipe is provided with concrete reaction blocking, the pressure test shall not be made until at least five (5) days after the concrete reaction blocking is installed. If high-early cement is used for the concrete thrust blocking, the time may be cut to two (2) days instead of the five (5) previously specified.

Conduct the pressure test in the following manner: After the pipe has been backfilled or partially backfilled as specified, fill the pipe with water.

1. Test Pressure

Test pressure is in accordance with AWWA C600 and shall be one hundred eighty-eight (188) psig unless otherwise indicated on the plans or in the Contract Documents. Measured at the lowest elevation on the test section.

2. Duration

A minimum of two (2) hours.

3. Expelling Air

Before applying the specified test pressure, expel all air from the pipe.

4. Procedure

Slowly fill each valved section of pipe with water to fill the pipe and expel all air. Connect the test pump to the pipe in a satisfactory manner and operate the pump until the specified test pressure is achieved.

Valve off the pump and hold the pressure in the line for the test period. The pressure shall not vary more than five (5) percent from the specified test pressure during the test period. In the event that the pressure falls below the test pressure, the pump shall be operated to raise the pressure back to the specified test pressure. At the end of the specified time period, operate the pump to raise the pressure back to the specified test pressure. Measure all water necessary to restore the test pressure during and after the testing time period and include as leakage. The pump suction shall be placed in a graduated container so that the amount of water required to restore the test pressure can be measured accurately. Test equipment, which drips or leaks is not acceptable for pressure testing and will be rejected.

Mainline Hydrostatic Test

Make-up is defined as the total quantity of water necessary to maintain and restore the specified test pressure during and at the end of the test period. Water lines will not be accepted for payment until the makeup water is less than the number of gallons per hour as determined by the following formula:

$$L = \frac{SD(P)^{1/2}}{148,000}$$

in which:

L = Allowable makeup water in gallons per hour

D = Nominal diameter of pipe in inches

P = Average test pressuring during the mainline hydrostatic test in pounds per square inch

S = Length of pipe tested in feet

Water lines which do not comply with the specified makeup water requirements will be rejected, and the **CONTRACTOR** shall, at his own expense, locate and repair the defective joints or pipe sections until the makeup water is within the specified allowance. ALL VISIBLE LEAKS SHALL BE REPAIRED REGARDLESS OF INITIAL TEST RESULTS AND SHALL BE RETESTED AFTER REPAIRS ARE MADE.

1.3 Submittals

A. Certificate of Compliance and Descriptions

1. Pipe
2. Valves
3. Fittings
4. Valve Boxes
5. Miscellaneous appurtenances

1.4 Product Delivery, Storage and Handling

Take all necessary precautions whether unloading, storing, and placing all equipment and components so as not to damage the product. All products with visible damage are subject to rejection.

PART 2 - MATERIALS

2.0 General

All materials utilized in the construction of reuse facilities, whether it is the replacement or relocation of existing facilities or the construction of new facilities, shall be new, previously unused, and in excellent condition. No existing materials shall be incorporated into the work, either by relocation or replacement of existing facilities, unless specifically stated on plans and indicated in the Contract Documents as directing the Contractor to reuse existing materials.

2.1 Pipe and Fittings

A. Ductile Iron Pipe

AWWA C151, with the thickness class indicated on the drawings or as recommended by the pipe manufacturer, but not less than the requirements of thickness Class 51 for push-on or mechanical joint pipe

1. Push-on and Mechanical Joints, AWWA C111.
2. Threaded Flanges, Ductile Iron, AWWA C115. DIP requiring threads for flanges shall not be less than that required by thickness Class 53.
3. Flange Bolts and Gaskets, AWWA C115, Appendix A.

B. Concrete Cylinder Pipe

Concrete cylinder pipe shall be manufactured and tested in accordance with AWWA C303. The average circumferential stress in the steel cylinder and bar or wire reinforcement of the pipe at design pressure shall not exceed 16,500 psi, nor 50 percent of the minimum yield strength of the steel used in the cylinder.

C. Ductile Iron Fittings

AWWA C110. Cement mortar lined and seal coated.

D. Polyvinyl Chloride (PVC)

Pipe shall conform to requirements of AWWA C900 (pressure-rated pipe, DR 25) for pressure pipe and fabricated fittings, 4 inch through 12-inch nominal pipe sizes. The pipe shall be made of PVC

plastic having a cell classification of 12454-B as defined in ASTM D1784.

E. Welded Steel Fusion Bond Epoxy Lined and Coated Pipe

Pipe shall conform to requirements of ASTM A381-96 for pressure pipe and fabricated fittings, for pipe 16 inches and larger. The pipe shall be made of Steel and will have fusion bond epoxy lining and coating per AWWA C213-01.

2.2 Couplings and Adapters

A. Flanged Coupling Adapter

Ductile iron or steel with flange template compatible with adjacent fitting or valve. Minimum working pressure rating not less than the adjacent valve, fitting or piping. Factory furnished with fusion bonded epoxy coating per AWWA C213. FCA shall be manufactured by Rockwell, Dresser or approved equal.

B. Flexible Couplings

One cylindrical steel middle ring, two steel follower rings, two resilient gaskets and high grade, high strength nuts and bolts. Factory furnished with fusion bonded epoxy coating per AWWA C213. Coupling shall be as manufactured by Rockwell, Dresser or approved equal.

2.3 Valves

A. Valves, 12 Inch and Larger

1. Butterfly Valve

AWWA C504, minimum 150 psig working pressure, NRS, 2 inch square operating nut, left hand opening, counter clockwise, EPDM seat, stainless steel valve shaft, ductile iron disk with stainless steel disk edge. Installed with valve shaft in horizontal position.

Factory applied minimum 6 mil dry film thickness epoxy coating on all interior and exterior ferrous surfaces. Epoxy coating per AWWA C550.

B. Gate Valves, 3 Inch to 10 Inch

AWWA C509, minimum 150 psig working pressure, resilient seated wedge, non-rising stem, O-ring packing, 2 inch square operator nut for buried service. Left hand opening, counter clockwise.

Factory applied minimum 6 mils dry film thickness, epoxy coating on all interior and exterior ferrous surfaces. Epoxy coating per AWWA C550.

C. Gate Valves, 2 Inches and Smaller

AWWA C800, minimum 150 psig working pressure. Threaded, all bronze, double disk, non-rising stem.

2.4 Valve Box and Riser

Valve boxes shall be Tyler Pipe/Union Foundry for 6850/60 series or an approved equal.

A. Operating Nut Less Than 3 Feet Below Surface

Valve boxes shall be two (2) piece or three (3) piece, depending on the manufacturer's recommendations. Valve boxes shall be the screw-type with a minimum 5-1/4 inch diameter shaft utilizing a standard drop lid. Valve boxes including upper part, lower part, extensions and lids shall be cast iron. The valve box shall be specifically designed for the type of valve for which it is used. The valve box shall be of proper length for the depth of cover. The word "REUSE", shall be cast into the top of the Lid.

B. Operating Nut Greater Than 3 Feet Below Surface

Riser pipe shall be minimum six (6) inch diameter Ductile Iron, Class 51 or an approved equal. Frame and cover, per ASTM A48, Class 30 painted or dipped with asphalt paint. Provide extension stem per detail. The word "REUSE" shall be cast into the top of the lid.

2.5 Combination Air Release Valves

Single body units built for 150 psi service. Design to vent large quantities or air during filling, opening to atmosphere during draining, and venting small amounts of air when pipeline is under pressure. Combination air release valve shall be the size and style indicated on Drawings, or approved equal.

2.6 Bolts and Nuts

A. Pipe Larger than 12-inches

ASTM A307, Grade B, carbon steel or ASTM A276, stainless steel.

B. Pipe 12 inches and smaller

ASTM A276, stainless steel or ASTM A307, Grade B, cadmium plated carbon steel per ASTM B766, minimum plating thickness of 0.0002 inches Class 2A threads, Class 2B threaded nuts or AWWA C111 cast iron tee head bolts with hexagon nuts.

2.7 Below Ground Corrosion Protection

A. Ferrous flanges, bolts, nuts, anchor bolts, rods, etc.

AWWA C203, hot coal tar epoxy minimum thickness 1/16 inch, with pan or cocoon method, complete coverage. The coal tar epoxy coating will not be required on stainless steel components.

B. Ferrous Pipe Polyethylene Protective Wrap

AWWA C105 plastic tube, 8 mils minimum, virgin polyethylene, purple. Secure with 2 inch wide pressure sensitive plastic tape, 10 mils minimum.

2.8 Concrete

Per Specification Section 3300, Concrete Structures, compressive strength as indicated on the plans but not less than 2500 psi.

PART 3 - EXECUTION

3.1 Preliminary Investigation of the Work

Verify all preliminary work has been performed in accordance with these Specifications prior to performing water line construction.

3.2 Minimum Cover

Measure minimum cover from existing or proposed finish grade of pavement or natural ground, whichever is deeper. Place to depth as shown on the plan. If not shown, minimum cover from finish grade shall be as follows:

- A. Pipe less than 12 inches, minimum cover of 36 inches.**
- B. Pipe 12 inches or larger, minimum cover of 48 inches.**

3.3 Trench Excavation and Backfill

Per Specification Section 02300.

3.4 Installation

A. Ductile Iron Pipe

AWWA C600

B. General

1. Alignment and Grade

Lay pipes to the line and grade indicated on the plans. Place fittings and valves at the required locations. Plumb and level all equipment, fittings, valve stems, etc. Maximum deviation from alignment and grade shall not exceed 0.1 feet - horizontally or vertically. Where a deviation from the alignment or grade occurs, the pipeline will be gradually realigned to the proper location. Maintain positive or negative slopes as indicated on plans. Avoid making high spots in the pipeline. If a high spot cannot be avoided, an air release assembly must be installed at the high point.

2. Pipe Installation

Examine piping and appurtenances prior to placement. Replace defective materials. Prevent foreign materials from entering the pipe while it is being placed. No debris, tools, clothing or other materials shall be placed in the pipe at any time. As each joint of pipe is placed in the trench, assemble that joint and adjust the pipe to the proper line and grade. Install polyethylene encasement on ferrous pipe and fittings per ASTM C105 as pipeline placement proceeds.

3. Joint Assembly

Grind smooth and bevel cut ends and rough edges. Repair interior linings and coatings as required. Thoroughly clean bell and spigot ends, paying particular attention to the gasket and gasket recess. Use lubricant as recommended by the manufacturer, which meet the requirements of AWWA C111. Torque mechanical and flange joint bolts to specified torque. Do not exceed specified joint deflection.

C. PVC Pipe

AWWA C605-94

D. General

1. Alignment and Grade

Lay pipes to the line and grade indicated on the plans. Place fittings, valves, and hydrants at the required locations. Plumb and level all equipment, fittings, valve stems, etc. Maximum deviation from alignment and grade shall not exceed 0.1 feet - horizontally or vertically. Where a deviation from the alignment or grade occurs, the pipeline will be gradually realigned to the proper location. Maintain positive or negative slopes as indicated on plans. Avoid making high spots in the pipeline. If a high spot cannot be avoided, an air release assembly must be installed at the high point.

2. Pipe Installation

Examine piping and appurtenances prior to placement. Replace defective materials. Prevent foreign materials from entering the pipe while it is being placed. No debris, tools, clothing or other materials shall be placed in the pipe at any time. As each joint of pipe is placed in the trench, assemble that joint and adjust the pipe to the proper line and grade. Tracing Wire is required for all PVC or C900 force mains. For metal-detection equipment to assist in locating the line after installation, a tracer wire (Tapped/Attached to Pipe) or coated metal strip should be placed immediately above the initial backfill material and directly over the pipe. The tracer wire shall be insulated for protection from corrosion and be 12 or 14 gauge. Alternatively, plastic-coated metal strips that have been specifically designed for this purpose shall be used.

3. Joint Assembly

Inspect the bell and remove any foreign matter. Clean off the spigot end of the pipe and apply lubricant. Place the beveled end in the companion bell and provide straight alignment. Push the pipe straight into the bell with a block and bar until the stop mark on the spigot is even with the end of the bell.

E. Welded Steel Fusion Bond Epoxy Lined and Coated Pipe

AWWA C206-03

F. General

1. Alignment and Grade

Lay pipes to the line and grade indicated on the plans. Place fittings, valves, and hydrants at the required locations. Plumb and level all equipment, fittings, valve stems, etc. Maximum deviation from alignment and grade shall not exceed 0.1 feet - horizontally or vertically. Where a deviation from the alignment or grade occurs, the pipeline will be gradually realigned to the proper location. Maintain positive or negative slopes as indicated on plans. Avoid making high spots in the pipeline. If a high spot cannot be avoided, an air release assembly must be installed at the high point.

2. Pipe Installation

Examine piping and appurtenances prior to placement. Replace defective materials. Prevent foreign materials from entering the pipe while it is being placed. No debris, tools, clothing or other materials shall be placed in the pipe at any time. As each joint of pipe is placed in the trench, assemble that joint and adjust the pipe to the proper line and grade.

3.5 Polyethylene Pipe Wrap

AWWA C105, Method A. Place properly sized polywrap on each section of pipe prior to joining. Cut polyethylene tube 2 feet longer than length of pipe. Fold back excess over top of pipe and secure with tape at quarter points along the length of the pipe. Secure to previous section with 360 degree tape wrap. Polywrap shall be purple in color and conform to Arizona Code

R18-9-602.G.1

3.6 Valves and Valve Boxes

AWWA C600. Inspect valve and appurtenances. Check valve for direction of opening, freedom of operation, cleanliness and seating surfaces. Replace defective materials. Install valve on concrete slabs as detailed. Wrap valve and valve joints with polyethylene encasement per AWWA C105.

Place and plumb valve riser pipe as indicated, clean all rocks and debris from around operating nut. Set box frame to provide a minimum of 2 inches of travel between the box and the riser.

At the end of every day, valve boxes that are not clearly visible shall be marked with a stake indicating the location and depth in which to find the valve.

3.7 Connection to Existing Mains

Any connection to an existing main shall include a new valve. Expose existing pipe to be connected and verify location, size and type prior to constructing new mainline. The locations, sizes and depths of existing mains indicated on the plans are approximate only. Provide new reuse line as indicated on the plans prior to making connection to the existing reuse line. Coordinate connection to existing main with **OWNER** at least 48 hours in advance. The **OWNER** will operate existing valves but will not guarantee a complete shut down.

3.8 Mainline Pipe Replacement, 100 Feet in Length or Less

Gate valves shall be provided at the locations indicated on the plans prior to performing any work on the main line pipe. The maximum time allowed to install the gate valves shall be two hours unless separate arrangements have been made by the **CONTRACTOR** to supply water to the affected properties. After the gate valves have been accepted by the **ENGINEER**, City forces will close the valves and replacement of the main line pipe by the **CONTRACTOR** may proceed. Remove and replace piping per plans and these specifications. Place thrust blocking, temporary blocking, tie rods and backfill as required to hold the line in place for pressurization. Leave all joints, valves and fittings exposed for visual leakage inspection during pressurization. Upon approval of visual leakage inspection, complete placement and backfill per these specifications.

3.9 Anchor, Thrust Blocking and Joint Restraint

Place anchor, thrust blocking and joint restraint to MAG Specifications and Details 301, 302, 380, and 381 for all tees, plugs, caps, and bends and other locations where unbalanced forces exist. Place blocking against undisturbed ground surfaces. Do not place blocking or joint restraints until polyethylene wrap is secured in place. Place blocking neatly with straight sides and so joint bolts are accessible for future repairs.

3.10 Reuse line Crossings

A. Reuse Line Crossing Sewers

When constructing reuse lines near sewer pipe, construction shall be in accordance with Arizona Administrative Code R18-4-502 Minimum Design Criteria:

1. A reuse line shall not be placed:

- a.** Within six feet, horizontal distance, and less than two feet, vertical distance, above the top of a sewer main unless extra protection is provided. Extra Protection shall consist of constructing the sewer main with mechanical joint ductile iron pipe or with slip-joint ductile iron pipe if joint restraint is provided. Alternate extra protection shall consist of encasing both the water and sewer mains in at least six inches of concrete for at least ten feet beyond the area covered by this subsection.
- b.** Within two feet horizontally and two feet below the sewer main.

2. Minimum Separation

No reuse pipe shall pass through or come into contact with any part of the sewer manhole. The minimum horizontal separation between reuse mains and manholes shall be six feet measured from the center of the manhole.

B. Reuse Line Crossing Water Lines

When constructing reuse lines near water lines, or water lines near

reuse lines, construction shall be in accordance with Arizona Administrative Code R18-4-502 Minimum Design Criteria:

1. A water main shall not be placed:

- a. Within six feet, horizontal distance, or less than two feet vertical distance above the top of a reuse line unless extra protection is provided. For PVC pipe, Extra Protection shall consist of encasing both the water and reuse mains in at least six inches of concrete for at least ten feet in both directions of the crossing. When using mechanical joint ductile iron pipe or slip on joint ductile iron pipe, joint restraint is acceptable.
- b. Within two feet horizontally and two feet below the bottom of reuse main.

PART 4 - MEASUREMENT AND PAYMENT – Not Applicable

**** END OF SECTION 02551 ****

SECTION 09900

PROTECTIVE COATINGS

PART 1 - GENERAL

1.1 Summary

- A. This Section includes coating of exterior and interior surfaces throughout the Project and which are listed in PART 2 with systems specified in PART 2.
- B. Coating systems include surface preparation, prime coat (first coat), finish coats (second and third coats), inspection, cleaning, and touch-up of surfaces and equipment. Shop preparation, prime coat, and finish coats to be shop-applied, may be specified elsewhere or referenced to this Section so that a complete system is specified and coordinated.
 - 1. Where surface preparation and first (prime) coat are specified in other Sections to be shop-applied, such as for structural steel, or equipment, only the touch-up and finish coats are a part of field painting. Surface preparation is the required degree of preparation prior to application of first (prime) coat regardless if done in shop or field.
 - 2. If materials are provided without shop primer then surface preparation, first, second, and third coats are a part of field painting.
 - 3. Concealed surfaces are generally not required to have finish-coats unless otherwise specified, but prime coat should be applied and touched up prior to concealment.
 - 4. Where Equipment and Materials are provided with shop-applied finished coating system, only touch-up is a part of field painting.
 - 5. Refer to applicable Sections to determine whether surface preparation and first coat, or complete coating system, is to be shop-applied.

C. Related Work Specified Elsewhere

1. **Shop Painting and Coatings:** All applicable Divisions.
2. **Factory Prefinished Items:** All applicable Divisions.

D. Colors

1. Color of finish coatings shall match accepted color Samples.
2. When second and finish coats of a system are of same type, tint or use an alternate color on second coat to enable visual coverage inspection of the third coat. When first and second coats only are specified and are of same or different types, tint or use an alternate color on first coat to enable visual coverage inspection of the second coat.
3. Contract Price shall include the following approximate number of finish coat colors to form a basis for bidding:
 - a. **Epoxy:** Eight colors, with 50% deep tone colors.
 - b. **Ceramic:** Two colors, with 50% deep tone colors.

1.2 Quality Assurance

A. Reference Standards and Specifications

1. American National Standards Institute (ANSI)

ANSI A 13.1 - Scheme for the Identification of Piping Systems.

ANSI Z 53.1 - Safety Color Code for Marking Physical Hazards.

2. American Society for Testing and Materials (ASTM)

ASTM D4258 - Surface Cleaning Concrete for Coating.

ASTM D4261 - Surface Cleaning Concrete Unit Masonry for Coating.

3. Society for Protective Coatings (SSPC) Surface Preparation Specifications

SP1 - Solvent Cleaning: Removes oil, grease, soil, drawing and cutting compounds, and other soluble contaminants.

SP2 - Hand Tool Cleaning: Remove loose material. Not intended to remove adherent mill scale, rust, and paint.

SP3 - Power Tool Cleaning: Removes loose material. Not intended to remove all scale or rust.

SP5 - White Metal Blast Cleaning: Removes all scale, rust, foreign matter. Leaves surface gray-white uniform metallic color.

SP6 - Commercial Blast Cleaning: Two-thirds of each square inch free of all visible residues; remainder only light discoloration.

SP10 - Near-White Metal Blast Cleaning.

SP11 - Power Tool Cleaning to Bare Metal.

4. American Waterworks Association (AWWA)

Standard for Painting and Repainting Steel Tanks, Stand-Pipes, Reservoirs, and Elevated Tanks for Water Storage, D-102.

5. American Concrete Institute (ACI)

ACI 515.1R Guide to the Use of Waterproofing, Damp-proofing, Protective and Decorative Barrier Systems for Concrete

B. Include on label of container:

1. Manufacturer's name, product name, and number.
2. Type of paint and generic name.
3. Color name and number.

4. Storage and temperature limits.
5. Mixing and application instructions, including requirements for precautions which must be taken.
6. Drying, recoat, or curing time.

C. Prepainting Conference

1. Before Project field painting starts, representatives for the Owner, Contractor, coating applicator, and coating manufacturer's technical representative shall meet with Engineer.
2. Agenda for the meeting will include details of surface preparations and coating systems to ensure understanding and agreement by all parties for compliance.

D. Warranty

1. The coating manufacturers and applicators shall warrant their products and applications respectively against defects for a period of five (5) years under normal use. The warranty shall be in printed form.

E. In the event a problem occurs with coating system, surface preparation, or application, coating applicator and coating manufacturer's technical representative shall promptly investigate the problem and submit results to Engineer.

F. Stated VOC shall be unthinned maximum VOC certified by manufacturer.

G. A coating report shall be completed daily by Contractor at each phase of the coating system starting with surface preparation. These shall be submitted on the form attached at the end of this Section.

1.3 Submittals

- A.** Submit as specified in Section 1330.
- B.** Includes, but not limited to, the following:

1. Schedule of products and paint systems to be used. Schedule shall include the following information:
 - a. Surfaces for system to be applied.
 - b. Surface preparation method and degree of cleanliness.
 - c. Product manufacturer, name, and number.
 - d. Method of application.
 - e. Dry-film mil thickness per coat of coating to be applied.
2. Color charts for selection and acceptance.
3. Technical and material safety data sheets.
4. Certification by coating manufacturer(s) that all coatings are suitable for service intended as stated on each coating system sheet. If manufacturer has an equivalent product as that specified, but it is not suitable for the intended purpose, he shall submit the recommended product for approval at no increase in cost, and state reasons for substitution.
5. Contractor shall certify in writing to the Engineer that applicators have previously applied all the systems in this Specification and have the ability and equipment to prepare the surfaces and apply the coatings correctly.

1.4 Delivery, Storage, and Handling

A. Delivery of Materials

1. Deliver in original unbroken sealed containers with labels and information legible and intact. Containers shall also have correct labels with required information.
2. Allow sufficient time for testing if required.
3. Open and mix on the premises and in the presence of the Engineer. Any rejected material shall be at once removed from the premises. Colors shall be as selected by Engineer.

B. Storage of Materials

1. Store only acceptable materials on Project site in enclosed structures to protect them from weather and excessive heat and cold. Store in accordance with County and State Safety Codes.
2. Provide separate area and suitable containers for storage of coatings and related coating equipment.
3. Dispose of used or leftover containers, thinners, rags, brushes, and rollers in accordance with applicable regulations.

1.5 Regulatory Requirements

- A. In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local and regional jurisdiction. Notify Engineer of any coating specified herein that fails to conform to the requirements for the location of the project or location of application.
- B. **Lead Content:** Use only coatings that are totally lead free except for zinc-rich primers which shall not have a lead content over 0.06% by weight of nonvolatile content.
- C. **Chromate Content:** Do not use coatings containing zinc-chromate or strontium chromate.
- D. **Asbestos Content:** Materials shall not contain asbestos.
- E. **Mercury Content:** Materials shall not contain mercury or mercury compounds.

1.6 Project Conditions

- A. This Project is in a location in which drifting coatings, if spray-applied, could contaminate adjacent surfaces or vehicles nearby. All containment precautions and application methods shall be taken into consideration and implemented to prevent the above from occurring.

1.7 Inspection Service

- A.** Owner will engage in the services of an independent NACE certified coating inspection service, Level III certification.
- B.** Inspection service will provide full-time inspection of all field surface preparation and coating applications to ensure full compliance with the requirements of this Specification. The presence of the inspection service shall not relieve Contractor for compliance with Specifications or authorized changes.
- C.** Inspection service will document all work, including nonconformance, using forms acceptable to Owner and Engineer. All documentation and reports will be prepared and signed by the Inspection service representative, and submitted to Engineer on a daily basis. At the completion of all coating applications, Inspection service representative will also submit a conformance report certifying that all Work relative to coatings complies with the Specifications or authorized change.
- D.** Inspection service will be responsible for field verification and recommendations of the following field coating operations:
 - 1.** Surface preparation methods, equipment.
 - 2.** Substrate conditions, moisture content of concrete, substrate profiles, and surface temperatures.
 - 3.** Temperature, humidity, and wind conditions at times of coating applications.
 - 4.** Specified or approved coating verification.
 - 5.** Application equipment.
 - 6.** Coating wet and dry film thickness.
 - 7.** Proper coating curing.
 - 8.** Coating system failure, causes, and remedy.

- E. Inspection service representative will discuss with Engineer, Owner, and Contractor all recommended Specification deviations, changes in products, or application methods.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

- A. Acceptable manufacturers are as follows:
 - 1. Sauereisen
 - 2. Carboline
 - 3. Raven Lining Systems
 - 4. Ameron Protective Coatings Systems Group, Ameron Corp.
 - 5. Devoe Coating Company, Division of ICI.
 - 6. Futura Coatings, Inc.
 - 7. The Glidden Company.
 - 8. International Protective Coatings.
 - 9. Keeler & Long, Inc.
 - 10. Kop-Coat, Inc., Division of Carboline.
 - 11. Pittsburgh Paints, PPG Industries Inc.
 - 12. Santile, Division of Carboline Company, Inc.
 - 13. Tnemec Company, Inc.
 - 14. Polyken

2.2 General

- A. Materials furnished for each coating system must be compatible to the substrate.

- B.** When unprimed surfaces are to be coated, entire coating system shall be by the same coating manufacturer to assure compatibility of coatings.
- C.** When shop-painted surfaces are to be coated, ascertain whether finish materials will be compatible with shop coating. Inform Engineer/ Architect of any unsuitable substrate or coating conditions.
- D.** Coating system shall be as specified below or to the manufacturer's standard, whichever is more stringent.

2.3 Areas of Application

- A.** Submerged Concrete Surfaces, exposed to H₂S vapor:
 - 1.** Surface Preparation and coating system: In accordance with manufacturer's recommendations.
 - 2.** Applied to all concrete surfaces including floors, walls, baffles and ceilings.
 - 3.** Product and Manufacturer:
 - a.** Sauereisen 210
 - b.** Raven 405
 - c.** Plasite 5371
 - d.** Or approved equal.
- B.** Ferrous Metals including all Structural Steel, Miscellaneous Ferrous Metals, and all Ferrous Piping; Interior Non-submerged:
 - 1.** Surface Preparation: SSPC-SP6 Commercial Blast Cleaning as specified in Paragraph 3.1.
 - 2.** Interior non-submerged applies to areas that are housed within a building and/or within a non-process, enclosed structure.
 - 3.** Product and Manufacturer: Provide one of the following:
 - a.** Tnemec:
 - 1)** Shop Primer: 66 H.B. Epoxoline – two coats, 2-3 dry mils per coat
 - 2)** Field Primer or Field Touchup: 66 H.B. Epoxoline – one coat, 2-3 dry mils per coat.
 - 3)** Finish: 69 H.B. Epoxoline II – two coats, 4-5 dry mils per coat.
 - b.** Or approved equal

- C. Ferrous Metals, Including all Ferrous Piping; Exterior Non-submerged:
 - 1. Surface Preparation: SSPC-SP6 Commercial Blast Cleaning as specified in Paragraph 3.1.
 - 2. Exterior non-submerged applies to areas that are not housed within a building or structure, and that are not located within process and / or water carrying structures or tanks.
 - 3. Product and Manufacturer: Provided one of the following:
 - a. Tnemec:
 - 1) Primer: 66 H.B. Epoxoline – tow coats, 2-3 dry mils per coat.
 - 2) Intermediate: 69 H.B. Epoxoline II – one coat, 4-5 dry mils.
 - 3) Finish: 75 Endura-Shield – tow coats, 1.5-2 dry mils per coat
 - b. Or approved equal.

- D. Galvanized Metal and Non-Ferrous Metal; Interior Non-Submerged:
 - 1. Surface Preparation: SSPC-SP1 Solvent Cleaning, as specified in Paragraph 3.1.
 - 2. Interior non-submerged applies to areas that are housed within a building and/or within a non-process, enclosed structure.
 - 3. Product and Manufacturer: Provide one of the following:
 - a. Tnemec:
 - 1) Primer: 66 H.B. Epoxoline – one coat, 3-4 dry mils
 - 2) Finish: 69 H.B. Epoxoline II – one coat, 4-5 dry mils.
 - b. Or approved equal.

- E. All Aluminum in Contact with Dissimilar Materials:
 - 1. Surface Preparation: Remove all foreign matter.
 - 2. Product and Manufacturer: Provide one of the following:
 - a. Tnemec:
 - 1) 66 H.B. Epoxoline – two coats, 2.0 – 3.0 dry mils per coat
 - b. Or approved equal.

- F. PVC Piping, CPVC Piping, Fiberglass, Fiberglass Insulation Covering; Exterior:
 - 1. Surface Preparation: Sand as specified by the coating manufacturer.

2. Exterior applies to areas that are not housed within a building and/or within an enclosed structure.
 3. Product and Manufacturer: provide one of the following
 - a. Tnemec:
 - 1) Primer/Intermediate: 66 H.B. Epoxoline – one coat each, 2.0 – 3.0
 - 2) Finish: 75 Endura-Shield – one coat, 3.0 dry mils
 - b. Or approved equal.
- G.** PVC Piping, CPVC Piping, Fiberglass, Fiberglass Insulation Covering; Interior Non-Submerged:
1. Surface Preparation: Sand as specified by the coating manufacturer.
 2. Product and Manufacturer: Provide one of the following:
 - a. Tnemec:
 - 1) Primer/Intermediate/Finish: 66 H.B. Epoxoline – one coat each, 2.0 – 3.0 dry mils per coat.
 - b. Or approved equal.
- H.** Steel and Galvanized Steel Pipe; Buried Exterior:
1. Surface Preparation: SSPC-SP10, Near-White Blast, as specified in Paragraph 3.1.
 2. Product and Manufacturer: Provide one of the following:
 - a. Tnemec:
 - 1) Primer: 66-1211 Epoxoline – two coats, 3-4 dry mils per coat.
 - 2) Field Primer or Field Touchup: Surface preparation as specified.
 - 3) Finish: 46-413 Tneme-Tar – two coats, 10.0 dry mils per coat.
 - b. Or approved equal.
- I.** Submerged or Intermittently Submerged Ferrous Metals; Interior and Exterior:
1. Definition: Submerged shall apply to all metals below the maximum water surface elevation in open top structure unless otherwise noted or otherwise shown; and to all metals within liquid or residual solids carrying structures that are covered, including all metals on the underside of the covers unless otherwise noted or otherwise shown; and to all metals within an enclosed process structure. This shall apply to all metals whether intermittently or

continuously submerged.

2. Surface Preparation: SSPC-SP 10 Near-White Blast Cleaning as specified in Paragraph 3.1.
 - a. Tnemec:
 - 1) Primer: 69-1211 Epoxoline II – tow coats, 3-4 dry mils per coat.
 - 2) Intermediate: 69 H.B. Epoxoline II – tow coats, 5 dry mils per coat.
 - 3) Finish: 69 H.B. Epoxoline II – two coats, 5 dry mils per coat.
 - b. Or approved equal.

J. Special Requirements for Aluminum:

1. Aluminum surfaces bearing in or embedded in concrete and fayin surfaces of bolted aluminum joints ,except anchor bolts, shall be given two coats of 66 H.B. Epoxoline Primer, or approved equal. The primer shall be allowed to dry between coats and before concrete is poured against it.
2. Where aluminum metals are placed in contact with or fastened to ferrous or stainless steel metals, the contact surfaces of each shall receive the protective coating specified for that metal and a gasket shall be placed between the two contact surfaces. The gasket material shall be non-conductive commercial grade neoprene, 60 durometer, 0.03-inch in thickness unless otherwise specified. Bolts shall be isolated using one piece non-conductive sleeves and washers as manufactured by PSI Products, Inc., Burbank, California: Parker Seal Col, Culvert City, California, or approved equal.

K. Galvanizing: All galvanizing, where called for in the Contract Documents, shall be hot-dip process conforming to ASTM A-123:

1. Surface Preparation: All surfaces to be clean and free of contaminants prior to application of the coating system.
2. Prime Coat: Series 104 H.S. Epoxy; one coat 4-5 mils DFT.
3. Finish Coat: Series 104 H.S. Epoxy; one coat 4-54 mils DFT.

L. Concrete Semi-Gloss Latex:

1. Surface Preparation: All surfaces to be clean and free of contaminants prior to application of the coating system.

2. Prime Coat: Series 7 Tneme-Cryl; one coat 2-3 mils DFT.
3. Finish Coat: Series 7 Tneme-Cryl; one coat 2-3 mils DFT.

M. Ductile and Cast Iron (Exterior Exposure):

1. Surface Preparation: Solvent scrub with stiff bristle brush followed by brush-off abrasive blast cleaning to a minimum surfaces profile depth of 1.5 mils.
2. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II; one coat 3-5 mils DFT.
3. Finish Coat: Series 73 Endura-Shield; one coat 3-4 mils DFT.

N. Ductile and Cast Iron (Interior Exposure):

1. Surface Preparation: Clean, dry, and free of contaminants
2. Prime Coat: Series 135 Chembuild; one coat 4-6 mils DFT.
3. Finish Coat: Series 69 H.B. Epoxoline II; one coat 4-6 mils DFT.

O. Ductile and Cast Iron (Buried):

1. Surface Preparation: Solvent scrub with stiff bristle brush followed by brush-off abrasive blast cleaning to a minimum surface profile depth of 1.5 mils.
2. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II; one coat 3-5 mils DFT.
3. Finish Coat: Series 69 H.B. Epoxoline II; one coat 4-6 mils DFT.

P. Ductile and Cast Iron (Immersion):

1. Surface Preparation: Solvent scrub with stiff bristle brush followed by brush-off abrasive blast cleaning to a minimum surface profile depth of 1.5 mils.
2. Prime Coat: Series 66 H.B. Epoxoline; one coat 4-6 mils DFT.
3. Finish Coat: Series 69 H.B./ Epoxoline II; one coat 4-6 mils thick.

Q. Stainless Steel Duct (Buried):

1. Surface Preparation: SSPC-SP6 Commercial Blast Cleaning or manufacturer's recommendations, whichever is more stringent.
2. Prime Coat: Polyken 1019 or 1027, or approved equal.
3. Finish Coat: Polyken 905 tape, or approved equal.

2.4 Surfaces Not to be Coated

- A. Do not field paint any of the following items unless specifically noted otherwise.
1. Factory finished equipment, except for touch-up.
 2. Metal surfaces of aluminum, stainless steel, copper, bronze and similar finished materials.
 3. Equipment nameplates, valve stems, moving shafts and linkages.

2.5 Color Coding of Piping

- A. **Color Coding of Piping:** Exterior and interior by color coding entire pipe.
1. **General**
 - a. Coat piping with solid colors as specified below for entire length of pipe in exposed finished and unfinished areas. Exclude areas in pipe chases and furred areas.
 - b. Coat all other piping in colors matching adjacent surfaces. If adjacent area is unfinished, paint in color determined by Engineer/Architect.
 - c. Identify piping with letters, arrows and bands as specified below. Apply after completion of finish coating.

2. Color Scheme

Description	Pipe and Band Color	Letter and Arrow Color
Potable Water (hot or cold)	Light blue	Black
Nonpotable or Raw Water	Light blue with red bands	Black
Seal Water	Dark blue with red bands	White
Low Pressure (Air) Aeration supply	Light green	Black
Sewage	Light gray	Black
Sludge	Light brown	White
Scum	Dark brown	White
Drain	Dark gray	White
Sample	Light gray with green bands	Black
Sprinkler Piping	Red	White

In addition, special painting of the following items will be required.

Item	Color
Valve handwheels and levers	Red

Number at least 2 inches high shall be painted on or adjacent to all accessible valves, pumps, flowmeters, and other items of equipment which are identified on the drawings or in the specifications by number.

3. Location of Letters, Arrows and Bands

- a. Place letters, arrows and bands on piping near connections to equipment, adjacent to valves or fittings, on both sides of walls penetrated, and at intervals not to exceed 25 feet.
- b. Place arrows adjacent to or below letters depending upon visibility. Place arrows in direction of flow. For dual-flow piping, indicate both directions.

- c. Locate letters to be visible from normal line of vision above floor level. Letter locations subject to approval of Engineer/Architect.
- d. Band to be full circumference of pipe.

4. Letter, Arrow and Band Size

- a. Block-style letters, all capitals, conforming to ANSI A13.1 and as follows:

Outside Diameter of Letters Pipe or Covering	Size of Letters and Arrows	Width of Banding
Less than 3/4"	Approved metal tag or band	6"
3/4" to 1-1/4"	1/2"	8"
1-1/2" to 2"	3/4"	8"
2-1/2" to 6"	1-1/4"	12"
8" to 10"	2-1/2"	24"
Over 10"	3-1/2"	32"

- 5. Vent lines, electrical conduit and related electrical accessories shall be painted to match adjacent wall surfaces as directed by ceiling space shall be painted same as surfaces adjacent to the wall surfaces.

PART 3 - EXECUTION

3.1 Surface Preparation

- A. Prepare surfaces for each coating system conforming to SSPC or ASTM surface preparation specifications listed.
 - 1. If grease or oils are present, SSPC-SP1 must precede any other method specified.
 - 2. Remove surface irregularities such as weld spatter, burrs, or sharp edges prior to specified surface preparation.
 - 3. Undertake specified surface preparation in accordance with the coating manufacturer's recommendations.

- B.** Depth of profile will be as specified or as recommended by the manufacturer for each system, but in no instance shall it exceed one-third of the total dry film thickness of complete system.
- C.** Prepare only those areas which will receive the first coat of the system on the same day.
 - 1.** On steel substrates, apply coating before rust bloom forms.
- D.** Concrete surfaces shall be adequately cured in accordance with SECTION 3300 and a minimum of 28 days old prior to coating application.
- E.** Abrasives for blasting shall be free of oil, washed and dry, unused silica sand, coal, copper or nickel slag that have sharp and hard cutting surfaces. Abrasives approved by Powertech Laboratories are strongly recommended.
- F.** Sharp projections and weld splatter shall be ground smooth. All areas ground smooth shall be reblasted prior to the coating application.
- G.** Sharp edges shall be ground round and smooth to radius = 1/8 prior to the coating applications for structural steel in Highly Corrosive Areas and for Immersion Services.
- H.** After abrasive blasting, steel surfaces must be completely dust free (cleaned by vacuum and/or blown off with oil/water-free compressed air), oil and grease free, and have a chloride concentration of less than 3 µg/cm².
- I.** Unless otherwise specified, the steel profile must be 1.5 - 2.5 mils in depth and jagged as opposed to a peen pattern.
- J.** All welds shall be stripe coated by brush with the primer, prior to the application of the full primer coat. Note that inorganic zinc coatings shall not be applied by brush except to very small areas. Stripe coating shall be by spray.
- K.** Unless approved by the Paint Manufacturer to the contrary, the blast surface shall be primed prior to the development of rust bloom or other contaminants and not later than 8 hours after surface preparation.

- L. Oxidation of the steel due to deleterious conditions may necessitate reblasting or sweepblasting the surface to restore the specified cleanliness standard.

3.2 Application

- A. Apply coatings in accordance with coating manufacturer's recommendations.
- B. All work shall be undertaken by skilled applicators who are qualified to perform the required work and have a minimum of 5 years experience in similar applications. The work shall be done in a manner comparable to the best standards of practice found in that trade. All materials shall be evenly applied so as to be free from sags, runs, crawls, wrinkles, holidays, or any other defects. All coats shall be of the minimum of brush marks. When finished and dried, brush strokes shall appear in one direction only, and there shall be no curved brush marks showing. All coats shall be thoroughly dry before the succeeding coat is applied. All coats that are intended to hide shall be given another coat if the coating does not properly hide the undercoat.
- C. Use properly designed brushes, rollers, and spray equipment for all applications.
- D. Spraying shall be done in the cross lap method of spraying, streaking first in one direction and shortly later spraying across this section at right angles to the first set of passes.
- E. On unprimed surfaces apply first coat of the system the same day as surface preparation.
- F. Dry film thickness of each system shall meet the minimum specified. Maximum dry film thickness shall not exceed the minimum more than 20% or coating manufacturer's requirements if less. Where a dry film thickness range is specified, the range shall not be less than or exceeded.
- G. Shop and field painting shall remain 3 inches away from unprepared surface of any substrate such as areas to be welded or bolted.

H. Environmental Conditions:

- 1.** Do not apply coatings when inclement weather or freezing temperature may occur within coating curing time requirements. Atmospheric temperature must be maintained between 60°F and 85°F for at least 48 hours prior to and during application, unless otherwise approved by coating manufacturer.
- 2.** Wind velocities for exterior applications shall be at a minimum to prevent overspray or fallout and not greater than coating manufacturer's limits.
- 3.** Relative humidity must be less than 85% and the temperature of the surface to be painted must be at least 5°F above the dew point.
- 4.** Provide adequate ventilation in all areas of application to ensure that at no time does the content of air exceed the Threshold Limit Value given on the manufacturer's Material Safety Data Sheets for the specific coatings being applied.

- I. Recoat Time:** In the event a coating, such as an epoxy, has exceeded its recoat time limit, prepare the applied coating in accordance with manufacturer's recommendations.

J. Protection

- 1.** Cover or otherwise protect surfaces not to be painted. Remove protective materials when appropriate.
- 2.** Provide signs to indicate fresh paint areas.
- 3.** Provide daily cleanup of both storage and working areas and removal of all paint refuse, trash, rags, and thinners. Dispose of leftover containers, thinners, rags, brushes, and rollers which cannot be reused in accordance with applicable regulations.
- 4.** Do not remove or paint over Equipment data plates or code stamps on piping.

5. Mask, remove, or otherwise protect finish hardware, machined surfaces, grilles, lighting fixtures, and prefinished units as necessary.
6. Provide cover to prevent paints from entering orifices in electrical or mechanical equipment.

3.3 Inspection

- A. Contractor shall provide and use a wet film gauges to check each application approximately every 15 minutes in order to immediately correct film thickness under or over that specified.
- B. Contractor shall provide and use a dry film gauge to check each coat mm (mil) thickness when dry, and the total system mm (mil) thickness when completed.
- C. Use holiday or pinhole detector on systems over metal substrates to detect and correct voids when indicated on system sheet.
- D. Furnish a sling psychrometer and perform periodic checks on both relative humidity and temperature limits.
- E. Check temperature of the substrate at regular intervals to be certain surface is 5°F or more above the dew point.

3.4 Cleaning and Repairs

- A. Remove spilled, dripped, or splattered paint from surfaces.
- B. Touch up and restore damaged finishes to original condition. This includes surface preparation and application of coatings specified.

PART 4 - MEASUREMENT AND PAYMENT

- 4.1 **Measurement:** No measurement will be made for this item, Protective Coatings.
- 4.2 **Payment:** Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

COATING REPORT

Contract Name: _____ Contract No.: _____
Coating Contractor: _____ Foreman: _____
Unit or Surface Identification: _____
Unit or Surface Location: Exterior: _____, Interior: _____

Surface Preparation:

Date _____; Air Temp _____°F; Relative Humidity _____%
Method of Surface Preparation: _____
Profile achieved _____ mils (if applicable).

Touch-Up:

Date _____; Time _____; Air Temp _____°F; Surface Temp _____°F
Relative Humidity _____%; Dew Point _____°F
Coating Used _____; Dry Film Obtained _____ mils.

First Coat:

Date _____; Time _____; Air Temp _____°F; Surface Temp _____°F
Relative Humidity _____%; Dew Point _____°F
Coating Used _____; Dry Time Before Recoat _____ hrs.
Dry Film Obtained _____ mils.

Second Coat:

Date _____; Time _____; Air Temp _____°F; Surface Temp _____°F
Relative Humidity _____%; Dew Point _____°F
Coating Used _____; Dry Time Before Recoat _____ hrs.
Dry Film Obtained _____ mils.

Third Coat:

Date _____; Time _____; Air Temp _____°F; Surface Temp _____°F
Relative Humidity _____%; Dew Point _____°F
Coating Used _____; Dry Film Obtained _____ mils.

****END OF SECTION 9900****

SECTION 16000

GENERAL ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- A. Furnish and install all electrical Work as shown on the Drawings and specified. Work includes electrical connections to equipment, wiring devices, disconnects, panelboards for electrical distribution, conductors, and control panels.

1.2 RELATED WORK

- A. Refer to all drawing sheets for the scope of the electrical work.

1.3 QUALITY ASSURANCE

- A. All work to be completed to latest edition of National Electrical Code.
- B. All material to be U.L. listed.
- C. All equipment to conform to ANSI and NEMA standards.

1.4 SHOP DRAWINGS

- A. Submit complete Shop Drawings for:
 - 1. Conduit, Fittings and accessories, (See Section 16111)
 - 2. Wire, Cable and accessories (See Section 16120)
 - 3. Grounding (See Section 16450)
 - 4. General Requirements – Instrumentation and Controls (See Section 16900)
 - 5. Control Panels Instrumentation and Controls (See Section 16901)
 - 6. Measuring and Controlling Instruments and Loops (See Section 16902)
 - 7. Programmable Logic Controllers (PLC) and Accessories (See Section 16924)

1.5 CERTIFICATES AND FEES

- A. The Electrical Contractor will pay for all fees, connection charges, permits and inspections.

1.6 GROUNDING

- A. All grounding, as a minimum, will be according to the latest edition of the National Electrical Code, Article 250. Provide a full-size grounding conductor in all conduits.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials and equipment direct to the job site utilizing Contractor's personnel and not to the Owner's receiving area.
- B. Store all materials and equipment in a dry area, protected from the weather. Verify location of storage areas with the Owner.

1.8 EXISTING CONDITIONS

- A. Visit the site and become familiar with existing conditions and limitations.
- B. Perform all cutting necessary to install the electrical work indicated and all patching, painting, etc. to return the finished surfaces to the original condition. All wiring devices to be installed flush unless noted otherwise.

PART 2 PRODUCTS

2.1 Service Entrance Section SES – Not used

PART 3 EXECUTION

3.1 GENERAL

- A. Install all electrical Work as shown on the Drawings.
- B. Utilize conduit for all feeders, branch circuiting, and control wiring.

**** END OF SECTION 16000 ****

SECTION 16111

CONDUIT, FITTINGS AND ACCESSORIES

PART 1 - GENERAL

1.1 Description: This Section includes all conduit, fittings and accessories.

1.2 References

1. American National Standards Institute (ANSI)

ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated.

2. American Society For Testing and Materials (ASTM)

ASTM A123 - Zinc (Hot Galvanized) Coating on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strips.

ASTM A153 - Zinc Coating (Hot Dip) on Iron and Steel Hardware.

3. National Electrical Code (NEC)

4. National Electrical Manufacturers Association (NEMA)

FB1 - Fittings and Supports for Conduit and Cable Assemblies.

RN1 - Polyvinyl-Chloride Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing.

5. Underwriters' Laboratories, Inc. (UL)

1 - Flexible Metal Electric Conduit.

6 - Rigid Metal Electrical Conduit.

263 - Fire Tests of Building Construction and Materials.

360 - Liquid tight Flexible Steel Conduit

514A - Metallic Outlet Boxes, Electrical.

514B - Fittings for conduit and Outlet Boxes.

514C - Nonmetallic Outlet Boxes, Flush Device Boxes and Covers.

6. Steel Structures Painting Council (SSPC)

SP3 - Power Tool Cleaning.

SP11 - Power Tool Cleaning to Bare Metal.

- 7.** All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor's responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

1.3 Submittals

- . Submit as specified in SECTION 1330.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Rigid Steel Conduit

1. Allied Tube and Conduit Corporation.
2. LTV Steel.

B. Rigid Steel Conduit with Bonded Polyvinyl Chloride (PVC) Jacket

1. OCAL Inc.
2. Robroy Industries.
3. Perma-Cote Industries.

C. Liquid-tight: Flexible Metal Conduit:

1. Anamet, Inc.

2. Electri-Flex Company.

D. Rigid Polyvinyl Chloride (PVC) Conduit

1. Kraloy Plastic Pipe Company.
2. Certain-Teed Products Corporation.
3. Carlon Products Division

E. InnerDuct for Fiber Optic Cable

Smoothwall, HDPE Innerduct may be used only and exclusively for underground installation of fiber optic cable.

1. Kraloy Plastic Pipe Company.
2. Certain-Teed Products Corporation.
3. Carlon Products Division

E. Rigid Steel Conduit Fittings

1. Heavy-duty Cast Malleable Iron Fittings

- a. Appleton Electric Company.
- b. Crouse Hinds Company.

2. Conduit Expansion and Deflection Fittings

- a. O-Z /Gedney Company.

F. Rigid Steel Conduit Boxes

1. Indoor and Outdoor Boxes

- a. Hoffman Engineering Company of Anoka, Minnesota.

2. Conduit Hubs

- a. Appleton Electric Company.
- b. Myers Industries, Inc. (ITT).
- c. Crouse-Hinds Company.
- d. O-Z /Gedney Company.

G. Supports

1. B-Line Company.
2. Midland-Ross Corporation.
3. Unistrut Products Corporation.
4. U.S. Gypsum Company.
5. Van-Huffel Tube Corporation.

H. Wall Entrance Seals

1. O-Z/Gedney Company.

I. Explosion-proof Fittings

1. Crouse-Hinds Company
2. Appleton Electric Company

J. Fire-stopping Materials

1. 3M, (Minnesota Mining and Manufacturing Company)
2. Thomas and Betts
3. Hilti
4. Dow Corning

K. Duct Seal

1. Ideal Industries
2. 3M, (Minnesota Mining and Manufacturing Company)

2.2 Design Requirements

- A.** Each length of threaded conduit furnished with coupling on one end and metal or plastic thread protector on other end.
- B.** UL listed and labeled conduit, on each length, fittings and accessories.
- C.** Sizes of conduit, fittings and accessories as indicated, specified or as required by Electrical Codes and Standards.
- D.** Provide and meet the requirements of the following sections for the conduit, fittings and accessories indicated.

2.3 Rigid Steel Conduit

- A.** Conform to ANSI C80.1 and UL-6.
- B.** Mild ductile steel, circular in cross section with uniform wall thickness sufficiently accurate to cut clean threads.
- C.** Each length threaded on both ends with threads protected.
- D.** All scale, grease, dirt, burrs and other foreign matter removed from inside and outside prior to application of coating materials.
- E.** Galvanized by the hot-dip process as follows:
 - 1.** Interior and exterior surfaces coated with a solid, unbroken layer of 99% virgin zinc by dipping.
 - 2.** Coating not to show fixed deposits of copper after four 1-minute immersions in a standard copper sulfate solution.
 - 3.** One coat of zinc chromate finish on inside and outside surfaces to prevent oxidation and white rust.
- F.** Couplings and elbows fabricated, coated and finished by the same process as conduit.

2.4 Rigid Steel Conduit and Fittings with Bonded Polyvinyl Chloride (PVC) Jacket

- A.** Conform to hot-dipped galvanized rigid steel conduit as specified in NEMA-RN1, RIGID STEEL CONDUIT, this Section, and as follows.

- B.** Prior to application of PVC coating, clean interior and exterior surfaces to remove contaminants to provide a suitable surface for bonding.
- C.** Bond the PVC coating to the conduit. Extruded PVC jackets are unacceptable.
- D.** Coated externally with PVC to a nominal 40 mils, 0.035-inch to 0.045-inch.
- E.** Uniformly coat around outside diameter and full length of the conduit.
- F.** Coat the prethreaded ends with a urethane coating having a nominal thickness of 2 mils (0.002-inch).
- G.** Coat the interior surfaces of all conduits and feed-through fittings (except where prohibited by design) with a two-part, chemically cured, urethane coating having a nominal thickness of 2 mils (0.002-inch).
- H.** Exceed the tensile strength of coating with bond between metal and jacket.
- I.** Couplings, elbows, and other conduit fittings, boxes, cover-plates, supports, hardware and related items shall be treated and coated with the same process as conduit.
- J.** Each coupling and fitting shall include a PVC sleeve that overlaps the conduit.
- K.** Length of the overlapping sleeve equals diameter of the conduit or 2 inches, whichever is least.
- L.** Final cured PVC coating capable of withstanding a minimum electrical potential of 2000V.
- M.** All conduit accessories, clamps, and hardware that are uncoated shall be stainless steel.

2.5 Liquid-Tight Flexible Metal Conduit

- A.** Conform to UL-360.

- B. Liquid-tight conduit with flexible galvanized-steel core and a synthetic rubber, polyvinyl chloride, or thermoplastic covering.
- C. Spiral encased copper bonding conductors for conduit in sizes 1-1/4 inches and smaller.
- D. External grounding jumper as required.
- E. Polyvinyl chloride (PVC) jacket, Type HA or Type O.R. "Seal-Tite" for oil-resistant applications.

2.6 Rigid Polyvinyl Chloride (PVC) Conduit

- A. Fabricated from self-extinguishing high-impact polyvinyl chloride designed for aboveground and underground installations.
- B. Type EPC Schedule 80 heavy-wall rigid conduit.
- C. Fittings and accessories fabricated from same materials as conduit.
- D. Solvent-cement-type joints as recommended by manufacturer.

2.7 Rigid Steel Fittings

A. Heavy-Duty Cast Malleable Iron Fittings

1. Mogul type for conduit sizes 1-1/2 inches and larger.
2. LBD or roller action type LB for right angle fittings for conduit sizes 2 inches and larger.
3. Full-threaded hubs and rubber-gasketed covers.
4. Zinc, cadmium-plated or bronze hardware bolts and screws for assembly.
5. Finish with cadmium-plated or galvanizing.
6. Standard and junction fittings.

B. Conduit Expansion Fittings

1. Line of Conduit Type

- a. Galvanized expansion fittings for rigid conduit movement up to 4 inches.
- b. Insulated metal bushing on ends of the conduit, bonding jumper, and with expansion head sealed with a high-grade graphite packing.
- c. O-Z/Gedney Company, Type AX with Type AJ bonding jumper or Thomas and Betts Corporation, Type XJG.

2. End Type

- a. For conduit terminating in a junction box.
- b. O-Z/Gedney Company, Type EXE with Type BJ-E bonding jumper.

C. Conduit Expansion and Deflection Fittings

1. Provide for movement of 3/4-inch from normal in all directions between two rigid conduits.
2. Integral bonding jumper.
3. O-Z/Gedney Company, Type DX.

D. Conduit Wall Entrance Seals

1. Provide where required or indicated.
2. O-Z/Gedney Company Type FSK.

- E.** Conform to NEMA Type 3R enclosure in all nonhazardous areas except as specified or indicated otherwise.

2.8 Fittings, Couplings and Boxes for Rigid Steel Conduit

A. Fittings

1. Explosion-proof or weather-proof as specified.
2. Cast malleable iron.
3. Threaded cover to conform to NEC.

4. Full thread hubs.
5. Seal compound well for seal.
6. Drain seals as indicated or required to provide a continuous automatic drain of water.
7. Chico compound for all sealing fittings.
8. PVC jacketed in corrosive areas and where indicated.

B. Couplings

1. Explosion-proof or weather-proof as specified.
2. Flexible.
3. Conform to NEC.
4. Threaded, steel or bronze end fittings securely fastened to the core and braided to ensure electrical continuity.
5. Vinyl plastic coating in severely corrosive locations as indicated.

2.9 Rigid Steel Conduit Boxes

A. Indoor Boxes

1. Hot-dipped galvanized steel.
2. Galvanized steel covers.
2. For special boxes where it is not possible to provide hot-dip galvanizing, apply organic zinc-rich primer at 3 mils dry film thickness after SSPC-SP3 Power Tool Cleaning.
3. Minimum gage requirements:

No surface area exceeds	No single dimension exceeds	Steel Gage
1000 sq in.	40 in.	14

1500 sq in.	60 in.	12
over 1500 sq in.	over 60 in.	10

4. Explosion-proof or weather-proof as specified.
5. Threaded conduit entrances or rigid conduit hubs on all boxes.
6. Include piano-hinged, gasketed cover, and interior mounting panel when used for enclosing terminal blocks and control relays.
9. Oiltight JIC boxes modified for NEMA Type 3R or Type 4 enclosure for non-explosion-proof areas.

B. Outdoor Boxes

1. 11-gauge minimum galvanized steel with drip lip and galvanized-steel covers fastened with bronze or cadmium-plated screws or bolts, or cast iron with galvanized finish and flanged bolted covers.
2. For special boxes where it is not possible to provide hot-dip galvanizing, apply organic zinc-rich primer at 3 mils dry film thickness after SSPC-SP3 Power Tool Cleaning.
3. Threaded conduit entrances or rigid conduit hubs on all boxes.
4. Rubber or neoprene gasket for cover.
5. Explosion-proof or weather-proof as specified. Conform to NEMA Type 3R enclosure for non-explosion-proof applications in all outdoor installations unless indicated otherwise.
6. Include piano-hinged, gasketed cover, and interior mounting panel when used for enclosing terminal blocks and control relays.
7. Oiltight JIC boxes modified for NEMA Type 3R or Type 4 enclosure in non-explosion-proof applications.

B. Metallic Barriers

1. Designed not to separate phases of a power circuit.

- 2. Provide as indicated for the isolation of power circuits from other type circuits.
- C. Box size as required, or as indicated, for each particular installation.
- D. Include provisions for mounting cable supports where indicated, specified or as required by NEC.
- E. Provide as required for cable pulling, junctions, terminals, and for mounting of switches, outlets and control devices.

2.10 Support System

- A. Fabricated from structural steel or manufactured framing members equal to "Unistrut" P-3000 series as manufactured by Unistrut Corporation.
- B. Minimum 12 gage.
- C. Construct as required to rigidly support all conduit runs and boxes.
- D. Hot-dip galvanized steel conduit clamps or stainless steel, sized for the specific conduit size, to support all exposed metallic conduit.
- E. Nonmagnetic clamps to support nonmetallic conduits.
- F. Provide stainless steel rods, anchors, inserts, bolts, washer, and nuts.
- G. Materials shall be compatible with the equipment supported.
- H. Manufactured Framing Members
 - 1. **Wet Locations**
 - a. Channel hot-dipped galvanized after all manufacturing operations are completed.
 - b. Galvanizing zinc weight of 2 ounces per square foot on surface to conform to ASTM A123 and ASTM A153.

2.11 Fire-stopping and Duct Seal

A. Fire-stopping

1. Weather-resistant silicone sealant.
2. Provide 4-hour fire rating.
3. UL tested system.

B. Duct Seal

1. Non-corrosive, permanently soft compound.
2. Nontoxic.
3. Provide flexible re-enterable and repairable seal around cables in conduit.
4. Prevent air movement and drafts through conduits.
- 5.

PART 3 - EXECUTION

3.1 Preparation

- A.** Provide suitable protection for conduit risers against damage during construction.
- B.** Cap ends of all conduits before concrete is poured.
- C.** Cap all conduits and provide pullstring after cleaning where conduits are to be left empty by this contract.
- D.** Carefully ream ends of all conduit lengths after cutting to eliminate sharp burrs.
- E.** Clean out all conduit before pulling wire.
- F.** Clean out all conduits immediately after concrete work is finished.

3.2 Installation

A. General Requirements

1. Location

- a. Install conduit as near as possible to the routing indicated.
 - b. Shift locations as required to avoid interference with other equipment and piping being installed.
 - c. Where routing of conduit is not indicated, such as for lighting home run circuits and other systems requiring small conduit runs, route conduit as specified subject to approval by Engineer.
2. Do not use conduit in sizes smaller than 3/4-inch, except 1/2-inch may be used for connections to control devices and thermocouples where necessary.
3. **Holes and Sleeves**
- a. Provide through floors, walls and roofs as necessary for conduit runs, including approved flashing and weather proofing at outside walls and on roofs.
 - b. Install sleeves or forms for all openings in new work.
 - c. Provide the required inserts and holes, completely sleeved, bonded, curbed, flashed and finished off in an approved manner, whether in concrete, steel grating, metal panels or roofs.
 - d. Core-drill all holes required in existing building work using a dustless method.
 - e. Place nonshrinking grout or Dow Corning 3-6548 Silicone RTV (or equivalent General Electric RTF 762) foam as specified, in the following locations:
 - (1) All holes in concrete, walls, floor and roof slabs after installation of conduit.
 - (2) All unused holes and sleeves as approved by Engineer.
 - f. Install wall entrance seals where conduit enters the building or vaults from exterior underground.

7. Comply with applicable requirements of NEC pertaining to installation of conduit systems.
8. Place drainage fittings or weep holes at unavoidable low points where moisture can collect.
9. Install an entire conduit system that is electrically continuous with bonding jumpers provided as necessary to conform to NEC.
10. Install expansion fittings at all building expansion joints and every 100 feet of continuous conduit.
11. Provide all spare or empty conduits with pullstrings for future use.

B. Rigid Steel Conduit

1. Exposed

- a. Install where specified or indicated on drawings.
- b. Install above grade outdoors.
- c. Install horizontal runs as high above floor as possible and in no case lower than 7 feet above floor, walkway or platforms in passage areas.
- d. Run conduit parallel or perpendicular to walls, ceiling, beams, and columns unless indicated otherwise.
- e. Route to clear all doors, windows, access wells, and openings.
- f. Group parallel runs in neatly aligned banks where possible with minimum of 1-inch clearance between conduits.
- g. Maintain 6-inch clearance between conduit and coverings on all hot lines; steam, hot water, etc.
- h. Do not exceed a distance of 8 feet between supports on horizontal or vertical runs.

- i. When terminating at cable tray, attach conduit to tray and electrically bond conduit with ground wire to the cable tray. Install duct seal in conduits around cables to prevent ingress of water.

2. Concealed

- a. Conceal conduit for lighting, convenience outlets, and other circuits in walls, ceiling and floors where possible.
- b. Do not install conduit in concrete where conduit outside diameter exceeds one-third of concrete thickness.
- c. Install parallel runs with a minimum spacing of three conduit diameters between conduits.
- d. Use expansion and deflection fitting with bonding jumpers at all concrete expansion joints.
- e. Tie securely in place to prevent movement when concrete is poured.
- f. Install in floor slabs in as straight a run as possible. Conduit crossovers are not permitted unless conduit total outside diameter is one-third of the concrete thickness or less.
- g. Use long radius elbows except on risers where curved portion of elbow would extend above the finished floor or foundation.
- h. Make all joints watertight after installation by coating all finished joints with coal tar solution applied at 15 mils minimum dry film.

(1) Kop-Coat - No. 50.

(2) Tnemec - 46-449.

3. Buried

- a. Place where indicated.

- b.** Use PVC jacketed conduit or rigid PVC Schedule 80 as indicated.
- c.** Make all joints watertight by field-applied coat of vinyl plastic compound or PVC welding solution furnished by the conduit manufacturer.
- d.** Use bender one size larger for conduit sized 1 inch or less and conventional bender for conduit sized above 1 inch.
- e.** Use strap wrench to tighten conduit. Repair damaged coating with liquid patching compound recommended by conduit manufacturer.
- f.** Install in as straight a run as possible between termination points of exact routing to be determined in the field and subject to approval by Engineer.
- g.** Bury conduits a minimum of 24 inches (to top of conduit) below finish grade unless indicated otherwise or required by code.
- h.** Slope conduit away from conduit risers where possible.
- i.** Maintain 6-inch separation from underground piping.
- j.** Use long radius bends at all risers unless indicated otherwise.
- k.** After trench bottom has been finished to grade, lay conduit. Backfilling shall be as specified in DIVISION 2.
- l.** Cap ends of all conduit risers before backfilling.
- m.** Provide watertight seal around wires where conduit terminates in pull box.
- n.** Use PVC coated rigid galvanized steel conduit when making transitions from buried to above ground conduit runs.

C. Liquid-Tight Flexible Metal Conduit

1. Use between rigid conduit and motor terminal boxes except where conduit runs down from above and cannot be conveniently supported by a floor flange.
2. Place between rigid conduit or conduit box and control device cases where direct connection is not desirable for reasons of equipment movement, vibration, or for ease of maintenance.
3. Install at all points of connection to equipment mounted on supports to allow for expansion and contraction.
4. Conform to NEC with installation of conductors.
5. Install at locations where rigid conduit connections are impractical.
6. Use minimum length consistent with manufacturer's standard lengths, the acceptable bending radius, and with required movement of equipment.
7. Maximum length of 3 feet unless otherwise approved by Engineer.
8. Install an external bonding jumper to conform to NEC on conduit sized 1-1/2 inches and larger.

D. Flexible Metal Conduit

1. Use between rigid conduit and devices, except in hazardous areas and areas subject to dampness, water, and corrosive fumes. Do not use with vapor-tight fixtures. Use in accordance with the National Electrical Code Article 350.
2. Use in lieu of direct connection of rigid conduit where it is not desirable for reasons of equipment movement, vibration, or for ease of maintenance.
3. Install as required for expansion and contraction.
4. Use minimum length consistent with manufacturers' standard lengths, the acceptable bending radius, and with required movement of equipment.

5. Maximum length of 3 feet unless otherwise approved by Engineer.
6. Install in sizes smaller than 3 inches.
7. Install an external bonding jumper to conform to the National Electrical Code on conduit sized 1-1/2 inches and larger.

E. Conduit Fittings

1. Installations of special fittings as required.
2. All materials shall be compatible.
3. Install as required.

F. Boxes

1. Install special boxes as indicated of size required for conduits and cables entering and leaving box.
2. Install where required for pull or junction boxes and for mounting or connecting to switches, outlets, intermediate terminal blocks or control devices.
3. Provide 1/4-inch weep holes in interior boxes where conduits enter from exterior or buried installation.

G. Supports

1. Construct with sufficient rigidity to hold all mounted equipment and material in permanent and neat alignment.
2. Design to provide 1/4-inch space between equipment housings and walls or columns upon which they are mounted.
3. Do not exceed load requirements in NEC and NEMA standards.
4. After Power Tool Cleaning SSPC-SP11, paint all welds, field cuts and damaged areas with organic zinc-rich primer at 3 mils dry film thickness.
 - a. Ameron - 68HS.

- b. Carboline - Carbozinc 858.
 - c. Porter - Zinc-Lock 308.
 - d. Tnemec-Tneme Zinc 90-93.
5. Use electrogalvanized steel conduit clamps and nonmagnetic conduit clamps to support electrogalvanized steel conduit and nonmagnetic conduit, respectively.
6. Provide stainless steel rods, anchors, inserts, bolts, washers and nuts.

I. Explosion-proof Fittings

- 1. Install explosion-proof fittings in the rigid steel conduit system as required by the NEC.
- 2. Install necessary fittings where not indicated, but required by code.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

- A. No measurement will be made for this item.

4.2 Payment

- A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

**** END OF SECTION 16111 ****

SECTION 16120

WIRE, CABLE, AND ACCESSORIES

PART 1 - GENERAL

1.1 Description

A. This Section includes furnishing and installing (including terminations) of all electrical wire, cable, and accessories.

B. Related Work Specified Elsewhere

Lighting.....	Section 16500
Grounding	Section 16450
Field Testing	Section 16950
Instruments and Controls.....	Sections 16900-16950

1.2 References

1. American Society for Testing and Materials (ASTM)

ASTM B3 - Soft or Annealed Copper Wire.

ASTM B8 - Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

ASTM B33 - Tinned Soft or Annealed Copper Wire for Electrical Purposes.

ASTM B172 - Rope-Lay-Stranded Copper Conductors, Having Bunch Stranded Members, for Electrical Conductors.

ASTM B189 - Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes.

2. Insulated Cable Engineers Association (ICEA)

S-19-81 - Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

S-61-402 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

S-66-524 - Cross-Linked Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

S-68-516 - Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

S-81-570 – 600-Volt Rated Cables of Ruggedized Design for Direct Burial.

S-105-692 – 600Volt Single Layer Thermoset Insulated Utility Underground Distribution Cables.

T-29-520 – Vertical Cable Tray Flame Tests at 210,000 Btu.

3. National Electric Manufacturers Association (NEMA) and Insulated Cable Engineers Association (ICEA)

WC55/S-82-552 – Instrumentation Cables and T.C. Wire.

WC57/S-73-532 – Standard for Control Cables.

WC70/95-658 - Non-Shielded Power Cables Rated 2000V or Less.

4. Institute of Electrical and Electronic Engineers (IEEE)

48 - Test Procedures and Requirements for High Voltage Alternating-Current Cable Terminations.

5. National Fire Protection Association

National Electrical Code (NEC) NFPA-70.

Standard for Electrical Safety in the Workplace, NFPA 70E

6. Underwriters Laboratories, Inc. (UL)

44 - Rubber-Insulated Wires and Cables.

83 - Thermoplastic-Insulated Wires and Cables.

263 - Fire Tests of Building Construction and Materials.

854 - Service Entrance Cables.

1277 - Electrical Power and Control Tray Cables with Optional Optical Fiber Members.

- 7. National Electrical Safety Code, IEEE C2.**
- 8. Occupational Safety and Health Administration, OSHA.**
9. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor's responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

1.3 Submittals

- A. Submit as specified in Section 1330.
- B. Includes, but not limited to, the following:
 1. Data sheets for each wire and cable type specified.
 2. Data sheets for wire and cable accessories.
 3. Cable manufacturer's approval of splicing and terminating materials.
 4. Cable manufacturer's approval of pulling compounds.
 5. Cable manufacturer's installation requirements such as maximum pulling tensions, sidewall pressures, minimum bending radii, etc.
 6. Other equipment and materials to be used.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Wire and Cable

Acceptable manufacturers for each wire and cable type will be manufacturers that have been manufacturing the specified cable for a minimum of five years and meet all the requirements listed on the Wire and Cable Specification Sheets.

B. Wire and Cable Accessories

1. Cable Connectors for Control and Instrument Cable

- a. AMP Special Industries.
- b. Hollingsworth Solderless Terminal Company.
- c. Panduit Corporation.
- d. Minnesota Mining and Manufacturing (3M).
- e. Thomas and Betts Company, Inc.

2. Cable Connectors for Power Cable

- a. AMP Special Industries.
- b. Thomas and Betts Company, Inc.
- c. Minnesota Mining and Manufacturing (3M).
- d. Panduit Corporation.

3. Termination and Splice Kits

- a. Minnesota Mining and Manufacturing (3M).
- b. Raychem.

4. Tape and Insulation Putty: Minnesota Mining and Manufacturing (3M).

5. Cable Ties

- a. AMP Special Industries.
- b. Dennison Manufacturing Company.
- c. Panduit Corporation.
- d. Minnesota Mining and Manufacturing (3M).

- e. Thomas and Betts Company, Inc.

6. Cable Supports

- a. O-Z/Gedney Company.
- b. Hubbell, Kellems Grips.

7. Terminal Blocks

- a. Allen-Bradley.
- b. Buchanan.
- c. Phoenix Contact.
- d. Weidmuller.

8. Cable Identification Tags

- a. Allen Marking Products, Kansas City, MO.
- b. Floy Tag and Manufacturing Co., Seattle, WA.
- c. Panduit Corporation (Panduit).
- d. Specialty Products Company, Rock Hill, SC.
- e. Thomas and Betts Company, Inc. (Thomas and Betts).

9. Cable Fire and Smoke Stop Fittings

- a. Crouse Hinds.
- b. Nelson Electric.
- c. O-Z/Gedney Company.

2.2 Wire and Cable

A. Building Wires

1. Conductors: stranded for 12 AWG and larger. Minimum size: 12 AWG.

2. Copper conductors: size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

B. MC, Metal Clad Cables

1. Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
2. Insulation: Chemically cross-linked thermosetting polyethylene rated type RW90, 600 V.
3. Inner jacket.
4. Armour: continuous aluminum.
5. Overall covering: flame retardant polyvinyl chloride material meeting requirements of Vertical Tray Fire Test.

C. Instrument Cable – Shielded Twisted Pairs/Triads

1. Conductors: stranded for 16 AWG and larger. Minimum size: 16 AWG.
2. Copper conductors: size as indicated, with 600 V insulation of PVC material rated RW90. Color code shall use pigmented compounds, white and black for pairs, white, black and red for triads. Each conductor shall include sequential numbers printed on surface of conductors.
3. Conductor jacket: nylon.
4. Shields: aluminized mylar or polyester tape with tinned copper drain wire.
5. Jacket: Polyvinyl chloride (PVC).

D. Control Cables

1. Class B or C soft annealed stranded copper conductors, sized as indicated, with cross-linked thermosetting polyethylene, outer PVC jacket rated for outdoor use.

2. 600 V type: with cross-linked polyethylene type, RW90 (x-link) and overall jacket.

E. Temperature Rating

Cables shall be suitable for operation with a maximum conductor temperature of 90°C, continuous, wet or dry locations.

F. Insulation and Jacket Thickness

See references, Section 1.2.

G. Factory Tests

See references, Section 1.2, including the flame test requirement, ICEA T-29-520 and UL 1277.

H. Certification

Cables shall be certified to be in conformance with all applicable codes and standards as referenced.

All cables shall include surface identification showing manufacturer's name, insulation type, conductor size, conductor type, voltage rating and UL label.

2.3 Connectors

A. General Requirements

1. Designed and sized for specific cable being connected.
2. Solderless, pressure-type connectors constructed of non-corrodible tin-plated copper.
3. Rated current-carrying capacity equal to or greater than the cable being connected.
4. Application tooling for connectors shall contain die or piston stops to prevent over-crimping and cycling or pressure relief to prevent under-crimping. Dies of all application tooling shall provide dot or wire size coding for quality control verification. All tooling shall be manufactured by the connector manufacturer.

B. Power Connectors (10 AWG and Smaller) 600V and Below

1. "Scotchlok" preinsulated spring wire connectors.
2. Buchanan open-end copper splicing caps, applied with "Lok-Seal" tool, with nylon snap-on insulators.

C. Power Connectors (sizes 8-4 AWG) 600V and Below

1. Noninsulated ring-tongue type.
2. Ring tongue sized to match terminal stud size.
3. Brazed barrel seam.
4. Application tooling designed to crimp the wire barrel (conductor grip) with a one-step crimp.

D. Power Connectors (sizes 2 AWG - 750 kcmil) 600V and Below

1. Non-insulated one-hole rectangular tongue for sizes 2 AWG through 3/0 AWG and two-hole rectangular tongue for 4/0 AWG through 750 kcmil.
2. Application tooling shall be hydraulically operated.

E. Control, Instrument, and Specialty Cable Connectors

1. Tin-plated copper.
2. Vinyl preinsulated spring-type spade terminals. (Hollingsworth "Mini Spring Spades"; Thomas and Betts "Locking-Fork"; Panduit "Locking Fork.")
3. Sized to match terminal stud size.
4. Have insulation grip sleeve to firmly hold to cable insulation.
5. Insulation grip sleeve shall be funneled to facilitate wire insertion and prevent turned-back strands.
6. Application tooling designed to crimp the wire barrel (conductor grip) and the insulation grip sleeve with a one-step crimp.

2.4 Motor Lead Termination/Splice (Low-Voltage, 600v and Below, Power Cable)

- A.** Splices shall be made using compression-type connectors bolted together. The compression-type connectors shall be properly sized for the cables.
- B.** Splice to be covered with heat-shrinkable tubing connector insulators or slip-on rubber boot or sleeve.
- C.** Splicing shall be done in accordance with the instructions provided with the Raychem brand MCK Motor Connector Kit or 3M Company 5300 Series Motor Lead Splice Kit.

2.5 Cable Supports

- A.** Cable supports for cables in vertical conduit risers shall be O-Z/Gedney Type "R" wedging plug type or approved equal.
- B.** Kellems basket type wire mesh grip for cables in vertical installations.

2.6 Cable Ties

- A.** Nylon self-locking type.
- B.** Have a normal service temperature range of -40°C to 85°C.
- C.** Be weather-resistant and sun-light resistant type for outdoor use.
- D.** Meet requirements of Military Specifications MIL-S-23190D.
- E.** AMP Special Industries "AMP-TY," Dennison Manufacturing Company "BAR-LOK," Panduit Corporation "PAN-TY," Thomas & Betts "TY-RAP," or Minnesota Mining and Manufacturing 3M Brand cable ties.

2.7 Terminal Blocks

- A. For mounting in terminal boxes (TBs)**
 - 1.** Designed and sized for the cables being terminated.
 - 2.** Block rated 600V.

3. Binding screw-type terminals for power cables and strap screw or tubular clamp terminals for control and instrument cables.
4. Rated current carrying capacity equal to or greater than the cable being terminated.
5. Marking strip.

B. For Mounting in Cabinets, Panels, Control Boards, Etc.

1. Designed and sized for the cables being terminated.
2. Block rated 600V.
3. Binding screw type terminals for power cables and current transformer circuits and strap screw or tubular clamp terminals for control and instrument cables.
4. Rated current carrying capacity equal to or greater than the cable being terminated.
5. Marking strip on blocks for power cables and control and instrument cables.
6. Short-circuit strips with one shorting screw for each terminal for current transformer circuits.

2.8 Cable Identification Tags

- A. Designed to provide a permanent wire and cable identification system.
- B. Show complete cable number. Cable numbers are defined in the Cable Schedule and/or Contract Drawings.
- C. Cable numbers may be stamped or typed in a legible and permanent manner. Hand-lettering is not acceptable.
- D. Character size for cable numbers shall be a minimum of 1/8-inch.
- E. Material shall be nonmetallic and impervious to moisture and resistant to fading in sun-light.
- F. Be securely attached to cables and accessible for inspection.

- G. Cable identification tags, marking and attachment methods shall be subject to approval of the Engineer.

2.9 Fastenings

- 1. One hole malleable iron straps to secure surface cables 2 inch diameter and smaller. Two hole steel straps for cables larger than 2 inches.
- 2. Channel type supports for two or more cables.
- 3. Threaded rods: 3/8 inch dia. stainless steel to support suspended channels.

PART 3 – EXECUTION

3.1 Installation

A. Wire and Cable

1. General Requirements

- a. Install in conduit, duct system or tray as indicated.
- b. Do not subject cable to pulling tensions or sidewall pressures in excess of manufacturer's recommendations.
- c. Attach pulling grips over the cable sheath to prevent slipping of the insulation.
- d. Do not subject cable to bending radius less than those recommended by the cable manufacturer or as noted below (whichever is greater) during or after installation:
 - (1) Eight times the cable outside diameter for 600V or lower rated cables.
- e. Install intermediate splices only as indicated or as required to avoid subjecting cable to excessive pulling tension or sidewall pressures. Cable splicing locations

shall be approved by Engineer prior to cable installation.

- f. Support cables at connections or termination points such that any strain on cable will not be transmitted to the connection or termination.
- g. Install cable supports in vertical runs of conduit, at boxes and at terminations in equipment, and as required to meet intermediate support requirements of National Electrical Code (NEC).
- h. All pulling compounds shall be approved by wire and cable manufacturer as being compatible with cable materials.
- i. Attach a cable identification tag to each cable at all termination or end points.
- j. Install fire and smoke stop fittings at all cable penetration of fire rated walls, floors and ceilings.

2. Power (600V and Below), Control, Instrument, and Specialty Cable

- a. Install metallic barrier in all tray and boxes to separate power, control and instrumentation from low-level signal (50V or less) instrumentation circuits where run in the same box.
- b. Cables in vertical trays shall be secured every 3 feet or less.
- c. Tie together with cable ties all single conductor cable on each individual circuit in each junction box, and equipment at intervals not to exceed 6 feet.
- d. **Attach a cable identification tag to each cable.**
 - (1) At each terminal to identify the circuit and cable.
 - (2) Use nylon ties and identification tabs color coded as follows:

- (a) 480V circuits - Red.
- (b) 277, 240, or 208Vac circuits - Orange.
- (c) 120V circuits - White.
- (d) Control cables - Natural Nylon.

e. Insulation Color Coding

- (1) Conductors shall be coded or numbered over the entire length.
- (2) Colors shall not be changed between source and device. No white wire shall be used in lighting and convenience outlets except as a grounded neutral conductor.

f. Tag each individual conductor or wire with wire markers as follows:

- (1) With terminal designation indicated on schematic diagrams or given on manufacturer's equipment drawings.
- (2) At each terminal.
- (3) In addition to specified circuit tags.

g. Terminate and ground, control, instrument, and specialty cable shields as indicated and recommended by the manufacturer of the equipment being connected. In general, ground the shields at the control boards for control cables and at the receiving end equipment for instrumentation and specialty cables.

h. Control and instrument cable splices shall be as follows:

- (1) Made only in junction or terminal boxes.
- (2) Made on terminal blocks with marking strips.

- (3) Conductor color coding shall be maintained.
- (4) For shielded cables, shield continuity and isolation shall be maintained.
- i. **Power cable (600V or below) splices and motor terminations shall be as follows:**
 - (1) Made only in junction or terminal boxes.
 - (2) Splices shall be made using compression type connectors bolted together.
 - (3) Splice to be covered with a heat-shrinkable connector insulator.
- j. **Lighting Cable:** Install as specified in this Division.
- k. **Ground Cable:** Install as specified in this Division.
- l. Install fire and smoke stop fittings at all cable penetrations of fire-rated walls, floors, and ceilings.

3. Cable Connections and Terminations

- a. Make up clean and tight to assure a low-resistance joint.
- b. Make only in terminal boxes, equipment or other accepted enclosures and not in conduit.
- c. Install all connectors with tooling manufactured by the connector manufacturer and as specified.

3.2 Field Quality Control

- A. Manufacturer's Field Services:** Provide as specified in DIVISION 1.
- B. Field Testing:** Specified in Section 16950.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Measurement

- A. No measurement will be made for this item.

4.2 Payment

- A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

**** END OF SECTION 16120 ****

SECTION 16450

GROUNDING

PART 1 - GENERAL

1.1 Description

- A. This Section includes the following:
1. Facility ground grid and ground rod system.
 2. Ground riser extensions to structural steel, electrical equipment, and mechanical equipment.

1.2 References

1. **American Society For Testing and Materials (ASTM)**

ASTM B8 - Concentric-Lay Stranded-Copper Conductors, Hard, Medium-Hard, or Soft.

2. **National Electrical Safety Code (NESC)**

3. **National Fire Protection Association (NFPA)**

70 - National Electrical Code.

70E – Standard for Electrical Safety in the Workplace

4. **Underwriters' Laboratories (UL)**

467 - Electrical Grounding and Bonding Equipment.

5. **Occupational Safety and Health Administration, OSHA.**

6. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor's responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

1.3 Submittals

- A.** Submit as specified in Section 1330.
- B.** Includes, but not limited to, catalog cuts for the following:
 - 1.** Ground Rods.
 - 2.** Cable.
 - 3.** Grounding Lugs.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Ground Rods

- 1.** Joslyn Manufacturing and Supply Company.
- 2.** Copperweld Bimetallics Group.
- 3.** Knight-Metalcraft, Division of Whitaker Cable.
- 4.** ITT Blackburn Company, a Division of International Telephone and Telegraph Corporation.
- 5.** Harger

B. Cable-to-Equipment Ground Lugs

- 1.** Burndy Corporation (Burndy).
- 2.** Knight-Metalcraft, Division of Whitaker Cable.
- 3.** Harger

2.2 Wire and Cable

- A.** Type BC2 as specified in this Division (Section 16120).
- B. Conductor Sizes**
 - 1.** As indicated for specific connections.

2. For required connections not indicated, use conductor size not less than No. 4/0 AWG if buried in earth or cast in concrete, or No.2 AWG at other locations, unless otherwise noted.

2.3 Ground Rods

- A. Copper-clad steel or copper-alloy sectional-type rods.
- B. One end pointed to facilitate driving.
- C. 3/4-inch diameter x 10 feet long with diameter and length stamped near top of rod.

2.4 Connection Materials

- A. Cable-to-cable and cable-to-rod cable-to-connector connections of exothermic-welding-type process.
- B. **Cable-To-Equipment Ground Lugs**
 1. Compression type.
 2. Bolted to equipment housing with silicon bronze bolts and lock washers.

2.5 Coatings

- A. **Coal Tar**
 1. Kop Coat - No. 50.
 2. Tnemec - 46-449.

PART 3 - EXECUTION

- 3.1 **Inspection:** Do not cover up connections before they are inspected by Engineer.

3.2 Installation

- A. **Wire and Cable**
 1. Install using as few joints as possible.

2. Protect against abrasion by several wrappings of rubber tape at all points where cable leaves concrete in exposed areas.
3. Suitably protect cable against damage during construction.
4. Replace or suitably repair cable if damaged by anyone before final acceptance.
5. All Connections to be metal to metal. Remove all paint, grease, dirt, etc. before making connections.

6. In Exposed Installations

- a. Route runs as indicated.
- b. Route along the webs of columns and beams, and in corners where possible for maximum physical protection.
- c. Support at intervals of 3 feet or less with nonmagnetic clamp-type supports.
- d. Where exposed and no natural protection available, provide physical protection as required to protect ground conductor.

7. In Buried Installations

- a. Lay in bottom of trench or in other excavations at least 30 inches below finished grade.
- b. Maintain clearance of at least 12 inches from all underground metal piping or structures, except where connections thereto are specifically indicated.
- c. Backfill as specified in DIVISION 2.

B. Ground Rods

1. Install rods as indicated by driving and not by drilling or jetting.
2. Drive rods into undisturbed earth where possible.

3. Where rods must be installed in excavated areas, drive rods into earth after compaction of backfill is completed.
4. Drive to a depth such that top of rods will be approximately 18 inches below final grade or subgrade, and connect main grid ground cable thereto.

C. Connections

1. Conform to manufacturer's instructions.
2. Chemically degrease and dry completely before welding.
3. Apply one coat of coal tar coating at 15 mils dry film thickness to all exothermic-welded connections to be buried.
4. **Make connections to equipment as follows:**
 - a. Make up clean and tight to assure a low-resistance connection with resistance not exceeding 1 ohm.
 - b. Install so as not to be susceptible to mechanical damage during operation or maintenance of equipment.
 - c. Provide direct copper connection to buried ground grid system.
 - d. Prior to making connections remove all paint, grease, etc. from connection location.

D. Metallic Conduit Grounds

1. Adequately and properly ground at all terminal points and wherever isolated from equipment or grounded steel.
2. Where extending into floor-mounted equipment from below, connect to equipment ground bus or frame.
3. Where extending into manholes, handholes, or cable trenches, connect to the ground riser or cable at that structure using grounding bushings.

E. Rack Grounds

1. Ground at intervals not to exceed 20 feet.
2. Ground all continuous runs as well as isolated sections at least at one point.

F. Box Grounds: Unless grounded by conduit system, ground all boxes by direct copper connection to the buried ground grid system.

G. Motor Grounds: Ground all motors with "identified" ground conductor in addition to conduit system. Route in conduit with phase conductors unless external ground is indicated.

3.3 Field Testing: Specified in Section 16950.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

**** END OF SECTION 16450 ****

SECTION 16900

GENERAL REQUIREMENTS INSTRUMENTATION AND CONTROLS

PART 1-GENERAL

1.1 SUMMARY

- A. This Section includes the extension of the NRWTP control system and connection to the new Vadose Well. This includes modifications of the control panels and other control enclosures for the instruments for the Project.
- B. Work Includes:
 - a. The Engineering, furnishing, installing, calibrating, adjusting, testing, documenting, starting up, and Owner training for complete Process Instrumentation and Control (PIC) for each well site.
- C. Major Components:
 - a. Primary instrumentation elements, transmitters, and control devices.
 - b. Exterior, weatherproof and environmentally conditioned control panels.
 - c. Programmable logic controllers and remote I/O modules.
 - d. Coordinated startup activities for new PLCs Division includes instruments, meters, control devices. and control panels as specified in each Section.
- D. Complete Detailed PIC Design: PIC as shown and specified includes functional and performance requirements and component specifications.
- E. Coordinated Startup and Commissioning: Coordinate with other trades, vendors, and programmers for testing, startup, and commissioning.
- F. **Work performed by Others - Owner/Engineer**
 - a. Programming of PLC.
 - b. Programming of SCADA Interface.
 - c. Review of contractor provided submittals, control panels, including I/O tables and tag names, etc.
 - d. Assistance during Startup and Commissioning.

1.2 Related Work

1. Section 16901 - Control Panels Instrumentation and Controls
2. Section 16902 – Measuring and Controlling Instruments and Loops
3. Section 16924 PLC and Accessories
4. SCADA Programming and Extension of Existing North Regional Waste Water Treatment Plant. PROVIDED BY OWNER/Others

1.3 References

1. Instrument Society of America (ISA)

S20 - Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.

2. Others as specified in applicable Sections.

3. National Fire Protection Association

National Electrical Code, NFPA 70

Standard for Electrical Safety in the Workplace, NFPA 70E

4. National Electrical Safety Code, IEEE C2.

5. Occupational Safety and Health Administration, OSHA.

6. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor's responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

1.4 System Responsibility – System Integrator

Systems may utilize equipment of different manufacturers but one System Integrator is to assume overall responsibility for the complete system.

A. Approved System Integrator

1. Alliance Service and Control Specialists, Inc.
2. HSQ Technologies
3. Engineer prior approved

B. System Integrator Pre-Qualification

System Integrator shall be provided by a firm specializing in control panel construction. Request for approval shall be submitted to engineer a minimum of 10 days prior to bid.

1.5 Submittals

A. Compliance Submittals

1. Submit as specified in Section 1330.
2. Manufacturer with prime responsibility shall assume responsibility for all Compliance Submittals.
3. **Includes, but not limited to, the following:**
 - a. Fabrication drawings, front elevation, wiring, diagrams, and bills of material for control panels.
 - b. Engraving schedule and physical dimensions for nameplates and phenolic overlays.
 - c. Electrical and mechanical connection diagrams for all separately mounted instruments.
 - d. Individual specification or descriptive sheets for instruments, annunciators and similar major system components to conform to ISA S20.
 - e. **Instruction Books**

For all instruments, transducers, and similar major system equipment.

In addition to the requirements as specified in DIVISION 1, submit single-page specification sheets

for each instrument which lists the type, model number, function, scale, input, actuation, output and other specific features of that instrument.

B. Action Submittals:

1. General:
 - a. Shop Drawings, full-scaled details, wiring diagrams, catalog cuts, and descriptive literature.
 - b. Identify proposed items and options. Identify installed spares and other provisions for future work (for example, reserved panel space; unused components, wiring, and terminals).
 - c. Legends and Abbreviation Lists: Complete definition of symbols and abbreviations used on this Project (for example, engineering units, flow streams, instruments, structures, and other process items used in nameplates, legends, and data sheets).

2. Bill of Materials: List of required equipment.
 - a. Group equipment items as follows:
 - 1) I&C Components: By component identification code.
 - 2) Other Equipment: By equipment type.
 - b. Data Included:
 - 1) Equipment tag number.
 - 2) Description.
 - 3) Manufacturer, complete model number, and all options not defined by model number.
 - 4) Quantity supplied.
 - 5) Component identification code where applicable.

3. Catalog Cuts:
 - a. I&C Components, Electrical Devices, and Mechanical Devices:
 - 1) Catalog information, mark to identify proposed items and options.
 - 2) Descriptive literature.
 - 3) External power and signal connections.
 - 4) Scaled drawings showing exterior dimensions and locations of electrical and mechanical interfaces.

4. Component Data Sheets: Data sheets for I&C components.
 - a. Format and Level of Detail: In accordance with ISA-S20.

- b. Include component type identification code and tag number on data sheet.
 - c. Specific features and configuration data for each component:
 - 1) Location or service.
 - 2) Manufacturer and complete model number.
 - 3) Size and scale range.
 - 4) Setpoints.
 - 5) Materials of construction.
 - 6) Options included.
 - d. Name, address, and telephone number of manufacturer's local office, representative, distributor, or service facility.
5. Sizing and Selection Calculations:
- a. Primary Elements: Complete calculations plus process data used. Example, for flow elements, minimum and maximum values, permanent head loss, and assumptions made.
 - b. Controlling, Computing and Function Generating Modules: Actual scaling factors with units and how they were computed.
6. Panel Construction Drawings:
- a. Scale Drawings: Show dimensions and location of panel mounted devices, doors, louvers, and subpanels, internal and external.
 - b. Panel Legend: List front of panel devices by tag numbers, nameplate inscriptions, service legends, and annunciator inscriptions.
 - c. Bill of Materials: List devices mounted within panel that are not listed in panel legend. Include tag number, description, manufacturer, and model number.
 - d. Construction Details: NEMA rating, materials, material thickness, structural stiffeners and brackets, lifting lugs, mounting brackets and tabs, door hinges and latches, and welding and other connection callouts and details.
 - e. Construction Notes: Finishes, wire color schemes, wire ratings, wire and terminal block, numbering and labeling scheme.
7. Panel Control Diagrams: For discrete control and power circuits.
- a. Diagram Type: Ladder diagrams. Include devices, related to discrete functions, that are mounted in

- or on the panel and that require electrical connections. Show unique rung numbers on left side of each rung.
- b. Item Identification: Identify each item with attributes listed.
 - 1) Wires: Wire number and color. Cable number if part of multiconductor cable.
 - 2) Terminals: Location (enclosure number, terminal junction box number, or MCC number), terminal strip number, and terminal block number.
 - 3) Discrete Components:
 - a) Tag number, terminal numbers, and location ("FIELD", enclosure number, or MCC number).
 - b) Switching action (open or close on rising or falling process variable), setpoint value and units, and process variable description (for example, Sump Level High).
 - 4) Relay Coils:
 - a) Tag number and its function.
 - b) On right side of run where coil is located, list contact location by ladder number and sheet number. Underline normally closed contacts.
 - 5) Relay Contacts: Coil tag number, function, and coil location (ladder rung number and sheet number).
 - c. Show each circuit individually. No "typical" diagrams or "typical" wire lists will be permitted.
 - d. Ground wires, surge protectors, and connections.
 - e. Circuit Names: Show names corresponding to Circuit and Raceway Schedule for circuits entering and leaving a panel.
8. Panel Wiring Diagrams: Show point-to-point and terminal-to-terminal wiring within panel.
 9. Installation Details: Include modifications or further details required to adequately define installation of I&C components.
 10. List of spares, expendables, test equipment and tools.
 11. Additional Equipment Recommended: List of, and descriptive literature for, additional spares, expendables, test equipment and tools recommended.

B. Informational Submittals:

Provide Manufacturer's Certificate of Proper Installation and readiness for operation.

1. Operation and Maintenance (O&M) Manuals: Operation and Maintenance Data, unless otherwise specified in this section.
 - a. Content and Format:
 - 1) Complete sets O&M manuals.
 - 2) Sufficient detail to allow operation, removal, installation, adjustment, calibration, maintenance and purchasing replacements for each PIC component.
 - 3) Final versions of Legend and Abbreviation Lists.
 - b. Include:
 - 1) Process and Instrumentation Diagrams: One reproducible copy of revised P&ID to reflect as-built PIC design.
 - 2) Refer to Paragraph Shop Drawings for the following items:
 - a) Bill of Materials.
 - b) Catalog Cuts.
 - c) Component Data Sheets.
 - d) Panel Control Diagrams.
 - e) Panel Wiring Diagrams, one reproducible copy.
 - f) Panel Plumbing Diagrams, one reproducible copy.
 - g) Loop Diagrams, one reproducible copy.
 - h) Interconnecting Wiring Diagrams, one reproducible copy.
 - i) Application Software Documentation.
 - 3) Device O&M manuals for components, electrical devices, and mechanical devices include:
 - a) Operations procedures.
 - b) Installation requirements and procedures.
 - c) Maintenance requirements and procedures.
 - d) Troubleshooting procedures.
 - e) Calibration procedures.
 - f) Internal schematic and wiring diagrams.
 - g) Component Calibration Sheets from field quality control calibrations.
 - 4) List of spares, expendables, test equipment and tools provided.
 - 5) List of additional spares, expendables, test

equipment and tools recommended.

2. **Performance Acceptance Tests (PAT) Submittals:**
 - a. Preliminary Test Procedures: Outlines of proposed tests, forms, and checklists.
 - b. Final Test Procedures: Proposed test procedures, forms, and checklists.
 - c. Test Documentation: Copy of signed off test procedures when tests are completed.

PART 2 - MATERIALS - Specified in applicable sections, SECTIONS 16901-16924.

PART 3 - EXECUTION

3.1 Testing

- A. As a minimum, the manufacturer's standard tests and calibration procedures shall be conducted on all instruments.
- B. Factory Acceptance Tests (FAT): All field devices to be calibrated at factory prior to shipment to site. Applicable test reports to be shipped with field device.
- C. **Performance Acceptance Tests (PAT):** All field devices to be calibrated at factory prior to shipment to site. Applicable test reports to be shipped with field device.
- D. Conduct all tests in the presence of Engineer or Owner under the supervision of equipment manufacturer's field engineer.
 1. Notify Engineer two weeks prior to the commencement of all tests.
 2. Include all tests recommended by the equipment manufacturer unless specifically waived by Engineer.
 3. Include all additional tests recommended by Engineer that he deems necessary because of field conditions, to determine that equipment and material and systems meet requirements of Contract Documents.
 4. Be responsible for all damage to equipment and material due to improper test procedures or test apparatus handling.

3.2 Acceptance Testing Procedures – Systems Integrator

1. Prior to Startup and Performance Evaluation period, inspect, test, and document that associated PIC equipment is ready for operation. Divide Functional Test into two parts.
 - Functional Test Part 1.
 - Functional Test Part 2.

2. **Functional Test Part 1:** Performed by Systems Integrator to test and document that PIC is ready for operation. Excluding Owner/Programmer provided applications software.
 - a. Loop/Component Inspections and Tests:
 - 1) These inspections and tests do not require witnessing will be spot checked by Engineer.
 - 2) Check PIC for proper installation, calibration, and adjustment on loop-by-loop and component-by-component basis.
 - 3) Provide space on forms for signoff by PICS Subcontractor.
 - 4) Use loop status report to organize and track inspection, adjustment, and calibration of each loop and include the following:
 - a) Project name.
 - b) Loop number.
 - c) Tag number for each component.
 - d) Checkoffs/Signoffs for Each Component:
 - (1) Tag/identification.
 - (2) Installation.
 - (3) Termination wiring.
 - (4) Termination tubing.
 - (5) Calibration/adjustment.
 - e) Checkoffs/Signoffs for the Loop:
 - (1) Panel interface terminations.
 - (2) I/O interface terminations with PLCs.
 - f) I/O Signals for PLCs, RTUs are Operational: Received/sent, processed, adjusted.
 - g) Total loop operational.
 - h) Space for comments.
 - 5) Component calibration sheet for each active I&C component (except simple hand switches, lights, gauges, and similar items) and each PLCs, I/O module and include the following:

- a) Project name.
 - b) Loop number.
 - c) Component tag number or I/O module number.
 - d) Component code number for I&C elements.
 - e) Manufacturer for I&C elements.
 - f) Model number/serial number for I&C elements.
 - g) Summary of Functional Requirements; For Example:
 - (1) Indicators and recorders, scale and chart ranges.
 - (2) Transmitters/converters, input and output ranges.
 - (3) Computing elements' function.
 - (4) Controllers, action (direct/reverse) and control modes (P, I, D).
 - (5) Switching elements, unit range, differential (fixed/adjustable), reset (auto/manual).
 - (6) I/O Modules: Input or output.
 - h) Calibrations, for example, but not limited to:
 - (1) Analog Devices: Actual inputs and outputs at 0, 10, 50, and 100 percent of span, rising and falling.
 - (2) Discrete Devices: Actual trip points and reset points.
 - (3) Controllers: Mode settings (P&ID).
 - (4) I/O Modules: Actual inputs or outputs of 0, 10, 50, and 100 percent of span, rising and falling.
 - (5) Space for comments.
 - b. Maintain loop status reports, and component calibration sheets at Site and make them available to Engineer at all times.
 - c. Engineer reviews loop status sheets and component calibration sheets and spot-check their entries periodically, and upon completion of Preparation for Testing. Correct deficiencies found.
 - d. Forms: See example Performance Acceptance Test Sheet in Article Supplements.
3. **Functional Test Part 2:** Combined effort between Contractor, Systems Integrator, and Owner/Programmer/Engineer to confirm PIC is ready for operation. This is to include the software and Owner/Programmer/Engineer provided software configurations.
- a. Prerequisite:

- 1) Completion of Functional Test Part 1.
 - b. Joint test with Owner/Programmer.
 - c. Test procedures provided by Engineer based on Functional Test Part 1 and application software tests.
 - d. Completed when Functional Test has been conducted and Engineer has approved associated test forms and checklists in field.
4. Required Test Documentation: Test procedures, forms, and checklists. Signed by Engineer and Contractor except for Functional Test items signed only by Contractor.

B. Performance Test During and After Facility Startup:

- 1. Some control processes cannot be completely tested until the facility is up and able to pump water. These functions require an additional performance testing after or during facility startup. Once a facility's Functional Test has been completed, perform jointly with Engineer, and Owner/Programmer. Make O&M data available to Engineer at Site both before and during testing.
- 2. Determination of Ready for Operation: When Functional Test has been completed.

3.3 System Integrator Field Services

- A. Testing and Startup Period:** Provide Systems Integrator Field Services for a minimum of **one working days**, with additional days as necessary to accommodate the commissioning and startup. Coordinate startup periods with the engineer, owner and general contractor.
- C.** Test and start-up supervision shall continue until the system is in proper operating condition as determined by the Engineer.
- D.** Provide Systems Integrator Field Services during Work to correct deficiencies in equipment and to correct deficiencies in the installation and wiring of equipment. Corrections shall be at no increase in the contract price.
- F.** Provide Systems Integrator Field Services for all instruments, control devices, and other devices furnished as a part of the control panel or instruments and associated control devices separately mounted to assure proper installation, setting, connection. and functioning.

PART 4 CONTROL DESCRIPTION

4.1 GENERAL

Vadoze Zone type wells provide Injection of treated effluent from the North Regional Waste Water Treatment Plant. The control of the well is per operator input.

PLC Remote I/O Panel shall be fabricated, configured and tested by the Systems Integrator in accordance with these Specifications and Contract Requirements.

A Solenoid Control Valve enables discharge water for the vadoze injection well.

Instrumentation at each well includes, Flow Meter, Pressure Transducer, And Well Draw Down Level Transducer.

Programming and extension of the NRWTP Control and SCADA System is provided by OWNER/ENGINEER

4.2 DESCRIPTION OF OPERATION

A. Vadoze Well Operation Description: MANUAL

1. The MANUAL Run Sequence is initiated by placing the Well H-O-R (Hand-Off-Remote) Switch into "HAND" Position.

B. Vadoze Well Operation Description: Remote

1. The MANUAL Well Pump Run Sequence is initiated by placing the Well H-O-R (Hand-Off-Remote) Switch into "HAND" Position.

4.3 DESCRIPTION OF INSTRUMENTATION

A. Well Pump Discharge Pressure

An analog pressure transmitter, with local digital display, is installed in the discharge piping to provide SCADA monitoring and historical logging of discharge pressure.

B. Well Pump Flow

A flow meter, with local digital display, is installed in the pump discharge piping to provide SCADA monitoring and historical logging of discharge Flow.

- C. Well Draw Down Level
An analog level transmitter, no local display, is installed in the well casing to provide SCADA monitoring and historical logging of water depth in the well.
- D. PLC Panel Temperature Switch.
A High Temperature (adjustable) Alarm Switch shall indicate if temperatures within PLC Panel exceeds the setpoint. This digital alarm signal is transmitted to the NRWTP Control System via SCADA.

PART 5 MEASUREMENT AND PAYMENT

5.1 Measurement

- A. No measurement will be made for this item.

5.2 Payment

- A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

**** END OF SECTION 16900 ****

SECTION 16901
CONTROL PANELS - INSTRUMENTS AND CONTROLS

PART 1 - GENERAL

1.1 Description

- A.** This Section includes the extension of the NRWTP control system and connection to the new Vadose Well. This includes modifications of the control panels and other control enclosures for the instruments for the Project.
- B.** The Contractor shall have overall responsibility for providing a complete operable system and shall have sole responsibility for the functioning of every piece of equipment in the Well Pump Control Panel and PLC Panel.
- C.** The Contractor having overall responsibility for providing a complete operable system shall have sole responsible for the following work:
 - 1.** Provide and install fiber optic cable and data converters interface communication links between the existing Pump Station PLC and the new Remote I/O, and between the existing Pump Station PLC and the new Vadose Well location. .
 - 2.** Provide, install and calibrate new Remote I/O to accommodate the new Vadose Well and equipment.
 - 3.** Provide, install and calibrate well head equipment including pressure sensors, level sensors, flow meters and control valves.
 - 4.** Provision of and installation of PLC's, PLC Remote I/O, with analog and digital input/output for control and monitoring of well pump facilities.
 - 5.** Integrate all motor control , valve control and remote SCADA controls signals into the control system.

1.2 Work Performed by Owner/Others

1. **Programming Configuration of Water Treatment Plant Control System, SCADA and PLC's is PERFORMED BY OWNER/OTHERS.**
 - a. Programming and modifications to the existing SCADA programming to be provided by Owner/Others.
 - b. Programming for PLC logic to be provided by Owner/Others.

1.3 References

1. **American Society for Testing and Materials (ASTM)**
ASTM D1248 - Polyethylene Plastics Molding and Extrusion Materials.
2. **National Electrical Manufacturers Association (NEMA)**
ICS - Industrial Controls and Systems.
3. As specified in each applicable section, this Division.
4. National Fire Protection Association
National Electrical Code, NFPA 70
Standard for Electrical Safety in the Workplace, NFPA 70E
5. National Electrical Safety Code, IEEE C2.
6. Occupational Safety and Health Administration, OSHA.
7. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor's responsibility to obtain local inspection approval for all non-UL labeled equipment and pay all fees in connection with the same.

1.3 Submittals: Submit as specified in Section 16900

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Prefabricated Panel Enclosures

1. Hoffman Engineering Company (Hoffman).
2. Engineer approved equal.

B. Wire Terminals and Connectors

1. Alpha Wire Corporation (Alpha).
2. Amp, Inc.
3. Belden Corporation (Belden).
4. General Electric Company (General Electric).
5. Thomas and Betts.

C. Wire Markers

1. Brady.
2. Electrovert.
3. Floy Tag & Manufacturing, Inc. (Floy Tag).
4. Panduit Corporation.

D. Terminal Blocks and Test Switches

1. Allen-Bradley.
2. Buchanan.
3. Marathon Special Products.
4. Phoenix Contact.
5. Weidmuller.

E. Circuit Breakers

1. Square D
2. Allen Bradley
3. Eaton-Cutler Hammer

F. Interior Illumination (LED)

1. Cree.
2. Lithonia.

2.2 Control Panels

A. Pre-Fabricated Panel Design Requirements

1. UL 508A Listed Control panel and assembly. Totally enclosed cabinet with front door and continuous hinge.
2. Formed and welded construction, 14 gauge minimum steel.
3. NEMA Type 4, or Type 4X enclosure, with Environmentally Controlled Air Conditioning.
4. Interior 12-gauge minimum steel mounting panel.
5. Sized to house all equipment and devices indicated.
6. Provide lockable design.
7. Exterior free standing or strut mounted as required.
8. Furnish Hoffman vapor action corrosion inhibitor sized for enclosure volume
9. Painting
 - a. Paint system shall be manufacturer's standard system, suitable for service intended.
 - b. Prepare all surfaces prior to painting.
 - c. Provide special color finish of light gray.

d. Provide one pint of touch-up paint of each color.

10. Manufactured by Hoffman Engineering Company.

2.3 Control Panel and Recording and Indicating Instruments Nameplates

- A. Fabricate from laminated phenolic sheeting with white core and satin finish melamine overlay.
- B. Color shall be Manufacturers standard (if not specified designate black).
- C. Thickness: 1/16-inch nominal.
- D. Bevel edges to expose white core on perimeter.
- E. Engraved legend through overlay to expose core.
- F. Attach to panels and instruments with contact cement or double-faced tape.

2.4 Remote I/O Control panel.

- A. **Remote I/O PLC PANEL** The Panel contains PLC Remote I/O modules with inputs and outputs to interface local instrumentation and Manual Hardwired Switches to the existing North Regional Waste Water Treatment Plant SCADA and Control System. The PLC Panel includes communication modems and fiber cable splice patch panels. The PLC Panel shall operate on a service voltage of 120VAC, 1-phase, 3-wire, 60 hertz. The PLC Panel shall be Type NEMA 4 or NEMA X with integral Air Conditioning. Provide sunshield "air gap" for front, sides, rear and top of enclosure. See detail. Provide conduit penetrations only from the bottom of the enclosure. Seal conduit penetrations with approved conduit/duct sealant.

2.5 Electrical System

A. Wiring

- 1. P&IDs and Control Diagrams on Drawings show function only. Use following rules to determine field circuit wiring:

- a. Devices on Single Circuit: 20, maximum.
 - b. Multiple Units Performing Parallel Operations: To prevent failure of any single branch circuit from shutting down entire operation, do not group all units on same branch circuit.
 - c. Branch Circuit Loading: 12 amperes continuous, maximum.
 - d. Panel Lighting and Service Outlets: Put on separate 15-amp, 120V ac branch circuit.
 - e. Provide 120V ac plugmold for panel components with line cords.
2. Alpha or Belden 600V, 105°C, UL style 1015 wire or Houston Wire and Cable SI-57275, SIS Vulkene insulated switchboard wire. Dc signal wiring shall be as specified in this Division.

3. Wire Sizes

- a. No. 14 AWG, 41 strand, for all convenience outlets, interior lighting, and other similar loads.
- b. No. 16 or 18 AWG, 16- to 41-strand, for low power loads of 115V or lower voltage.

4. Wire Markers

- a. Hot-stamped tube-type, Brady Ty-grip, Electrovert slip-on Type Z, or Floy Tag FT200C wire markers sized for snug fit for wire size.
- b. Identify both ends of wire with the same unique wire number.
- c. Assign wire numbers where specific designations are not indicated.

5. Wiring Methods

- a. Route main groups of wires in plastic nonflammable wiring duct.
- b. Smaller groups of wire shall be cabled and secured with nylon cable clamps and ties or plastic spiral wraps.

- c. Route instrument dc signal wiring in separate ducts or groups from ac power and control wiring.
- d. **Equipment and Terminal Block Connections**
 - (1) Make all connections with insulated locking spade lug terminals except where devices specified are available only with solder type terminals, or tubular clamp terminals.
 - (2) Install terminals with tool as recommended by manufacturer to apply required amount of pressure correctly.
- e. **Solder Connections:** Soldering iron used shall not exceed 100 W.
- f. Provide terminal blocks for all external connections.

B. Terminal Blocks

- 1. 600V, sectional type nylon polypropylene blocks.
- 2. Tubular clamp contacts.
- 3. Slide-in vinyl marking strip for terminal identification.
- 4. Provide a minimum of 10% spare terminals.

C. Switch Action Fuse Blocks

- 1. Rated 600V, 30-A.
- 2. Sectional type nylon or polypropylene blocks.
- 3. Tubular clamp contacts.
- 3. Pressure sensitive marking tape for terminal identifications.

D. Circuit Breakers

1. Manufacturer per this Section 2.1E. E-frame breaker for each instrument system, annunciator, lighting circuit, control system or similar major device requiring 24 Vdc or 115Vac power.
2. Manufacturer per this Section 2.1E. Series CF, Curve 3, for devices or systems requiring 26V, dc power.
3. Trip rating as indicated or recommended by manufacturer of equipment being protected.
4. Necessary space on panel for a minimum of three future circuit breakers.
5. Mounted on a panel inside control panel in a readily accessible location.

E. Push Buttons and Selector Switches

1. Heavy-duty oiltight units, 30MM, with contacts rated 10-A continuous at 120Vac.
2. Provide the number of contacts and contact development as indicated.
3. Start or On push buttons shall have a black operator.
4. Stop or Off push buttons shall have a red operator.

F. Illuminated Push Buttons

1. Heavy-duty oiltight units with contacts rated 10-A continuous at 120Vac.
2. Provide the number of contacts and contact development as indicated.
3. LED type.
4. Color caps as indicated above.

G. Multilight Oiltight Controls

1. Honeywell, Square D, Allen Bradley, Eaton Cutler Hammer, Phoenix Contact, Type CMC. LED Type.

2. Provide with four lighted quadrants.
5. Provide number of contacts, arrangements, and positions as indicated.
4. Provide cover plates, legend plate and color inserts; color and engraving to be Manufacturers Standard.
5. Provide all mounting hardware and mount on the control panels as indicated.

H. General-Purpose Control Relays

1. Idec, Square D, Allen Bradley, Eaton-Cutler Hammer Phoenix Contacts
2. Provide with coil voltage as indicated with a neon coil energization indicator on 120Vac coils.
3. Number of contacts required rated at 10-A at 120VAC.
4. Provide plug-in relay with socket.

I. Time Delay Relays

1. Idec, Square D, Allen Bradley, Eaton-Cutler Hammer, Phoenix Contacts, SSC Series.
2. Solid-state timing relay, plug-in type with matching socket.
3. Time range and voltage as required or indicated.
4. Contact rating of 10-A at 120Vac.
5. Contact action as required or indicated.

J. Pilot Lights

1. Heavy-duty oiltight units.
2. LED Type.
3. Color caps as follows:

Red – motor running
Green – motor stopped
Amber – motor overload

4. Push-to-test type.

K. Interior Illumination

1. Two-foot LED strip light.
2. Single-pole switch mounted in handy box.
3. Includes the following panels
 - a. Pump Control Panel.

L. Mounting of Relays and Control Devices

1. Complete accessibility to all terminals, relay sockets, and other devices without dismantling of panel equipment.
2. Do not block access to any instruments or control devices mounted on face sheet.
3. Installed on swing-out panels if necessary.
4. Mount all diodes, resistors and similar equipment between terminal points on terminal blocks.

- N.** Electronic Filters – Provide Electronic Filters on incoming power to prevent local harmonic currents from effecting panel instrument operation.

PART 3 - EXECUTION

3.1 Installation

A. Control Panels

1. Seal all unnecessary openings in enclosures and cast or drilled in the housekeeping pad.

2. Mount to equipment rack as indicated using compatible metal nuts and bolts.
3. Shim plumb and level.
4. Install all electrical connections to remote mounted controls as specified in DIVISION 16.
5. Close all unnecessary and unused openings in the enclosures with Dow Corning 3-6548 silicone RTV or General Electric RTF762 foam after piping and wiring are installed to prevent dirt from entering the panel.

B. Electrical Connections

1. Install wire and cable as specified in Section 16120.
2. Install circuits to field-mounted equipment as indicated and required.
3. Connect all lightning and surge arresters to panels and ground system.

C. Commissioning and Start-Up Services

1. See Section 16900

3.2 Field Quality Control

- A. Factory Tests:** Specified in Section 16900.
- B. Field Tests:** Specified in Section 16900.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

- A.** No measurement will be made for this item.

4.2 Payment

- A.** Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

**** END OF SECTION 16901****

SECTION 16902

MEASURING AND CONTROLLING INSTRUMENTS AND LOOPS

PART 1 - GENERAL

1.1 Summary

A. This Section includes the following

1. Flow Meters and Indicators.
2. Controllers.
3. Transducers and function modules.
4. Float Switches and Pressure Switches.
5. Instrument loops.

1.2 References

1. **American National Standards Institute (ANSI)**
ANSI B16.1 - Cast-Iron Pipe Flanges and Flanged Fittings.
2. **National Electrical Manufacturers Association (NEMA)**
3. As specified in each applicable section, this Division.
4. **National Fire Protection Association**
National Electrical Code, NFPA 70
Standard for Electrical Safety in the Workplace, NFPA 70E
5. **National Electrical Safety Code, IEEE C2.**
6. **Occupational Safety and Health Administration, OSHA.**
7. All electrical and control equipment and material shall bear the recognized Underwriters Laboratories, Inc. (UL) seal of approval. It is Vendor's responsibility to obtain local inspection

approval for all non-UL labeled equipment and pay all fees in connection with the same.

1.3 Submittals: Submit as specified in Section 1330.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Transducers and Function Modules (with Local Digital Display)

1. Rosemount Inc. (Rosemount).
2. Honeywell Process Control Division (Honeywell).
3. Andress Hauser

B. Magnetic Flowmeters (with Local Digital Display)

1. Rosemount Inc. (Rosemount)

C. Level Transducers (W/O Local Display)

1. Druck – Model PTX 1830 with Druck Model STI 202-034-02
2. Keller
3. Engineer Approved Equal

2.2 General

- A.** Transmitters shall have an output signal of 4 to 20 mA dc into a minimum load range of 0-600 ohms at 24Vdc.
- B.** All analog indicating and recording receivers shall have evenly graduated scales.
- C.** Provide all mounting brackets, pipe stands, supports, physical protection, and accessories required to install all field-mounted instruments.

- D. Splices in transducer cable are not allowed. Provide sufficient length from transducer to PLC/Remote/IO termination block without splices.
- E. Furnish and install all accessories required for complete and working systems as specified and indicated.

2.3 Transducers and Function Modules

- A. Solid-state design.
- B. Housed in a NEMA 1 enclosure designed for surface mounting on control panel interior.
- C. Provide with terminals for external connections.
- D. Designed to operate from a 120Vac power source.
- E. **Signal Transducers**
 - 1. Input/output signal ranges shall be standard 1-5Vdc, 4-20 mA dc, or 3-15 psi as indicated.
 - 2. Provide where required, indicated, or specified to change signal to one compatible with the equipment furnished.

2.4 Float Switches (Not Used)

2.5 Magnetic Flowmeters

- A. Flowmeter system shall consist of a flow element and an indicating transmitter mounted remotely from the meter tube assembly.
- B. System shall be accurate to within (1% of flow rate for velocities between 3 and 30 feet per second.
- C. **Meter Body**
 - 1. 304 stainless steel tube with flanged ends.
 - 2. 150-pound steel with flange that matches the piping provided.

3. Electrodes shall be 316 stainless steel and conical shaped for self-cleaning action.
4. Liner shall be polyurethane, PTFE and Neoprene.
5. Size as specified in this Section.

D. Transmitter

1. Magnetic flowmeter shall have "DC" excited coils.
2. The transmitter electronics shall be microprocessor based.
3. Shall accept the millivolt input from the meter and provide a (4-20 mA) linear output signal proportional to flow.

E. Accessories

1. Provide a stainless steel grounding ring on the inlet and outlet.

2.6 Instrument Loops

A. Well Flow

1. Flow Indicating Transmitter (FIT)
 - a. Provide a mag flow meter as specified
 - b. Install the meter and ground it as indicated
 - c. Calibrate the remote transmitter for full range of meter.
 - d. Mount remote transmitter on equipment rack, and power it from 120 volt panelboard
 - e. Provide a linear 4-20 mA output signal over the specified range. As indicated, wire the output signal to the flow indicating controller and then to the PLC Remote I/O Modules.

PART 3 - EXECUTION

3.1 Installation

A. Panel Mounted Devices: As specified in Section 16901.

B. Field Mounted Devices

1. Install as follows

- a. Mount on floor or wall as required using 2 inch pipe mounts.
- b. Mount plumb and level.
- c. Mount on walls with bottom of box or instrument 4 feet above floor unless indicated otherwise and instrument case spaced at least 1/2-inch away from wall.
- d. Install supports as specified in this Division.
- e. Provide sunshade for all instrument displays located outdoors to prevent UV damage to instrument displays.

2. Connect inputs and outputs as indicated on the manufacturer's shop drawings and as follows:

- a. Transmitters requiring electric power are supplied from the control panels.

3.2 Manufacturer's Field Services: As specified in Section 16900.

3.3 Field Testing

A. Instrument Tests and Adjustments

- 1. All instruments to be calibrated at factory, where possible, prior to installation.
- 2. With each system variable transmitter disconnected from its normal source of input signal, apply an input with manometer, instrument potentiometer, or other device and adjust span and zero on all instruments transmitting, receiving, or retransmitting the resulting variable current or voltage signal and on all final control devices. Check instruments and final

control devices at several points over the instrument measuring or control device span.

3. Apply manually adjustable time duration or current signals directly to receivers where required to adjust zero and span and to check operation of the instrument over the measuring span.
4. Accurately measure variable current and voltage signals as required to adjust all receivers, transmitters, transducers, and final control devices.
5. With input signals as specified in 1 above, adjust zero and span of each controller; check operation of controller with various set points and system variable inputs; adjust controller proportional band, reset, and rate to conform to instructions from manufacturer's representative and Engineer.
6. Check operation of each instrument with system in actual operation.
7. Readjust controller settings as required to obtain desired control of the associated system variables.

B. Functional Testing of Controls

1. Perform before equipment is placed in service.
2. Include operating control system from each control point.
3. Completely check each annunciated point and equipment alarm.
4. Operate by hand all relays and other system components that cannot be operated in normal manner with plant not in service.
5. Repeat with plant in operation.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

- A. No measurement will be made for this item.

4.2 Payment

- A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

**** END OF SECTION 16902 ****

SECTION 16924

PROGRAMMABLE LOGIC CONTROLLER (PLC) AND ACCESSORIES

PART 1 GENERAL

1.1 Summary

- A. **Furnish PLC Remote I/O, and ancillary equipment. Incorporate into PLC Panel.**
- B. **Coordinate with OWNER/Others for related work that is provided outside of this contract. See 16924-1.5.**
- C. **Related Work:**
 - 1. Section 16900 General Requirements Instrumentation and Control
 - 2. Section 16901 Control Panels
 - 3. Section 16902 Measuring and Controlling Instruments

1.2 References:

A. **Applicable Codes and Standards:**

- 1. Contractor shall furnish Equipment which conforms in all respects to applicable industry standards and sound engineering practice.
- 2. Design, fabricate, assemble, install, and test Equipment to conform to the applicable provisions of the following standards:
 - a. Institute of Electrical and Electronics Engineers (IEEE):
 - 1) 472 – Surge Withstand Capability Test.
 - 2) 518- IEEE Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources.

- b. National Fire Protection Association (NFPA):
 - 1) 70 - National Electrical Code (NEC).
- c. National Electrical Manufacturers Association (NEMA):
 - 1) ICS – Industrial Controls and Systems.
- d. Underwriters Laboratories (UL):
 - 1) 508 - Industrial Control Equipment
- e. Scientific Apparatus Manufacturer's Association (SAMA).
- f. Instrument Society of America (ISA).
- g. National Electrical Safety Code (NESC).

3. Safety Codes:

- a. National Fire Protection Association
 - i. National Electrical Code, NFPA 70
 - ii. Standard for Electrical Safety in the Workplace, NFPA 70E
- b. National Electrical Safety Code, IEEE C2.
- c. Occupational Safety and Health Administration, OSHA.

1.3 Submittals:

- A. Submit as specified in SECTION 16900.**
- B. Specific Submittals to be furnished for Equipment shall include at least the following:**
 - 1. Device list and bills of material.
 - 2. Data sheets on all PLC and touchscreen components.
 - 3. System architecture drawing (Control System Block Diagram) showing all input/output cabinets, communications interfaces controller cabinets, operator interfaces devices, data storage devices, prefabricated cables and interfaces to other systems, and related components. This drawing shall represent the physical composition of the system.
 - 5. Instruction manuals.

6. Description of operation of control Equipment.
7. Description of power failure and restoration mode.

1.4 Quality Assurance

A. Experience:

1. All Equipment and Materials furnished shall have an acceptable history of satisfactory reliable service in similar use for a period of at least two years.
2. Equivalent newly developed Equipment with less than two years' actual service will be considered from established manufacturers, if it has been adequately tested, meet the requirements of this Contract, and is approved by Engineer. Such Equipment shall be noted in the proposal for review.

1.5 WORK TO BE PERFORMED BY OWNER/OTHERS

1. Control System Programming of PLC.
2. Update programming of SCADA Interface.
3. Review of contractor submittals, I/O tables and tag names.
4. Programming Assistance during Startup and Commissioning.
5. Program documentation for all software operating systems, editors, compilers, utilities, application, control, and logic programs, both for the control, data acquisition, and processing functions.
6. Software: By OWNER/Others
7. Programming: BY OWNER/OTHERS
 - a. PLC Programming:
 - i. The PLC shall be programmed to perform the required logic functions and control loops for proper operation of the equipment as indicated.
 - ii. The PLC shall monitor power status to the control panel. Logic shall implemented that shall

clear run contacts when power is lost and perform routine startup of equipment after a power restoration.

- iii. The PLC program shall be thoroughly documented with explanations in the program of the operation performed in each program line or rung.
 - iv. Shall be programmed utilizing the latest version of Windows based programming software from the manufacturer.
 - v. Both a hard and soft copy of the program shall be provided to the Owner.
- b. Touchscreen: Not Used

8. Programming O&M Manual: BY OWNER/OTHERS

Provide O&M Manuals for the complete system including hard copy documentation of all PLC and touchscreen programming and I/O addressing including programming documentation comments.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers:

A. PLC's:

- 1. Allen-Bradley – CompactLogix.

B. PLC Remote I/O

- 1. Allen-Bradley 1769 I/O

2.2 General

A. Contractor shall provide a complete system with all I/O, communications modules, processors, power suppliers, and other necessary items to meet the functional requirements of this Part.

B. The system shall consist of at least the following:

- 1. Base unit including power supply.
- 2. Processor, including memory.

3. Communication hardware.
4. Input/output hardware.
5. Real-time clock/memory module.
6. Cables.
7. Touchscreen.
8. Spare parts.

2.3 Programmable Logic Controller and Remote I/O (CompactLogix):

A. General:

1. The programmable controller shall receive status intelligence, perform logic functions, issue control commands, and provide alarms and status information for this systems described in these Specifications.
2. The programmable controller Equipment shall consist of a solid-state control system which has user programmable memory for storage of instructions to implement specific functions.
3. The PLC Equipment shall be purposely designed as an industrial control system which can perform functions equivalent to a relay panel or a wired sold-state logic system.
4. All PLC Equipment provided shall be capable of operation in ambient temperatures of 0°C to 55°C, and 5 to 95% relative humidity (non-condensing), without fans or other cooling equipment.
5. All external connection points shall be capable withstanding the ANSI surge withstand capability (SWC) test as defined in ANSI C37.90a.
6. The PLC's shall operate without damage according to IEEE Standard 281.
7. The PLC's shall be capable of reporting by exception to a master PLC.
8. The PLC shall operate from 120 VAC, 60-hertz, single-phase power.

B. Processor Module: Not Used.

C. Real-Time Clock/Memory Module. Not Used.

D. Communications Hardware:

1. Allen Bradley 1769-AENTR to match existing.
2. Communications shall be Ethernet/IP (Ethernet). Provide interface module for connection of the PLC to the Ethernet network. Provide all required cable between the PLC and interface module.
2. All data within a PLC shall be accessible via Ethernet ports.
3. Programming functions shall be possible through the Ethernet ports.
4. Unloading and downloading of programs shall be possible through the Ethernet ports.
5. The operating mode of the PLC shall be changeable through the Ethernet ports.

E. PLC Input and Output Modules:

PLC Panel Remote I/O Modules: Provide Remote I/O Modules with Ethernet communication to Existing PLC's. Provide modules to accommodate a minimum of 125% of the inputs and outputs used in the project. Include module quantity calculations in shop drawing submittal.

Combination I/O Modules are not allowed.

1. The PLC base unit shall be provided with 12, 24VDC digital inputs and 12 relay outputs rated 2.5 Amps at 24VDC continuous.
2. Digital Input Modules: Allen-Bradley I216
 - a. Provide 16, 24VDC digital inputs.
 - b. Maximum signal delay time of 20 ms
 - c. Provide modules required for 125% of Digital Inputs.
3. Relay Output Modules: Allen-Bradley OW8
 - a. Provide 8 individually isolated 120Vac relay outputs.
 - b. Current per output of 1.0 Amp.
 - c. Provide modules required for 125% of Relay Outputs.
4. Analog Input Modules: Allen-Bradley 1769-IF4
 - a. Provide 4 4-20 mA current inputs.
 - b. 16 bit resolution.
 - c. Provide modules required for 125% of Analog Inputs.

5. Analog Output Modules: Allen-Bradley 1769-OF4
 - a. Provide 4, 4-20 mA current outputs.
 - b. 16 bit resolution.
 - c. Provide modules required for 125% of Analog Outputs.

F. Expansion Power Supply:

1. Provide expansion power supply as indicated.
2. Input voltage 120Vac.
3. Output of 2 Amps at 5Vdc and 0.8 Amps at 24Vdc.
4. Over-voltage and short circuit protection.

2.4 Operator Interface Touchscreen: Not Used

2.6 Spare Parts:

A. Provide the following spare parts:

1. One spare input/output module of each type provided.
2. One spare communication module for each type provided.

B. Provide five (5) spare fuses of each type used.

- 2.7 Test Equipment:** Any special test kits, cables, software, or other test accessories that are unique to the manufacturers' Equipment, used in operation or maintenance of this Equipment shall be provided.

PART 3 - EXECUTION

3.1 Installation:

A. Programmable Logic Controllers and Remote I/O Modules:

1. Install Remote I/O Modules in PLC PANEL enclosure as indicated and specified.
2. Wire all inputs and outputs to terminal blocks within the PLC Panel.
3. Install all communication modules and required cables.

3.3 Field Testing: Specified in SECTION 16950

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

A. No measurement will be made for this item.

4.2 Payment

A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

**** END OF SECTION 16924 ****

SECTION 16950
FIELD TESTING

PART 1 - GENERAL

1.1 Description

A. This Section covers field testing of all wire, cable, and electrical equipment.

B. Related Work Specified Elsewhere

GroundingSection 16450

1.2 References

1. American Society For Testing and Material (ASTM):

ASTM D877 - Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.

2. Insulated Cable Engineers Association (ICEA):

S-19-81 - Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

S-66-524 - Cross-Linked Thermosetting Polyethylene - Insulated Wire and Cable for the Transmission and Distribution of Electric Energy.

S-68-516 - Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

3. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE):

C37.20 - Switchgear Assemblies, Including Metal-Enclosed Bus.

4. National Electrical Code (NEC).

5. National Electrical Manufacturers Association (NEMA).

6. **International Electrical Testing Association (NETA)**
7. **National Fire Protection Association**
8. **Standard for Electrical Safety in the Workplace, NFPA 70E**
9. **National Electrical Safety Code, IEEE C2.**
10. **Occupational Safety and Health Administration, OSHA.**
11. As specified in each applicable section, this Division.

1.3 Quality Assurance

A. Test Reports

1. Submit as specified in Section 1330.
2. Maintain a written record of all tests showing date, personnel making tests, equipment used, equipment or material tested, tests performed, and results.
3. Notify Engineer two weeks prior to commencement of all testing except for megger tests.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Ground Test Set

1. Associated Research, Inc.
2. James G. Biddle Company.
3. Engineer Approved Equal

B. Multimeter

1. Fluke.

2. Engineer Approved Equal

C. Insulation Test Set

2. Associated Research, Inc.
3. James G. Biddle Company.

2.2 Provide all testing equipment required which includes all or some of the following

- A. Wet- and dry-bulb thermometer.
- B. 500V meggers.
- C. Battery-powered portable telephone sets and portable radios.
- D. One Multimeter (Volt-Ohm-Milliammeter) rated 20 K ohms per volt (dc) or better, or digital readout multimeter.
- E. One phase rotation meter, 60-Hz.
- F. Commercial model three-point ground test set, James G. Biddle Company "Megger" Ground Tester or Associated Research, Inc., "Vibroground" tester.
- G. Miscellaneous cable, test lights, buzzers, bells, switches, receptacles, plugs, and other equipment as required.

PART 3 - EXECUTION

3.1 General Requirements

- A. Test all wire, cable, and electrical equipment installed or connected by Contractor to assure proper installation, setting, connection, and functioning as indicated or to conform to Contract Documents and manufacturer's instructions.
- B. Conduct all tests except megger insulation testing in the presence of Engineer or Owner and under the supervision of equipment manufacturer's field engineer.

- C. Include all tests recommended by the equipment manufacturer unless specifically waived by Engineer.
- D. Include all additional tests issued by Engineer that he deems necessary because of field conditions to determine that equipment and material and systems meet requirements of Contract Documents.
- E. Be responsible for all damage to equipment or material due to improper test procedures or test apparatus handling.
- F. Provide written reports of all testing to engineer within five (5) days of completion of test and prior to energizing.

3.2 Execution

A. Molded Case Circuit Breaker Tests

1. Visually inspect and manually operate each breaker, to insure proper alignment and smooth operation note any defects or operational problems.
2. Check nameplate data to drawing and specifications.
3. Check adjustable magnetic trip settings against values furnished by Engineer.
4. Megger each pole for freedom from grounds.
5. For breakers provided with shunt trips, check operation of shunt trip circuit.
6. Check all connections.
7. Check for proper current rating for circuit to which breaker is connected.

B. Motor Tests on All Motors

1. Check equipment ground to assure continuity of connections as specified in this Division.
2. Measure the insulation resistance of the stator winding before applying voltage. Compare this measured value against the

manufacturer's value. If there is no insulation resistance value furnished by manufacturer, use the following:

Motor Voltage	Insulation Resistance
600 volts and below	5 megohms

If measured resistance values are lower than above, record room temperature and humidity and submit readings to Engineer before energizing. Dry out motors as required by accepted method of application of external heat, and do not apply voltage to motor until substandard resistance condition is corrected. Megger readings are to be one-minute duration, using a 500V megger for all motors 600V and below.

3. Prior to final equipment alignment, disconnect motor from driven equipment where necessary to check lubrication, starter, and control circuits. If motor is free of dirt and dust, rotate rotor by hand to determine that motor turns freely. Clean out motor if necessary. Apply voltage momentarily and note direction of rotation. Correct rotation if necessary. Reconnect motor to driven equipment.
4. After the motor is placed in operation, observe the motor for heating at the bearings or windings. If the motor appears to be running hot, notify Engineer. Note: General purpose motors may reach temperatures up to 176 degrees F with a room temperature of 104 degrees F.
5. If motor is controlled by a VFD, Take motor load ampere readings (on all three legs of three-phase motors) at 60%, 70%, 80%, 90% and 100% of full speed. Submit results to Engineer.

C. Power Switches (Disconnects and Safety)

1. Inspect contacts and clean if required.
2. Inspect arc chutes if provided on switch.
3. Inspect fuses for proper rating if furnished on switch.
4. Operate switches (de-energized) for proper functioning.

D. Float Switches

1. Inspect and test switches to conform to manufacturer's recommended field tests.
2. Adjust switches to perform the design function for proper equipment operation.

E. Wire and Cable Tests: (Feeders and Control Circuits Only)

1. Megger all 600V insulated wire with a 500V megger for one minute, and values must be approximately as follows:

Conductor Capacity <u>Amperes</u>	Resistance <u>Ohms</u>
0-24	1,000,000
25-50	250,000
51-100	100,000
101-200	50,000
201-400	25,000
501-800	12,000
Over 800	5,000

Determine the values with all switchboards, panelboards, fuse holders, switches, and overcurrent devices in place. Do not connect motors and transformers during meggering. Megger wire and cable after installation and not on the cable reel.

2. Check all control cable by megger tests similar to those described for 600V insulated wire. Check all control wiring for tightness of terminal contacts and continuity (especially of current transformer leads) through each "run" of control circuiting. Thoroughly verify all wiring by means of battery-powered lights, buzzers, bells, or telephones.

After completing these checks and tests on a given control circuit, attach a temporary cardboard tag on each end of cable tested which bears date and name of Contractor's representative responsible for checking. Follow this procedure for each control circuit cable. Provide all phasing tests and make all changes necessary to assure proper rotation of all motors, the correct phasing and phase sequence of all circuits susceptible to being paralleled, the proper polarity on all instrument transformer wiring, and such other phasing tests as

may be required for the equipment being connected under this Contract.

Do not test cable with an ac test set. Disconnect cables from all equipment during testing. Testing cable on reel will not be acceptable. Make testing after installation but before final connection of equipment. Make high-potential tests phase-to-ground on each individual conductor.

F. Control Schemes Tests

1. Test all electrical controls by trial operation of control equipment after all wiring is completed to see that each interlock and control function operates to conform to the description of operation, as well as with the manufacturer's operating instructions.

G. Miscellaneous Equipment Tests

Test all miscellaneous equipment furnished by equipment manufacturer as recommended by manufacturer.

H. Lighting Tests

1. Test all systems for proper operation and correct phasing prior to final acceptance.

I. Grounding Tests

1. Measure resistance of ground system at each ground riser.
2. Record results and notify Engineer if any reading exceeds 1 ohms.
3. Test at least three of each type of ground connections and not less than 25 percent of all ground connections.
4. Test by one of the following methods for resistance measurement:
 - a. Three-point method using an ammeter and voltmeter with ac or dc power supply.

- b. Commercial instrument method using equipment as specified in this Section.

J. SCADA SYSTEM TESTING

- 1. Activate each monitored point in the new pump station and verify that the associated signal is received at the Central Monitoring Station at the Water Treatment Plant.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

- A. No measurement will be made for this item.

4.2 Payment

- A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

**** END OF SECTION 16950 ****