Chandler · Arizona Where Values Make The Difference	PURCHASING ITEM FOR COUNCIL AGENDA Memo No. CP16-214	1. Agenda Item Number: 17
		2. Council Meeting Date: June 9, 2016
TO:	MAYOR AND COUNCIL	3. Date Prepared: May 25, 2016
THROUGH:	CITY MANAGER	4. Requesting Department: Municipal Utilities

5. SUBJECT: Construction Manager at Risk Contract to Walsh Construction Group, an Illinois company dba Archer Western Construction, LLC, for the Manganaro Lift Station Improvements

6. RECOMMENDATION: Staff recommends City Council award a Construction Manager at Risk Contract to Walsh Construction Group, an Illinois company dba Archer Western Construction, LLC, for the Manganaro Lift Station Improvements, Project No. WW1504.401, in an amount not to exceed $1,734,570.

7. BACKGROUND/DISCUSSION: The Manganaro Lift Station is located at the southeast corner of Price and Ray Roads. The facility has been in operation since 1998. The Manganaro Lift Station conveys wastewater flows from northwest Chandler to the City's wastewater treatment facilities. This aging facility is in need of rehabilitation to maintain system reliability.

This project scope of work consists of: replacement of the existing wet well piping, rehabilitation of the lift station wet well and two adjacent manholes, as well as the installation of a new flow meter. Traffic flow along the northbound 101 frontage at Ray Road will be minimally affected during construction hours. Traffic control for this work has been coordinated with the Arizona Department of Transportation. Construction activities will be completed during the summer months and are being coordinated with the commercial businesses in the area to minimize impact to customer parking.

A Project Agreement for construction management services, Project No. WW1504.451, with Wilson Engineering, LLC, for the Manganaro Lift Station Improvements, is also scheduled for this City Council meeting.

8. EVALUATION: The selection process was followed in accordance with State law. Six (6) Statements of Qualifications were received from qualified firms on October 27, 2015. The Selection Committee reviewed the Statement of Qualifications and ranked each firm as follows:

1. Walsh Construction Group, an Illinois company dba Archer Western Construction, LLC
2. Felix Construction Company
3. Hunter Contracting Company
4. PCL Construction, Inc.
5. M.A. Mortenson Construction
6. MGC Contractors, Inc.

Staff recommends contract award to Walsh Construction Group, an Illinois company dba Archer Western Construction, LLC, based on qualifications, relevant firm experience, team experience, project understanding, and project approach. The construction contract time is 120 calendar days for substantial completion, and 165 calendar days for final completion.

9. FINANCIAL IMPLICATIONS:

Cost: $1,734,570
Savings: N/A
Long Term Costs: N/A

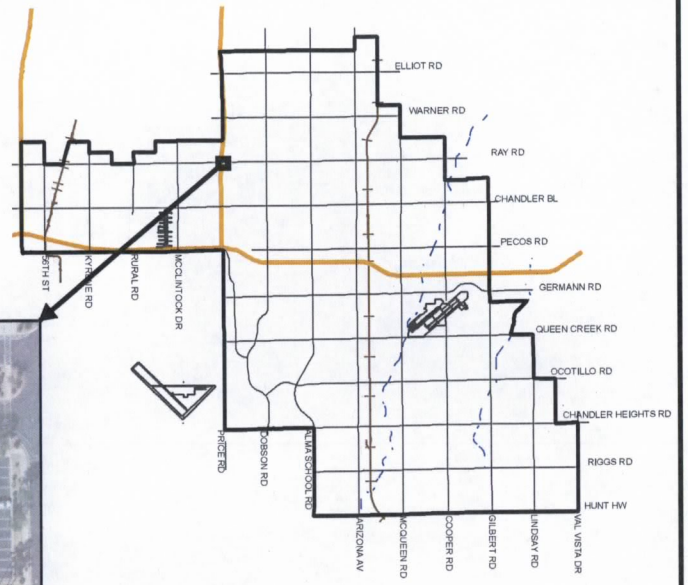
Fund Source:

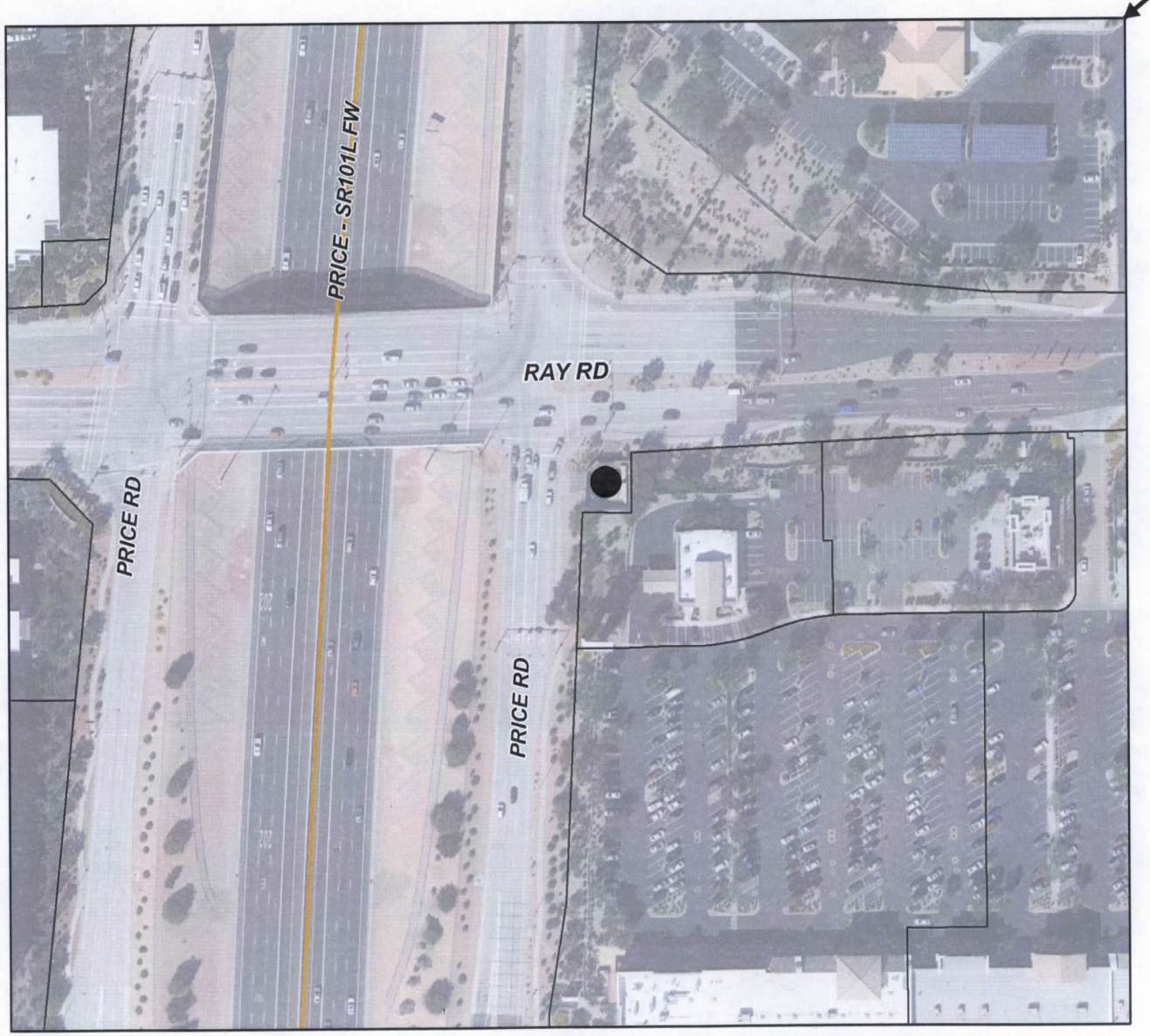
Account No.:	Fund Name:	Program Name:	CIP Funded:	Amount:
611.3910.6815.6WW196.0	Wastewater Bonds	Collection Systems Facility Improvements	Yes	$1,734,570

10. PROPOSED MOTION: Move City Council award a Construction Manager at Risk Contract to Walsh Construction Group, an Illinois company dba Archer Western Construction, LLC, for the Manganaro Lift Station Improvements, Project No. WW1504.401, in an amount not to exceed $1,734,570.	
ATTACHMENTS: Location Map, Contract	
APPROVALS	
11. Requesting Department Gina Ishida-Raybourn, Acting Utilities Engineering Manager	**13. Department Head** John Knudson, Municipal Utilities Director
12. Transportation & Development Bob Fortier, Capital Projects Manager	**14. City Manager** Marsha Reed

Chandler + Arizona

MANGANARO LIFT STATION IMPROVEMENTS
PROJECT NO. WW1504.401





MEMO NO. CP16-214

● PROJECT LOCATION

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CONSTRUCTION MANAGER AT RISK
CONSTRUCTION CONTRACT

PROJECT TITLE: MANGANARO LIFT STATION IMPROVEMENTS
PROJECT NO: WW1504.401

This CONTRACT is made this day of , 2016, by and between the City of Chandler, 215 E. Buffalo Street, Chandler, Arizona 85225, (hereinafter referred to as "CITY,") and **Walsh Construction Group, an Illinois company dba Archer Western Construction, LLC, a limited liability company**, (hereinafter referred to as "CM@RISK.")

CITY and CM@RISK, in consideration of the mutual covenants hereinafter set forth, agree as follows:

ARTICLE 1 – CITY'S STANDARD CONSTRUCTION GENERAL CONDITIONS:

The City's General Conditions for Construction Contracts are incorporated herein by reference and the parties agree to be bound by all provisions therein. If any of the provisions of the contract conflict with the City's General Conditions for Construction Contracts, the parties are bound by the General Conditions. For the purposes of this Contract, references to CONTRACTOR and to CM@RISK in said General Conditions refer to CM@RISK herein.

ARTICLE 2 – DEFINITIONS:

Words used in this Contract which are defined in CITY's General Conditions for Construction Contracts shall have the meaning stated therein. CM@RISK is the CONTRACTOR as defined in said General Conditions.

2.1 "Construction Allowance Items" means those items included in the GMP as allowances, which items shall be paid based on the actual cost to CM@RISK as described in the City's General Conditions for Construction Projects, Subsection 12.4., provided, however, no overhead or profit shall be included in the item as these are paid separately. The actual amounts paid for Allowance items shall be included in the Contract Price Subtotal by which the percentage for the Contractor's fee for overhead and profit is multiplied.

2.2 "Guaranteed Maximum Price" (GMP) means the maximum amount to be paid by the City to CM@RISK for the performance of the Work which shall constitute payment in full for the furnishing of all materials, equipment, appurtenances, labor, plant and tools necessary to provide a complete workmanlike, finished and satisfactory Project as described herein.

ARTICLE 3 – CM@RISK – FIDUCIARY DUTY:

3.1 This is a contract for complete construction services in accordance with the Construction Manager at Risk method of delivery of construction services. CM@RISK has participated in the design process and been an active member of the Project Design Team and is fully aware of any issues and constraints involved in this construction project.

3.2 CM@RISK is the CITY's fiduciary responsible for undertaking all necessary action contemplated under the contract documents to construct the Project and ensure

timely and quality completion of the project at a cost within the Guaranteed Maximum Price (GMP).

This project is an "open book" project. CITY is entitled to attend any and all meetings, and CITY shall have access to any and all records of CM@RISK or maintained by CM@RISK relating to the Project.

ARTICLE 4 – WORK:

4.1 CM@RISK shall perform all work necessary to complete the Project described herein. The Project is known as and is hereinafter referred to as, CITY PROJECT NO. WW1504.401 and is described as follows: construction of MANGANARO LIFT STATION IMPROVEMENTS described in the Contract Documents and including the furnishing of all materials, equipment, appurtenances, labor, plant and tools necessary to provide a complete workmanlike, finished and satisfactory Project as described herein. Each item shall be completed with all necessary connections, testing, painting and related work accomplished to provide for the satisfactory use and/or operation of the item.

4.2 CM@RISK shall complete, provide and perform, or cause to be performed, all work in a proper and workmanlike manner, with appropriate consideration for public safety and convenience, consistent with the highest standards of professional and construction practices and in full compliance with, and as required by or pursuant to, this Contract, and with the greatest economy, efficiency, and expediency consistent therewith all as more particularly described in the Contract Documents.

ARTICLE 5 – CITY'S REPRESENTATIVE:

5.1 CITY has appointed a CITY'S REPRESENTATIVE (sometimes referred to as CITY REP and sometimes known as the Owner's Representative or Construction Manager) to manage this Project and to represent the CITY on the Project site. The CITY REP will assume all duties and responsibilities and will have all rights and authority assigned to the CITY REP in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents. Any references in the Contract Documents, or other pertinent documents, to the Engineer or Project Engineer shall mean the CITY REP.

5.2 The CITY'S Representative is Allan Zimmerman / Alvin Robertson

ARTICLE 6 - CONTRACT TIME:

6.1 Completion time. The Work shall be substantially complete within **One Hundred Twenty (120)** calendar days after the date when the Contract Time commences to run as provided in the Contract Documents, and all Work shall be finally completed and ready for final payment in accordance with the Contract Documents within **One Hundred Sixty Five (165)** calendar days after the date when the Contract Time commences to run.

6.2 CPM Schedule. CM@RISK shall submit to CITY, on or before the effective date of the Construction Contract, a Construction Progress Schedule in Critical Path Method (CPM) format indicating the times for starting and completing the various stages of the Work, including any Milestones specified in this Contract and as more fully described in the General Conditions and other Contract Documents. Revisions/updates to the CPM

schedule shall be submitted as often as necessary to accurately reflect plans for completion of the work, but no less frequently than required in the Contract Documents.

6.3 Time is of the Essence. All of the time limits for Milestones, if any, for Substantial Completion and for Final Completion and readiness for final payment as stated in the Contract Documents, are of the essence of the Contract.

6.4 No Waiver. Failure of CITY to insist upon the performance of any covenant or condition within the time periods specified herein, shall not constitute a waiver of CM@RISK'S duty to perform every other covenant or condition within the designated periods, unless a specific waiver is granted in writing for each such covenant or condition.

6.5 Specific Waiver. CITY'S agreement to waive a specific time provision or to extend the time for performance shall not constitute a waiver of any other time provisions contained in the Contract Documents. Failure of CM@RISK to complete performance promptly within the additional time authorized in the waiver or extension of time agreement shall constitute a material breach of this Contract entitling CITY to all the remedies set forth herein or provided by law.

6.6 Material Breach. Failure of CM@RISK to perform any covenant or condition contained in the Contract Documents within the time periods specified herein, shall constitute a material breach of this Contract entitling CITY to terminate the Contract unless CM@RISK applies for and receives an extension of time, in accordance with the procedures set forth in the Contract Documents.

6.7 Written Extensions. Failure of CITY to insist upon the performance of any covenant or condition within the time periods specified herein, or CITY's agreement to waive a specific time provision or to extend the time for performance shall not constitute a waiver of CM@RISK's duty to perform every other covenant or condition within the designated periods, unless a specific waiver is granted in writing for each such covenant or condition. Failure of CM@RISK to complete performance promptly within the additional time authorized in the waiver or extension of time agreement shall constitute a material breach of this Contract entitling CITY to all the remedies set forth herein or provided by law.

ARTICLE 7 - LIQUIDATED AND SPECIAL DAMAGES:

7.1 Liquidated Damages: It is hereby agreed that the amounts per day set forth herein in paragraphs 7.1.2. are reasonable estimates of such damages, that said amounts do in fact bear a reasonable relationship to the damage that would be sustained by CITY, and CM@RISK agrees to pay such liquidated damages as herein provided.

7.1.1 CITY and CM@RISK recognize that time is of the essence of this Contract and that CITY will suffer financial loss, in addition to and apart from the costs described in Paragraph 7.2, if the Work and/or portions of the Work are not performed and completed within the times specified in Article Six, plus any extensions thereof allowed in accordance with the Contract Documents. CITY and CM@RISK also recognize the delays, expense, and difficulties involved in proving, through legal or arbitration proceedings, the actual loss suffered by CITY if the Work or portion of the Work is not completed on time. Accordingly, instead of requiring any such proof, CITY and CM@RISK agree that as liquidated

damages for delay (but not as a penalty) CM@RISK shall pay CITY **Seven Hundred Ten** dollars and no cents (**$710**) for each calendar day that expires after the time specified in Article Six for substantial completion, until the Work is substantially complete. After Substantial Completion, if CM@RISK shall neglect, refuse or fail to complete the remaining Work within the Contract Time or any proper extension thereof granted by CITY, CM@RISK shall pay CITY **Three Hundred Fifty Five** dollars and no cents (**$355**) for each day that expires after the time specified in Article Six for final completion and readiness for final payment.

7.2 Special Damages: In addition to the amounts provided for liquidated damages, CM@RISK shall pay CITY the actual costs reasonably incurred by CITY for the CITY REP, the Project Designer and for engineering and inspection forces employed on the Work for each day that expires after the time specified in Article Six for Final Completion, including any extensions thereof made in accordance with the Contract Documents, until the Work is finally complete. The rate for inspection services for this contract is One Hundred Forty Eight dollars ($148) per hour. The rate for work by the Project Designer for this Contract is One Hundred Ninety dollars ($190) per hour. The rate for work by the CITY REP is One Hundred Ninety dollars ($190) per hour. Each of these hourly rates is calculated at time and one half for work required to be performed during other than normal business hours.

7.3 CITY may withhold and deduct from any payment due to CM@RISK the amount of liquidated damages, special damages, and other costs, such as CM@RISK'S failed testing costs or damages to other CITY property, from any moneys due CM@RISK under the Contract.

ARTICLE 8 - CONTRACT PRICE:

8.1 Guaranteed Maximum Price. The Guaranteed Maximum Price (GMP) is the total amount payable by the City to Contractor for the complete construction of the Project. CM@RISK represents, warrants and guarantees to CITY that the total maximum cost to be paid by CITY for CM@RISK's complete performance of this Contract, including, without limitation, Final Completion of all Work, all services of CM@RISK under this Contract, and all fees, compensation and reimbursements to CM@RISK, shall not exceed the total amount of **One Million Seven Hundred Thirty Four Thousand Five Hundred Seventy dollars ($1,734,570)** ("Guaranteed Maximum Price"), as set forth in Exhibit C, attached hereto and incorporated herein by reference. Costs which would cause the Guaranteed Maximum Price to be exceeded shall be paid by the CM@RISK without reimbursement by CITY.

8.2 Guaranteed Maximum Price Components. The Guaranteed Maximum Price is comprised of the maximum amount payable by CITY for:

8.2.1 The Cost of the Work for full and complete performance of the Work to complete the Project as described herein. The items to be included in Cost of Work are those listed in Section 12.4 of the City's General Conditions for Construction Projects, except that no overhead and profit shall be included in the cost of work and shall be subtracted out of items listed in 12.4 A 5) c, and the items listed in 12.4.A 5) d and h are not included in the cost of the work. The Cost of the Work will be referred to as the Work Item Direct Costs. No additional payments will be made for any work included in and/or necessary for completion of the Project unless specifically noted and excluded from the GMP in the

assumptions and clarifications of the GMP. Progress payments will be made based on the schedule of values, however, City reserves the right to audit the books of CM@RISK, at any time, to determine actual costs and to modify the schedule of values to better reflect actual costs of the work.

8.2.2 A fee to CM@RISK for Overhead and Profit which has been estimated for inclusion in the GMP to be the amount of One Hundred Five Thousand Twenty Four dollars ($105,024) ("CM@RISK's Fee"). This fee shall be determined by multiplying the agreed upon percentages listed in the GMP by the Work Item Direct Costs less the amounts listed for Contractor's General Conditions. This CM@RISK's Fee shall be the CM@RISK's sole and exclusive compensation for all costs not included in Subsections 8.2.1 or 8.2.3 herein and for those costs and expenses listed in Subsection 12.4 B and 12.5 of the City's General Conditions for Construction Projects, and is inclusive of all overhead and profit arising out of or relating to the CM@RISK's Work.

8.2.3 Reimbursement to CM@RISK by CITY for the cost of insurance, bonds and taxes actually incurred by CM@RISK for this Project.

8.2.4 The Guaranteed Maximum Price is further broken down into line items and categories on Exhibit C attached hereto.

Quantities. The quantities set forth in the GMP are used only for the purpose of substantiating and demonstrating the basis for the GMP submitted by CM@RISK and are not a part of this Contract nor any guarantee by CITY. CM@RISK shall install and perform such quantities as necessary to complete the Project in accordance with the Project description and the Contractor agrees to perform all of the Work for costs plus fees and reimbursements described herein, not to exceed the Guaranteed Maximum Price, regardless of whether or not the items or units are decreased or increased.

8.3 Cost Overruns. CM@RISK shall be solely liable and responsible for and shall pay any and all costs, fees and other expenditures in excess of the Guaranteed Maximum Price for and/or relating to the Work, without entitlement to reimbursement from CITY. CM@RISK is not entitled to any fee, payment, compensation or reimbursement under this Contract or relating to the Work or Project other than as expressly provided in this Article 8.

8.4 Inferable Work (intent of the Project). CM@RISK agrees that the scope of the Guaranteed Maximum Price includes Work not expressly indicated on the Contract Documents, but which is reasonably inferable from the Project description and/or Contract Documents, or consistent therewith, and such Work shall be performed by CM@RISK without any increase in the Guaranteed Maximum Price.

8.5 Allowances. The GMP includes some work items with the cost listed as an allowance. Allowances are to be used specifically for the areas of work defined in the Contract Documents; provided however,

8.5.1 If the designated work is completed for less than the allowance, the surplus will revert to the project construction contingency.

8.5.2 If the designated work requires more than the allowance, the additional funds will be allocated by the CITY with assistance from CM@RISK within the

GMP by transferring excess from other allowance items, value engineering or using less expensive means, methods or components or as a last resort reducing the scope of the Project.

8.5.3 A running balance sheet will be kept concerning the various allowances so that monies can be floated among the allowances to maintain the integrity of the overall GMP. Thus, savings in one area of work will be available to offset overruns in another area of work specifically associated with these allowances.

8.6 Construction Contingency. This GMP includes a dollar amount listed as a Construction Contingency which shall be readily available for increased costs for subcontractors, material and equipment subject to prior approval of City, which approval will not be withheld unreasonably. The Construction Contingency may also be used, at the discretion of CITY, to reimburse CM@RISK for unexpected costs due to (a) scope gaps between trade subcontractors; (b) contract default by trade subcontractors; (c) unforeseen field conditions but only as defined in Subsection 4.3 of the City's General Conditions for Construction Projects; (d) work completed to meet the intent of the design, but which was not indicated on the plans; (e) costs overruns not covered by allowances; (f) costs of corrective work not provided for elsewhere and (g) implementation of any Recovery Plan. Cost for which CM@RISK desires to be paid from the Construction Contingency shall be documented by CM@RISK on a time and materials basis and are subject to verification by the CITY. If agreed to by CITY, a "Use of Contingency" form shall be executed by both parties authorizing the actual cost of the work to be paid and included in the Work Item Direct Costs. The Construction Contingency is not allocated to any particular item of the Project but may be used for any portion of the work as determined above. Any amount not used in the Construction Contingency shall belong to the CITY and shall reduce the GMP.

8.7 Owner's Contingency. This GMP also includes a dollar amount listed as an Owner's Contingency which may be used only by the CITY (owner department) for upgrades and changes in scope or other changes not already included within the intent of the Project Program. CITY shall provide CM@RISK with a Work Change Directive authorizing CM@RISK to perform the additional work and to transfer funds from the Owner's Contingency to the Work Item Direct Costs category to be paid with such direct costs. These additional costs shall be in amount mutually agreed upon by CM@RISK and CITY or shall be documented by CM@RISK on a time and materials basis and are subject to verification by the CITY. Any amount not used in the Owner's Contingency shall belong to the CITY and shall reduce the GMP.

8.8 Reduction of the Work. If CITY elects to have a party other than CM@RISK, or one of CM@RISK's Subcontractors, perform the Work related to an Allowance Item or other portion of the Work, or otherwise eliminates or reduces the scope of an Allowance Item or other portion of the Work, the Guaranteed Maximum Price shall be reduced by the Allowance Amount for any such Allowance Item or the budgeted amount in the Guaranteed Maximum Price for such item, and such amount shall be excluded from the Work Item Direct Costs upon which the CM@RISK's Fee is calculated.

8.9 Taxes. CM@RISK shall pay all existing and future applicable Federal, State and local sales, consumer, use and similar taxes, whether direct or indirect, relating to, or incurred in connection with the performance of the Work. In the event CM@RISK is obligated to pay any new or increased taxes or duties arising after the date hereof, the amount of such new or increased taxes shall increase the Guaranteed Maximum Price pursuant to the Change Order provisions of this Contract as set forth in the General

Conditions. In the event CM@RISK receives the benefit of a tax exemption or tax reduction taking effect after the date hereof, the amount of such exemption or reduction shall decrease the Guaranteed Maximum Price pursuant to the Change Order provisions of this Contract.

ARTICLE 9 - PAYMENT PROCEDURES:

9.1 Schedule of Values. Before the first application for Payment, CM@RISK shall submit to CITY, and the parties shall agree upon, a Schedule of Values, setting forth the various portions of the Work, and the costs listed in the Guaranteed Maximum Price allocated to each such portion of the Work. The Schedule shall be used as a basis for reviewing the contractor's applications for payment and as a basis for progress payments. The Schedule of values shall be updated as actual costs become known to accurately reflect the cost of the work. City reserves the right to audit the books of CM@RISK, at any time, to determine actual costs and to modify the schedule of values to better reflect actual costs of the work. At Project completion and prior to final payment the parties will reconcile the schedule of values with the actual costs in accordance with provisions in Article Eight herein to determine the final payment.

9.2 Applications for Payment. CM@RISK shall submit completed Applications for Payment in accordance with the Contract Documents. No payment application will be considered complete unless it is accompanied by an updated Construction Progress Schedule and a certification that the on-site, red lined, as-built drawings are up to date. Completed Applications for Payment will be processed by CITY REP as provided in the Contract Documents.

9.3 Waiver of Claims at Final Payment. Acceptance of Final Payment by CM@RISK shall constitute a waiver of affirmative claims by CM@RISK except those previously made in writing and identified as unsettled at the time of Final Payment.

9.4 Retention. Prior to Substantial Completion, progress payments will be made in the amount equal to the percentages indicated below, but in each case less the aggregate of payments previously made and less such amounts as CITY'S REPRESENTATIVE may determine, in accordance with the General Conditions or other provisions of the Contract Documents.

9.4.1 To insure the proper performance of the contract CITY shall retain ten per cent (10%) of the amount of each approved progress payment until the Work is fifty percent (50%) complete.

9.4.2 When the Work is fifty percent (50%) complete as measured by the schedule of values and approved by CITY REP, one-half of the amount retained under the ten percent (10%) retention provision, shall be paid to CM@RISK, provided CM@RISK is on schedule for project completion and is making satisfactory progress on the Work and there is no specific cause or claim requiring a greater amount to be retained. After fifty percent (50%) completion, CITY shall retain five percent (5%) of each approved progress payment providing CM@RISK is on schedule for project completion, is making satisfactory progress on the Work, except that if at any time CITY determines satisfactory progress is not being made, ten percent (10%) retention shall be reinstated for all progress payments made under the contract subsequent to such determination

9.4.3 In lieu of retention, CITY will, at the option of CM@RISK, accept security as provided in ARS § 34-221.

9.5 CITY may withhold and deduct from each progress payment and final payment an amount equal to CITY'S estimate of the liquidated damages then due, or that would become due based on CITY'S estimate of late completion of the Work, provided CM@RISK fails to submit and implement a written schedule recovery plan describing the cause of schedule slippage or delayed progress and the actions proposed and taken to recover schedule slippage.

9.6 Final Payment. Upon final completion and acceptance of the Work and upon compliance with all other terms and conditions of the Contract Documents, CITY shall pay the remainder of the Contract Price, including retainage withheld, less such deductions as may be withheld to cover claims in accordance with state law and the Contract Documents, and to cover liquidated and special damages and other charges owing to CITY.

ARTICLE 10 – CHANGES TO CONTRACT GMP:

10.1 Changes to Scope. CITY reserves the right to change the scope of the Project by adding or deducting work to be performed by CM@RISK under this Contract. Increases to the scope of work to be paid for out of the Owner's Contingency shall be documented by a Work Change Directive. Deductions from the work and additions after the Owner's Contingency has been exhausted shall be documented by a Change Order executed by both parties.

ARTICLE 11 - CM@RISK'S REPRESENTATIONS:

As part of the inducement for CITY to enter into this Contract, CM@RISK makes the following representations:

11.1 CM@RISK was a member of the Design Team for this Project and participated in and provided recommendations concerning the Contract Documents and Project Design.

11.2 CM@RISK has examined and carefully studied the Contract Documents (including any Addenda) and other related data identified in the Bidding Documents, including "technical data" and all federal, state and local laws, ordinances, standards, rules and regulations that in any manner may affect cost, progress, performance or furnishing of the Work.

11.3 CM@RISK has obtained and carefully studied (or assumes responsibility for having done so) the reports of investigations, explorations, tests, studies and data concerning conditions (surface, subsurface and Underground Facilities) and the drawings of physical conditions in or relating to existing surface or subsurface structures, at or contiguous to the site or otherwise which may affect cost, progress, performance or furnishing all the Work or which relate to any aspect of the means, methods, techniques, sequences and procedures of construction to be employed by CM@RISK and safety precautions and programs incident thereto. The reports and drawings available to CITY are listed in the Supplementary Conditions. CM@RISK acknowledges that such reports and drawings are not Contract Documents and may not be complete for CM@RISK's purposes. CM@RISK acknowledges that CITY and CITY'S REP do not assume responsibility for the accuracy or completeness of information and data shown or indicated therein with respect to Underground Facilities at or contiguous to the site.

CM@RISK acknowledges full responsibility for locating and resolving any conflicts with any Underground Facilities.

11.4 CM@RISK has visited the site and become familiar with and is satisfied as to the general, local and site conditions that may affect cost, progress, performance or furnishing of the Work.

11.5 CM@RISK has made or caused to be made examinations, investigations, tests, studies and related data as he deems necessary, and CM@RISK does not consider that any additional examinations, investigations, explorations, tests, studies or data are necessary for the performance and furnishing of the Work at the Contract Price, within the Contract Times and in accordance with the other terms and conditions of the Contract Documents.

11.6 CM@RISK has correlated the information known to CM@RISK, information and observations obtained from visits to the site, reports and drawings identified in the Contract Documents and all additional examinations, investigations, explorations, tests, studies, reports, and data, with the terms and conditions of the Contract Documents.

11.7 CM@RISK has given CITY REP written notice of all conflicts, errors, or discrepancies that CM@RISK has discovered in the Contract Documents, and the written resolution thereof by CITY is acceptable to CM@RISK, and the Contract Documents are sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work. CM@RISK assumes full responsibility and liability for any conflicts, errors or discrepancies in the Contract Documents, including, but not limited to, the specifications, design and engineering for the project, for which written notice has not been provided and which a reasonable Contractor, participating in the Design Process as the Construction Manager at Risk would have discovered.

ARTICLE 12 – CONTRACT DOCUMENTS, DRAWINGS AND ADDENDA:

The Contract Documents which comprise the entire Contract between CITY and CM@RISK concerning the Work consist of those listed below. There are no Contract Documents other than the following:

12.1 This Contract

12.2 The project Design, Engineering and Specifications entitled: MANGANARO LIFT STATION IMPROVEMENTS Project No. WW1504.401

12.3 The Drawings, comprised of a set entitled: MANGANARO LIFT STATION IMPROVEMENTS Project No. WW1504.401

12.4 Performance Bond and Payment Bond.

12.5 The approved Construction Schedule (CPM).

12.6 General Conditions (pages 1 to 55, inclusive).

12.7 Notice to Proceed.

12.8 Approved Construction GMP and attached Assumptions

12.9 CM@RISK'S Schedule of Manufacturers and Suppliers of Major Equipment and Material Items.

12.10 The following which may be delivered or issued after the Effective Date of this Contract and are not attached hereto:

A. Written Amendments;
B. Work Change Directives;
C. Change Order(s).

ARTICLE 13 – BONDS:

CM@RISK shall furnish Payment and Performance bonds, each in an amount at least equal to the Contract Price, as security of the faithful performance and payment of all CM@RISKS obligations under the contract documents. Exhibit F and Exhibit G attached hereto and incorporated in by reference.

ARTICLE 14 – INSURANCE:

1. General.

A. At the same time as execution of this Contract, the **CONTRACTOR** shall furnish the City a certificate of insurance on a standard insurance industry ACORD form. The ACORD form must be issued by an insurance company authorized to transact business in the State of Arizona possessing a current A.M. Best, Inc. rating of A-7, or better and legally authorized to do business in the State of Arizona with policies and forms satisfactory to CITY. Provided, however, the A.M. Best rating requirement shall not be deemed to apply to required Worker's Compensation coverage.

B. The **CONTRACTOR** and any of its subcontractors shall procure and maintain, until all of their obligations have been discharged, including any warranty periods under this Contract are satisfied, the insurances set forth below.

C. The insurance requirements set forth below are minimum requirements for this Contract and in no way limit the indemnity covenants contained in this Contract.

D. The City in no way warrants that the minimum insurance limits contained in this Contract are sufficient to protect **CONTRACTOR** from liabilities that might arise out of the performance of the Contract services under this Contract by **CONTRACTOR,** its agents, representatives, employees, or subcontractors and the **CONTRACTOR** is free to purchase any additional insurance as may be determined necessary.

E. Failure to demand evidence of full compliance with the insurance requirements in this Contract or failure to identify any insurance deficiency will not relieve the **CONTRACTOR** from, nor will it be considered a waiver of its obligation to maintain the required insurance at all times during the performance of this Contract.

F. Use of Subcontractors: If any work is subcontracted in any way, the CONTRACTOR shall execute a written agreement with Subcontractor containing the same Indemnification Clause and Insurance Requirements as the City requires of the **CONTRACTOR** in this Contract. The **CONTRACTOR** is responsible for executing the Contract with the Subcontractor and obtaining Certificates of Insurance and verifying the insurance requirements.

2. Minimum Scope and Limits of Insurance. The **CONTRACTOR** shall provide coverage with limits of liability not less than those stated below.

A. **Commercial General Liability-Occurrence Form.**

1. **CONTRACTOR** must maintain "occurrence" form Commercial General Liability insurance with a limit of not less than $2,000,000 for each occurrence, $4,000,000 aggregate. Said insurance must also include coverage for products and completed operations, independent contractors, personal injury

and advertising injury. If any Excess insurance is utilized to fulfill the requirements of this paragraph, the Excess insurance must be "follow form" equal or broader in coverage scope than underlying insurance.

B. **Automobile Liability-Any Automobile or Owned, Hired and Non-Owned Vehicles. CONTRACTOR** must maintain Business/Automobile Liability insurance with a limit of $1,000,000 each accident on **CONTRACTOR** owned, hired, and non-owned vehicles assigned to or used in the performance under this Contract. If any Excess or Umbrella insurance is utilized to fulfill the requirements of this paragraph, the Excess or Umbrella insurance must be "follow form" equal or broader in coverage scope than underlying insurance.

C. **Workers Compensation and Employers Liability Insurance: CONTRACTOR** must maintain Workers Compensation insurance to cover obligations imposed by federal and state statutes having jurisdiction of **CONTRACTOR** employees engaged in the performance of Work under this Contract and must also maintain Employers' Liability insurance of not less than $1,000,000 for each accident and $1,000,000 disease for each employee.

D. **Builders' Risk/Installation Floater Insurance:** The **CONTRACTOR** bears all responsibility for loss to all equipment or Work under construction. Unless waived in writing by the City the **CONTRACTOR** will purchase and maintain in force Builders' Risk/Installation Floater insurance on the entire Work until completed and accepted by the City. This insurance will be Special Causes of Loss policy form, (minimally including perils of fire, flood, lightning, explosion, windstorm and hail, smoke, aircraft and vehicles, riot and civil commotion, theft, vandalism, malicious mischief, and collapse), completed value, replacement cost policy form equal to the contract price and all subsequent modifications. The **CONTRACTOR**'s Builders' Risk/Installation Floater insurance must be primary and not contributory.

1. Builders' Risk/Installation Floater insurance must cover the entire Work including reasonable compensation for architects and engineers' services and expenses and other "soft costs" made necessary by an insured loss. Builders' Risk/Installation Floater insurance must provide coverage from the time any covered property comes under the **CONTRACTOR**'s control and or responsibility, and continue without interruption during course of construction, renovation and or installation, including any time during which any project property or equipment is in transit, off site, or while on site for future use or installation. Insured property must include, but not be limited to, scaffolding, false work, and temporary buildings at the site. This insurance must also cover the cost of removing debris, including demolition as may be legally required by operation of any law, ordinance, regulation or code.

2. The **CONTRACTOR** must also purchase and maintain Boiler and Machinery insurance with the same requirements as Builders' Risk/Installation Floater insurance cited above if the Work to be performed involves any exposures or insurable property normally covered under a Boiler and Machinery insurance policy or made necessary as required by law or testing requirements in the performance of this Contract/Agreement. The **CONTRACTOR** will be responsible for any and all deductibles under these policies and the **CONTRACTOR** waives all rights of recovery and subrogation against the City under the **CONTRACTOR**- Builders' Risk/Installation Floater insurance described herein.

3. Builders' Risk/Installation Floater Insurance must be maintained until whichever of the following first occurs: (i) final payment has been made; or, (ii) until no person or entity, other than the City, has an insurable interest in the property required to be covered.

a. The Builders' Risk/Installation Floater insurance must be endorsed so that the insurance will not be canceled or lapse because of any partial use or occupancy by the City.

b. The Builders Risk/Installation Floater insurance must include as named insureds, the City, the **CONTRACTOR**, and all tiers of subcontractors and others with an insurable interest in the Work who will be named as additional insureds unless they are able to provide the same level of coverage with the City and **CONTRACTOR** named as additional insureds. Certificates must contain a provision that the insurance will not be canceled or materially altered without at least 30 days advance notice to the City. The City must also be named as a Loss Payee under the Builders' Risk/Installation Floater coverage.

c. The Builders Risk/Installation Floater insurance must be written using the Special Causes of Loss policy form, replacement cost basis.

d. All rights of subrogation under the Builders Risk/Installation Floater insurance are, by this Contract/Agreement, waived against the City, its officers, officials, agents and employees.

e. The **CONTRACTOR** is responsible for payment of all deductibles under the Builders' Risk/Installation Floater insurance policy.

3. Additional Policy Provisions Required.

A. **Self-Insured Retentions Or Deductibles.** Any self-insured retentions and deductibles must be declared and approved by the City. If not approved, the City may require that the insurer reduce or eliminate any deductible or self-insured retentions with respect to the City, its officers, officials, agents, employees, and volunteers.

B. The **CONTRACTOR's** insurance must contain broad form contractual liability coverage.

C. The **CONTRACTOR**'s insurance coverage must be primary insurance with respect to the City, its officers, officials, agents, and employees. Any insurance or self-insurance maintained by the City, its officers, officials, agents, and employees shall be in excess of the coverage provided by the **CONTRACTOR** and must not contribute to it.

D. The **CONTRACTOR**'s insurance must apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability.

E. Coverage provided by the **CONTRACTOR** must not be limited to the liability assumed under the indemnification provisions of this Contract

F. The policies must contain a severability of interest clause and waiver of subrogation against the City, its officers, officials, agents, and employees, for losses arising from Work performed by the **CONTRACTOR** for the City.

G. The **CONTRACTOR**, its successors and or assigns, are required to maintain Commercial General Liability insurance as specified in this Contract for a minimum period of 3 years following completion and acceptance of the Work. The **CONTRACTOR** must submit a Certificate of Insurance evidencing Commercial General Liability insurance during this 3 year period containing all the Contract insurance requirements, including naming the required Additional Insureds set forth herein.

H. If a Certificate of Insurance is submitted as verification of coverage, the City will reasonably rely upon the Certificate of Insurance as evidence of coverage but this acceptance and reliance will not waive or alter in any way the insurance requirements or obligations of this Contract.

I. Insurance Cancellation During Term of Contract.

1. If any of the required policies expire during the life of this Contract, the **CONTRACTOR** must forward renewal or replacement Certificates to the City within 10 days after the renewal date containing all the required insurance provisions.

2. Each insurance policy required by the insurance provisions of this Contract shall provide the required coverage and shall not be suspended, voided or canceled except after thirty (30) days prior written notice has been given to the City, except when cancellation is for non-payment of premium, then ten (10) days prior notice may be given. Such notice shall be sent directly to Chandler Law-Risk Management Department, Post Office Box 4008, Mailstop 628, Chandler, Arizona 85225. If any insurance company refuses to provide the require notice, the **CONTRACTOR** or its insurance broker shall notify the City of any cancellation, suspension, non-renewal of any insurance within seven (7) days of receipt of insurers' notification to that effect.

J. **City as Additional Insured**. The above-referenced policies are to contain, or be endorsed to contain, the following provisions:

1. The Commercial General Liability and Automobile Liability policies are to contain, or be endorsed to contain, the following provisions: The City, its officers, officials, agents, and employees are additional insureds with respect to liability arising out of activities performed by, or on behalf of, the **CONTRACTOR** including the City's general supervision of the **CONTRACTOR**; Products and Completed Operations of the **CONTRACTOR**; and automobiles owned, leased, hired, or borrowed by the **CONTRACTOR**.

2. The City, its officers, officials, agents, and employees must be additional insureds 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.

ARTICLE 15 – INDEMNIFICATION:

To the fullest extent permitted by law, **CONTRACTOR**, its successors, assigns and guarantors, shall indemnify and hold harmless City and any of its elected or appointed officials, officers, directors, commissioners, board members, agents or employees from and against any and all allegations, demands, claims, proceedings, suits, actions, damages, including, without limitation, property damage, environmental damages, personal injury and wrongful death claims, losses, expenses (including claim adjusting and handling expenses), penalties and fines (including, but not limited to, attorney fees, court costs, and the cost of appellate proceedings), judgments or obligations, which may be imposed upon or incurred by or asserted against the City by reason of this Contract or the services performed or permissions granted under it, or related to, arising from or out of, or resulting from any negligent or intentional actions, acts, errors, mistakes or omissions caused in whole or part by **CONTRACTOR**, or any of its subcontractors, or anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, relating to the discharge of any duties or the exercise of any rights or privileges arising from or incidental to this Contract, including but not limited to, any injury or damages claimed by any of **CONTRACTOR**'s and subcontractor's employees.

ARTICLE 16 – MISCELLANEOUS:

16.1 Terms used in this Contract which are defined in the General Conditions, shall have the meanings indicated in the General Conditions.

16.2 The failure of any party to enforce against another party any provision of this Contract shall not constitute a waiver of that party's right to enforce such a provision at a later time, and shall not serve to vary the terms of this Contract.

16.3 CITY and CM@RISK each binds itself, its partners, successors, assigns and legal representatives to the other party hereto, its partners, successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in these Contract Documents.

ARTICLE 17 – CONFLICT OF INTEREST:

CONTRACTOR stipulates that its officers and employees do not now have a conflict of interest and it further agrees for itself, its officers and its employees that it will not contract for or accept employment for the performance of any work or services with any individual business, corporation or government unit that would create a conflict of interest in the performance of its obligations pursuant to this Contract.

Pursuant to A.R.S. Section 38-511, the City may cancel this contract within three (3) years after its execution without penalty or further obligation by the City if any person significantly involved in initiating, negotiating, securing, drafting or creating the contract on behalf of the City of Chandler 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.

ARTICLE 18 - TERMINATION WITHOUT CAUSE:

CITY may at any time and for any or no reason, at its convenience, terminate this Contract or any part of the services to be rendered pursuant thereto by ten (10) day written notice to CONTRACTOR specifying the termination date. Immediately after receiving such notice, CONTRACTOR shall discontinue advancing the work under this Contract and shall deliver to CITY all drawings, notes, calculations, sketches and other materials entirely or partially completed, together with all unused materials supplied by CITY.

ARTICLE 19 – COMPLIANCE WITH ARIZONA STATE PROCUREMENT LAW:

Compliance with A.R.S. § 41-4401. Pursuant to the provisions of A.R.S. § 41-4401, the Contractor hereby warrants to the City that the Contractor and each of its subcontractors ("Subcontractors") will comply with all Federal Immigration laws and regulations that relate to the immigration status of their employees and the requirement to use E-Verify set forth in A.R.S. §23-214(A) (hereinafter "Contractor Immigration Warranty").

A breach of the Contractor Immigration Warranty shall constitute a material breach of this Contract that is subject to penalties up to and including termination of the contract.

The City retains the legal right to inspect the papers of any Contractor or Subcontractor employee who works on this Contract to ensure that the Contractor or Subcontractor is complying with the Contractor Immigration Warranty. The Contractor agrees to assist the City in the conduct of any such inspections. The City may, at its sole discretion, conduct random verifications of the employment records of the Contractor and any Subcontractors to ensure compliance with Contractors Immigration Warranty. The Contractor agrees to assist the City in performing any such random verifications.

The provisions of this Article must be included in any contract the Contractor enters into with any and all of its subcontractors who provide services under this Contract or any subcontract. "Services" are defined as furnishing labor, time or effort in the State of Arizona by a contractor or subcontractor. Services include construction or maintenance of any structure, building or transportation facility or improvement to real property.

IN WITNESS WHEREOF, the parties hereto have executed this Contract on the day and year first written above.

This Contract will be effective on of , 2016.

CITY OF CHANDLER

MAYOR Date

ADDRESS FOR NOTICE

City of Chandler
P.O. Box 4008, Mail Stop 407
Chandler, AZ 85244-4008
Phone: 480-782-3307

ATTEST:

City Clerk

APPROVED AS TO FORM:

City Attorney by: SEAL

CONSTRUCTION MANAGER AT RISK

By: Signature

DANIEL P. WALSH
Printed or Typed

ADDRESS FOR NOTICE
Archer Western Construction
1830 N. 95th Ave., Ste. 114
Phoenix, AZ 85037
Phone:

ATTEST: If Corporation

Secretary

Contractor Immigration Warranty
To Be Completed by Contractor Prior to Execution of Contract

A.R.S. § 41-4401 requires as a condition of your contract verification of compliance by the contractor and subcontractors with the Federal Immigration and Nationality Act (FINA), all other Federal immigration laws and regulations, and A.R.S. § 23-214 related to the immigration status of its employees.

By completing and signing this form and attached Employee Verification Worksheet the contractor shall attest that it and all subcontractors performing work under the cited contract meet all conditions contained herein.

Project Number/Division: WW1504.401 MANGANARO LIFT STATION IMPROVEMENTS
Contractor Name (as listed in the contract): Archer Western Construction
Street Name and Number: 1830 N. 95th Ave., Ste. 114
City: Phoenix State: AZ Zip Code: 85037

I hereby attest that:

1. The contractor complies with the Federal Immigration and Nationality Act (FINA), all other Federal immigration laws and regulations, and A.R.S. § 23-214 related to the immigration status of those employees performing work under this contract;

2. All subcontractors performing work under this contract comply with the Federal Immigration and Nationality Act (FINA), all other Federal immigration laws and regulations, and A.R.S. § 23-214 related to the immigration status of their employees; and

3. The contractor has identified all contractor and subcontractor employees who perform work under the contract and has verified compliance with Federal Immigration and Nationality Act (FINA), all other Federal immigration laws and regulations, and A.R.S. § 23-214.

Signature of Contractor (Employer) or Authorized Designee:

Printed Name: DANIEL P. WALSH

Title: PRESIDENT

Date (month/day/year): MAY 19, 2016

EXHIBIT A
SCOPE OF WORK

The Manganaro lift station is located within the ADOT Right-of-Way at the southeast corner of Ray Road and Price Road. This lift station was built in 1998 as part of the City of Chandler Sanitary Sewer Relocation project by ADOT and as part of the construction effort for the Loop 101 Price Freeway. This lift station is approximately 15 feet long by 12 feet wide and 45 feet deep. It houses four centrifugal submersible pumps and has a firm capacity of 10 MGD (3 duty + 1 standby). Each pump is rated at 3.33 MGD with a TDH of 55 feet. The lift station receives wastewater flows from Manhole No. 6 (8-foot diameter, 37feet deep) that collects flows from a 36-inch vitrified clay pipe (VCP) sewer line carrying flows from the north and an 8-inch sewer line carrying flows from west of the Loop 101. The flow is then pumped from the lift station to Manhole No. 5 (8-foot diameter, 16 feet deep) just west of the facility. Manhole No. 5 collects flows from the lift station discharge and from the 36-inch VCP overflow pipe from Manhole No. 6, and conveys the flows to Manhole No. 4 located 400 feet south.

The work associated with the Manganaro Lift Station Improvements Project involves adding a flow meter to the lift station discharge. Scope of work also includes rehabilitation of the lift station wet well, manhole No. 5 and Manhole No. 6. The scope of work is itemized in greater detail below:

1. Addition of lift station discharge flow meter with isolation valves.
2. Installation of electrical and communication conduits and wiring for new flow meter element and transmitter.
3. Expansion of existing concrete valve vault to house new flow meter and bypass.
4. Installation of new FRP grating for entire vault.
5. Repair of existing protective coating within the lift station wet well based upon wall and coating inspection.
6. Removal and replacement of all pump discharge piping and supports within the wet well and replacement of all pump guide rails and guide rail supports.
7. Rehabilitation work inside the lift station wet well while at least two out of the four pumps are in operation.
8. Bypass pumping from the valve vault to Manhole No. 4 (located 500 feet south) is expected for a duration of three months.
9. During construction, a temporary odor control facility will be installed at a remote location.
10. Removal of existing abandoned odor control piping and concrete pad.
11. Re-routing of existing potable water line to odor control unit.

12. Rehabilitation of Manhole No. 5 including base repair based on coating inspector recommendations, and the installation of an FRP insert with cone, collar and cover.

13. Rehabilitation of Manhole No. 6 base and coating based upon inspection. Repair on Manhole No. 6 will require flow-through plugs and pipes.

14. Demolition and reconstruction of portions of the lift station perimeter wall, removal and reinstallation of sliding gate and electrical fixtures.

15. Secure and fence off the staging area and reinstall parking, striping and landscaping to its original condition.

16. Provide all temporary systems (traffic, safety, etc.) during construction as needed.

17. Asphalt paving and landscape restoration to its original condition.

18. All notifications to governmental and public agencies.

19. Application for and securing of all permits.

20. Prepare as-built Contract Documents to accurately reflect the final state of construction. Prepare and maintain Construction Schedules. Provide one year warranty on all warranted materials and labor.

21. All other miscellaneous work as specified in the Contract Documents

General Expectations and Requirements

1. Perform the work required using restricted access space to the site. Access to the site shall be of minimal disruption to the neighboring roadways, public transportation, utilities and businesses.

2. The lift station shall remain in service for the entire duration of the work.

3. CMAR will be required to perform the rehabilitation work inside the lift station wet well while at least two out of the four pumps are in operation. Only short shutdowns, limited to four (4) hours or less, will be allowed. CMAR shall provide proof of successful working experience in live sewage environment.

4. CMAR shall develop MOPOs to perform all the required work while keeping the lift station partially or fully operational.

EXHIBIT B
ASSUMPTIONS AND CLARIFICATIONS

In assembling the Guaranteed Maximum Price for the Manganaro Lift Station Improvements, Archer Western has made the following assumptions and clarifications:

- Contractor's Contingency of $66,284.00 has been included as a line item. This value represents 5% of the project's direct and indirect costs and exclude allowance values. All applicable fees, taxes, bonds, and insurance will be added to the direct cost of the work when calculating contingency use.
- Building permit fees from City and County Jurisdictions will be paid by others.
- City of Chandler encroachment permit and fees (if required) will be provided by others.
- Archer Western has identified and included the following list of permits.
    - MCDAQ Dust Control Permit
    - Storm Water Pollution Prevention Plan
    - ADOT Traffic Control Permit (N/B Price Road at S. of Ray Road)
    - ADOT Encroachment Permit
- Quality assurance testing such as concrete sampling and compaction testing will be performed by others as previously indicated.
- Cost model includes an independent coatings inspector to inspect the coatings repair work within the wetwell at the new pipe, base, and support replacement as well as within manholes 5 and 6.
- Cost model is based upon being able to shut down and remove two pumps at a time for replacement of the bases, discharge piping, guide rails, and pipe supports.
- Bypass pipe from lift station to manhole #4 is proposed as single contained 18" SDR 26 HDPE fused pipe. Temporary piping will be pressure tested prior to placing into service, and flushed prior to removal.
- Cost model assumes existing bases at manholes #5 and #6 can be reused.
- Cost model is based upon a standard forty-hour work week, M-F. However, Archer Western has included off-hours work for the cofferdam installation during periods of low-flow at the Lift Station when, at such time, (2) pumps will be taken out of service.
- Cost model includes $18,000.00 for lease procurement and temporary use of the proposed laydown and staging area located within the Whole Foods parking lot.
- Archer Western assumes the existing site is free of any hazardous materials; therefore, costs for hazardous material remediation have been excluded.
- Archer Western has excluded costs for aerial photography with the assumption that it is not the City's intent to utilize such services for this project.

The guarantee maximum price provided by Archer Western includes the following allowances:

- An allowance of $75,113.00 has been identified for the temporary calcium nitrate feed facility at the Shawnee Well Facility for a rental duration of three months. This allowance is comprised of Evoqua's preliminary proposal for mobilization and demobilization of the equipment, temporary piping to discharge into a facility drain that feeds the sewer system, three months of rental, and a maximum of 2,000 gallons of Bioxide® usage per month.
- An allowance of $36,318.00 to provide additional temporary pumping capacity of the wetwell has been included in the cost model. Operations have stated two of the existing pumps will provide enough capacity during peak flow conditions. However, the pump discharge pipe in its current condition, along with the additional head pressure during bypassing, may limit the capacity of the pumps. This allowance will provide a temporary submersible pump to be used during high flows while the leaking discharge pipe is being replaced. This work is anticipated to be performed on weekdays and the pump will need to be manually started. Therefore no pump watch has been included in this allowance.
- An allowance of $33,486.00 to replace driveway entrances and sidewalk at the southeast corner of northbound Price Road and Ray Road has been included in the cost model. This allowance assumes that only sidewalk, ramps, and curbs damaged during construction will be replaced. Replaced components will be per current standard details meeting ADA requirements. This

allowance does not include replacement of flatwork at any other corner, any traffic signal modifications, or striping replacement.

- An allowance of $40,000.00 for the perimeter wall adjustment has been included within the cost model.
- An Owner's allowance of $157,688.00 has been identified with regard to unforeseen conditions. This value represents 10% of the project's subtotal plus other identified allowances.

EXHIBIT C
GMP

AREA	Description	Takeoff Quantity		Labor Amount	Material Amount	Sub Amount	Equip Amount	Total Amount
	Manganaro Lift Station							
01000	TCE Lease							
	TCE Lease	6.00	MO		18000			18,000
	01000 TCE Lease	**6.00**	**MO**	**0**	**18,000**	**0**	**0**	**18,000**
02100	**Traffic Control**							
	Permits - Traffic Control	1.00	EA		500			500
	Traffic Control - Device Rental	120.00	day			3,000		3,000
	Traffic Control - Setup / Teardown	85.00	ls			17,000		17,000
	02100 Traffic Control	**1.00**	**LS**	**0**	**500**	**20,000**	**0**	**20,500**
02150	**Storm Water Pollution Prevention Plan**							
	Erosion Control -Silt Fence / SWPPP Development	400.00	lf	2,810		1,200		4,010
	Permits - SWPPP	1.00	ls		350			350
	Street Sweeping	5.00	mo			2,500		2,500
	Construction Equipment	1.00	LS				1299	1,299
	02150 Storm Water Pollution Prevention Plan	**1.00**	**LS**	**2,810**	**350**	**3,700**	**1,299**	**8,159**
02200	**Structural / Site Demolition**							
	Demolish Existing Asphalt	1,200.00	sf	1,891				1,891
	Saw Cut Asphalt for New Conduit	20.00	lf			200		200
	Saw Cut Asphalt Prior to Asphalt Demolition	40.00	lf			400		400
	Saw Cut Walls	312.00	lf			936		936
	Remove Landscape Curb	30.00	lf	225				225
	Demolish Existing Masonry Site Fence	400.00	sf	1,801				1,801
	Demolish Existing Masonry Fence Footing	13.00	cy	1,626				1,626
	Demolish Masonry Column	1.00	EA	450				450
	Demolish Odor Control Slab	14.00	cy	1,751				1,751
	Demolish Concrete Vault Wall	3.00	cy	1,501	150			1,651
	Demolish CLSM around existing vault wall	15.00	cy	1,201				1,201
	Demolish Conduit / Lights from Existing Wall	40.00	lf	672				672
	R&R Existing Chain Link - 4' Tall	30.00	lf	895		300		1,195
	Remove / Salvage Existing Rolling Gate	1.00	ea	1,343		250		1,593
	Remove / Salvage Gate Track	30.00	lf	672				672
	Salvage MH #6 Rings, Cone, and Cover	1.00	ea	1,343	250			1,593
	Remove MH #5 Rings, Cone, and Cover	1.00	ea	1,343	250			1,593
	Remove bollards at MH #6	3.00	ea	336				336
	Install Steel Plates over MH #6	1.00	ea	224	500			724
	Install Steel Plates over MH #5	1.00	ea	224	500			724
	Strip perimeter of existing DG / Landscaping	700.00	sf	1,646				1,646
	Remove Existing Shrubs / Trees	8.00	ea	1,646		600		2,246
	Haul Demo'd Block Offsite	14.00	CY			560		560
	Haul Demo'd Masonry Wall Footing Offsite	13.00	cy			520		520
	Haul Odor Control Slab Concrete Offsite	14.00	cy			560		560
	Haul Concrete Wall Offsite	3.00	cy			120		120
	Haul Demolished Asphalt offsite	13.00	cy			520		520
	Haul CLSM Offsite	15.00	cy			600		600
	Remove Existing FRP Grating	180.00	sf	553				553
	Construction Equipment	1.00	LS				9864	9,864
	02200 Structural / Site Demolition	**1.00**	**LS**	**21,343**	**1,650**	**5,566**	**9,864**	**38,423**
02201	**Mechanical Demolition**							
	Demolish Existing PW Line	78.00	lf	698	51			749
	Demolish Existing 10" Pipe Spools through Wall	4.00	ea	5,373				5,373
	Demolish Existing 16" Buried Line	25.00	lf	5,560				5,560
	Remove and Replace Odor Control Piping	40.00	lf	560	120			680
	Demo Existing Pump Bases	4.00	ea	2,239				2,239
	Demo Existing Guide Rails	8.00	ea	3,582				3,582
	Demo Existing Pipe Supports	12.00	ea	4,030				4,030
	Demo Existing 10" 90s	4.00	ea	895				895

	Remove and Store Existing Flygt Pumps	4.00	ea	448				448
	Construction Equipment	1.00	LS				10807	10,807
	02201 Mechanical Demolition	**1.00**	**LS**	**23,385**	**171**	**0**	**10,807**	**34,363**
02202	**Mitigate Discharge Pipe Leaks - Pumps 3 & 4**							
	Diver Subcontract	4.00	Day			16,660		16,660
	Pipe Removal - Boom Truck Service	10.00	EA			5,000		5,000
	Diver Assistance	4.00	day	5,734				5,734
	Construction Equipment	1.00	LS				2650	2,650
	02202 Mitigate Discharge Pipe Leaks - Pumps 1 & 2	**1.00**	**EA**	**5,734**	**0**	**21,660**	**2,650**	**30,044**
02203	**Air Products Test Station**							
	Remove Air Products Test Station/Protect UNderground	1.00	ea	448	50			498
	Trench and Install Air Products Test Station at New Location	65.00	lf	2,686	390			3,076
	Construction Equipment	1.00	LS				1448	1,448
	02203 Air Products Test Station	**1.00**	**EA**	**3,134**	**440**	**0**	**1,448**	**5,022**
02204	**Wetwell Cofferdam System**							
	Diver Subcontract	10.00	day			41,650		41,650
	Fabricate / Provide Cofferdam System	1.00	Ls		35,000			35,000
	Cofferdam Removal/Installation - Boom Truck Service	10.00	EA			5,000		5,000
	Diver Assistance	10.00	day	14,334				14,334
	Construction Equipment	1.00	LS				6625	6,625
	02204 Wetwell Cofferdam System	**1.00**	**EA**	**14,334**	**35,000**	**46,650**	**6,625**	**102,609**
02205	**Bypass Manhole #5**							
	Connect Temporary Bypass at LS for MH #5	1.00	EA	1,343	250			1,593
	Disconnect Temporary Bypass at LS for MH #5	1.00	EA	1,343				1,343
	Plug 36" Downstream of MH #5	1.00	EA	448	500			948
	Plug 36" Bypass Prior to MH #5	1.00	EA	448	500			948
	Temporary Bypass Pipe from LS to MH #4	1.00	LS			12,672		12,672
	Temporary Bypass Install	1.00	LS			6,200		6,200
	Temporary Bypass Removal	1.00	LS			4,800		4,800
	Temporary Bypass - Delivery / Pickup	1.00	LS			900		900
	Construction Equipment	1.00	LS				1655	1,655
	02205 Bypass Manhole #5	**1.00**	**EA**	**3,582**	**1,250**	**24,572**	**1,655**	**31,059**
02300	**Landscaping**							
	Landscape Subcontract - Pre-emergent	6,500.00	SF			650		650
	Landscape Subcontract - Decomposed Granite	200.00	TN			9,000		9,000
	Landscape Subcontract - Shrubs / Trees	32.00	EA			8,000		8,000
	Landscape Subcontract - Irrigation System	1.00	LS			3,500		3,500
	02300 Landscaping	**1.00**	**LS**	**0**	**0**	**21,150**	**0**	**21,150**
02301	**Asphalt Replacement**							
	Place / Compact ABC	1,200.00	sf			3,480		3,480
	Asphalt Paving Subcontract	1,200.00	sf			6,120		6,120
	Rough Grade Site	1,200.00	sf	1,958				1,958
	Construction Equipment	1.00	LS				905	905
	02301 Asphalt Replacement	**1,200.00**	**SF**	**1,958**	**0**	**9,600**	**905**	**12,463**
02350	**Excavate / Backfill For Site Wall**							
	Structural Excavation	39.00	cy	849				849
	Structural Backfill	27.00	cy	1,700				1,700
	Construction Equipment	1.00	LS				1178	1,178
	02350 Excavate / Backfill For Site Wall	**39.00**	**CY**	**2,549**	**0**	**0**	**1,178**	**3,727**
02351	**Excavate / Backfill for Meter Vault**							
	Haul Trucks off Site	292.00	cy			5,840		5,840
	Structural Excavation	292.00	cy	2,724				2,724
	Gravel For Sump Drain	1.00	TN		20			20
	Protect 36" Bypass	1.00	day	943		3,000		3,943
	Place CLSM Backfill	236.00	cy	1,803				1,803
	CLSM Backfill Material	236.00	cy		15,340			15,340
	Construction Equipment	1.00	LS				2528	2,528
	02351 Excavate / Backfill for Meter Vault	**292.00**	**CY**	**5,470**	**15,360**	**8,840**	**2,528**	**32,198**
03300	**Concrete Meter Vault**							
	Rebar Subcontractor	1.00	LS			6,500		6,500

	Hand Set 8' Fnd Walls	592.00	sf	9,091	1,776			10,867
	Pump Pour Foundation Wall	10.96	cy	419				419
	Finish Foundation Wall	37.00	sf	78				78
	Rub Foundation Wall	592.00	sf	2,486	178			2,664
	Point & Patch Foundation Wall	592.00	sf	621	178			799
	Cure	592.00	sf	219	178			397
	Fine Grade Slab on Grade	169.00	sf	323				323
	Edge sf Slab on Grade	78.00	sf	2,396	156			2,552
	Pump Pour Slab on Grade	9.39	cy	359				359
	Finish Slab on Grade	169.00	sf	85				85
	Cure Slab on Grade	169.00	sf	65	17			82
	Drill/Set Dowels	15.00	ea	230	150			380
	Drill/Set Dowels	20.00	ea	307	200			507
	Prep Construction Jts.	20.00	sf	76	10			86
	Prep Construction Jts.	57.00	sf	218	29			247
	6" Sleeve For Drain	1.00	EA	12	250			262
	Boxout	4.00	ea	737	120			857
	Pump	10.33	cy			775		775
	Pump	11.51	cy			863		863
	Normal Redimix 4000 psi	10.33	cy		1,012			1,012
	Normal Redimix 4000 psi	11.51	cy		1,128			1,128
	Construction Equipment	1.00	LS				8190	8,190
	03300 Concrete Meter Vault	**22.00**	CY	**17,722**	**5,382**	**8,138**	**8,190**	**39,432**
03301	**Masonry Wall Footing**							
	Rebar Subcontractor	1.00	LS			4,000		4,000
	Hand Set 4' Fnd Walls	280.00	sf	4,300	840			5,140
	Chute Pour Foundation Wall	3.47	cy	133				133
	Finish Foundation Wall	70.00	sf	147				147
	Rub Foundation Wall	280.00	sf	1,176	84			1,260
	Point & Patch Foundation Wall	280.00	sf	294	84			378
	Cure	280.00	sf	103	84			187
	Fine Grade Slab on Grade	233.10	sf	445				445
	Fine Grade Slab on Grade	40.00	sf	76				76
	Stone Fill Slab On Grade	2.85	cy	33	34			67
	Stone Fill Slab On Grade	0.49	cy	6	6			12
	Edge lf Slab on Grade	146.66	lf	2,252	293			2,545
	Edge lf Slab on Grade	36.00	lf	553	72			625
	Chute Pour Slab on Grade	8.63	cy	330				330
	Chute Pour Slab on Grade	1.48	cy	57				57
	Finish Slab on Grade	233.10	sf	118				118
	Finish Slab on Grade	40.00	sf	20				20
	Cure Slab on Grade	233.10	sf	89	23			112
	Cure Slab on Grade	40.00	sf	15	4			19
	Drill/Set Dowels	7.00	ea	108	70			178
	Drill/Set Dowels	7.00	ea	108	70			178
	Prep Construction Jts.	117.00	sf	447	59			506
	Normal Redimix 4000 psi	9.50	cy		931			931
	Normal Redimix 4000 psi	3.58	cy		351			351
	Normal Redimix 4000 psi	1.63	cy		160			160
	Construction Equipment	1.00	LS				4995	4,995
	03301 Masonry Wall Footing	**15.00**	CY	**10,810**	**3,165**	**4,000**	**4,995**	**22,970**
03302	**Site Curbs and Gate Track Footing**							
	Rebar Subcontractor	692.00	LB			588		588
	Fine Grade Slab on Grade	30.00	sf	57				57
	Fine Grade Slab on Grade	25.00	sf	48				48
	Stone Fill Slab On Grade	0.37	cy	4	4			8
	Stone Fill Slab On Grade	0.31	cy	3	4			7
	Edge sf Slab on Grade	124.00	sf	1,904	248			2,152
	Edge lf Slab on Grade	101.00	lf	1,551	202			1,753
	Chute Pour Slab on Grade	2.22	cy	85				85
	Chute Pour Slab on Grade	0.93	cy	35				35
	Finish Slab on Grade	30.00	sf	15				15
	Finish Slab on Grade	25.00	sf	13				13
	Cure Slab on Grade	30.00	sf	11	3			14
	Cure Slab on Grade	25.00	sf	10	3			13
	Normal Redimix 4000 psi	2.44	cy		240			240
	Normal Redimix 4000 psi	1.02	cy		100			100

	Construction Equipment	1.00	LS				1727	1,727
	03302 Site Curbs and Gate Track Footing	**4.00**	**CY**	**3,736**	**804**	**588**	**1,727**	**6,855**
04000	**Masonry**							
	Masonry Subcontractor	560.00	SF			11,200		11,200
	Masonry Subcontractor - End Columns	2.00	EA			5,000		5,000
	04000 Masonry	**1.00**	**LS**	**0**	**0**	**16,200**	**0**	**16,200**
05000	**Miscellaneous Metals**							
	Weld Beams/Brackets	4.00	EA	356	82			438
	Aluminum Access Ladder w/ Saf-T post	2.00	EA	37	3,720			3,757
	Blockout Beam Pockets	4.00	ea	1,106	60			1,166
	Beam Brackets	4.00	ea	1,106	850			1,956
	Install Grating Beams	2.00	ea	553	1,200			1,753
	Reinstall Existing Gate	1.00	EA	2,211	100			2,311
	FRP Grating, Over Existing Vault	170.00	sf	522	5,950			6,472
	FRP Grating, Over New Meter Vault	115.00	sf	353	4,025			4,378
	FRP Grating, Over Drain Vault	2.00	ea	234	70			304
	6" Sleeve for Floor Drain	2.00	ea	234	50			284
	Reinstall Existing Gate Track	30.00	LF	346	30			376
	Embeded Angles	33.00	LF	380	495			875
	Anchor Bolts	12.00	ea	276	144			420
	R&R Hatch Beams	3.00	ea	553	150			703
	Construction Equipment	1.00	LS				3605	3,605
	05000 Miscellaneous Metals	**1.00**	**LS**	**8,267**	**16,926**	**0**	**3,605**	**28,798**
09900	**Process Pipe Painting**							
	Paint Process Pipe	1.00	LS			9,669		9,669
	09900 Process Pipe Painting	**1.00**	**LS**	**0**	**0**	**9,669**	**0**	**9,669**
09901	**Wetwell Coatings**							
	Coat Existing Wetwell @ Pipe Supports	1.00	LS			14,000		14,000
	Clean Wetwell Prior to Coating Repairs	1.00	LS			2,500		2,500
	Wetwell Coatings Inspection - IIC	1.00	LS			4,800		4,800
	09901 Wetwell Coatings	**1.00**	**LS**	**0**	**0**	**21,300**	**0**	**21,300**
09902	**Recoat Manhole #5**							
	Recoat Manhole #5	1.00	EA			9,865		9,865
	09902 Recoat Manhole #5	**1.00**	**EA**	**0**	**0**	**9,865**	**0**	**9,865**
09903	**Rehab Manhole #6**							
	Rehab Manhole #6	1.00	EA			12,645		12,645
	Install Flow Through and Recoat MH Invert	1.00	EA			6,450		6,450
	09903 Rehab Manhole #6	**1.00**	**EA**	**0**	**0**	**19,095**	**0**	**19,095**
11300	**Submersible Sewage Pumps**							
	Intermediate Brackets	32.00	EA	5,373				5,373
	8" DISCHARGE ELBOW	4.00	EA	672	22,639			23,311
	Upper Guide Rail Brackets	4.00	EA	672				672
	Reinstall Floats	4.00	EA	672	100			772
	Remove and Reinstall Stationary Inductors	4.00	EA	672	160			832
	GUIDE RAILS	320.00	LF	4,477				4,477
	Reinstall Existing Pumps	4.00	EA	1,791				1,791
	STAINLESS STEEL ANCHOR BOLTS	24.00	EA	276	288			564
	NON-SHRINK GROUT	6.00	CF	129	150			279
	Construction Equipment	1.00	LS				5257	5,257
	11300 Submersible Sewage Pumps	**4.00**	**ea**	**14,734**	**23,337**	**0**	**5,257**	**43,328**
15000	**10"/16" Discharge to MH #5**							
	Temporary Blowers for H2S Gases	1.00	mo				9423	9,423
	Stairs & Ladders	4.00	mo	3,686	1,000			4,686
	DIP 16" 14<d<20	20.00	lf	7,075				7,075
	DIP 16"	40.00	lf		2,511			2,511
	Stone Backfill	156.71	CY		1,881			1,881
	Concrete Pipe Encasement	32.17	CY	2,378	3,217			5,595
	Spoil Removal	173.83	CY			348		348
	Testing	20.00	LF	18	20			38
	PIPE MARKER TAPE	20.00	LF	12	30			42
	Ftg 45 MJ DIP 16"	1.00	ea	37	700			737
	Megalugs 16"	9.00	ea	504	1,969			2,473
	Ftg 90 MJ DIP 16"	3.00	ea	112	2,625			2,737
	Ftg Wye MJ DIP 16"	1.00	ea	56	1,575			1,631
	Grout Sleeve at new Wall Pipe	8.00	CF	1,373	200			1,573
	Grout Penetrations in MH #5	4.00	CF	1,373	100			1,473

	Core drill 20"	2.00	EA			1,400		1,400
	1/2" SS Pipe	45.00	LF	438	338			776
	1/2" SS Pipe	30.00	LF	292	225			517
	Fab. SS pipe 2"	10.00	LF	102	120			222
	10" Ductile Iron Pipe 15'-0" FxF	8.00	ea	1,119	12,709			13,828
	10" Ductile Iron Pipe 9'-7" FxF	4.00	ea	560	5,200			5,760
	10" Ductile Iron Pipe 4'-0 FxF	4.00	ea	560	2,416			2,976
	16" Ductile Iron Pipe 6'-0 FxF	1.00	ea	196	1,251			1,447
	16" Ductile Iron Pipe 2'-0 FxF	1.00	ea	196	900			1,096
	16" Ductile Iron Pipe 2'-0 FxPE	1.00	ea	196	550			746
	16" Ductile Iron Pipe 4'-0 FxPE	1.00	ea	196	1,010			1,206
	Flex Coupling 10"	4.00	ea	448	600			1,048
	Ftg FCA Ductile iron 16"	1.00	ea	140	707			847
	Ftg Restrained Flex Couling Ductile iron 16"	1.00	ea	140	1,880			2,020
	Ftg 90 Flg Ductile iron 10"	4.00	ea	607	2,100			2,707
	Ftg 90 Flg Ductile iron 16"	5.00	ea	999	5,125			6,124
	Ftg RED. Flg Ductile iron 10"x8"	4.00	ea	607	1,700			2,307
	Ftg Tee Flg Ductile iron 16"	2.00	ea	400	2,800			3,200
	Ftg M-Adpt SS 1/2"	1.00	EA	28	15			43
	Ftg 90 SS 1/2"	9.00	EA	168	68			236
	Ftg 90 SS 1/2"	5.00	EA	93	38			131
	Ftg Union SS 1/2"	4.00	EA	112	72			184
	Ftg Union SS 1/2"	3.00	EA	84	54			138
	316SS Strut Support for 1/2" Pipe	10.00	ea	280	350			630
	Strut Support for 1/2" Pipe	5.00	ea	140	175			315
	16" Adjustable Pipe Supports x 2'6"	4.00	ea	448	1,620			2,068
	10" Knee Brace - 316 SS	32.00	ea	3,582	26,080			29,662
	20" Pipe Sleeves x 1'-0" 316 SS	1.00	EA	246	885			1,131
	10" Link seals LS-575	60.00	EA	504	960			1,464
	16" Link seals LS-425	16.00	EA	134	400			534
	16" Link seals LS-425	32.00	EA	269	800			1,069
	Bolt & gasket sets 8" SS	4.00	EA		342			342
	Bolt & gasket sets 10" SS	24.00	EA		2,680			2,680
	Bolt & gasket sets 16" SS	16.00	EA		2,773			2,773
	Service Saddle 16"	1.00	EA	168	225			393
	Flow Meter 16"	1.00	EA	336				336
	10" CS Dog Ears	4.00	EA	336	500			836
	Ball valves 1" - SS	1.00	EA	28	65			93
	Plug valves 16"	3.00	EA	672	16,200			16,872
	Plug valves 2"	1.00	EA	56	175			231
	Air release valves - 2" H-Tec 986 SST	1.00	EA	224	3,630			3,854
	SS pipe 1"	5.00	LF	32	125			157
	1" SS Nipple	4.00	ea	47	100			147
	Ftg 90 SS 1"	1.00	ea	36	35			71
	Ftg Tee SS 1"	1.00	ea	36	45			81
	Strut Support for 1" Pipe	2.00	ea	36	130			166
	Pressure Gauges	1.00	ea	36	250			286
	Ball valves 1"	2.00	ea	36	250			286
	Construction Equipment	1.00	LS				13627	13,627
	15000 10"/16" Discharge to MH #5	**1.00**	**LS**	**31,987**	**114,501**	**1,748**	**23,050**	**171,286**
15001	**R&R Odor Control at MH #6**							
	PVC 2" 0<d<5	15.00	lf	1,061				1,061
	PVC 2"	15.00	LF		45			45
	Sand Bedding	2.00	tn		30			30
	Spoil Removal	2.00	CY			4		4
	Testing	10.00	LF	9	10			19
	PIPE MARKER TAPE	10.00	LF	6	15			21
	Ftg 90 PVC 2"	5.00	Ea		8			8
	Core drill 4"	1.00	EA			200		200
	4" Link seals LS-300	6.00	EA	50	36			86
	Construction Equipment	1.00	LS				521	521
	15001 R&R Odor Control at MH #6	**15.00**	**LF**	**1,126**	**144**	**204**	**521**	**1,995**
15002	**Reinstall Odor Control Piping in Manhole #5**							
	PVC 2" 0<d<5	10.00	lf	707				707
	PVC 2"	10.00	LF		30			30

	Sand Bedding	1.42	tn		21			21
	Spoil Removal	0.72	CY			1		1
	Testing	10.00	LF	9	10			19
	PIPE MARKER TAPE	10.00	LF	6	15			21
	Ftg 90 PVC 2"	3.00	Ea		5			5
	Core drill 4"	1.00	EA			200		200
	4" Link seals LS-300	6.00	EA	50	36			86
	Construction Equipment	1.00	LS				357	357
	15002 Reinstall Odor Control Piping in Manhole #5	**10.00**	**LF**	**772**	**117**	**201**	**357**	**1,447**
16000	**Electrical**							
	Seal Core Drills	4.00	CF	86	100			186
	Core drill 6"	2.00	EA			600		600
	Electrical Subcontract	1.00	ls			35,000		35,000
	Construction Equipment	1.00	LS				40	40
	16000 Electrical	**1.00**	**LS**	**86**	**100**	**35,600**	**40**	**35,826**
19010	**General Expense**							
	Project Manager	8.00	wk	20,000			2187	22,187
	Ass't Project Manager	26.00	wk	49,400			7108	56,508
	General Superintendent	18.00	wk	39,600			4921	44,521
	Field Engineer	18.00	wk	27,000				27,000
	Safety Engineer	22.00	wk	39,600			6014	45,614
	Supervision Burden	175,600.00	$	60,582				60,582
	Field Offices	6.00	mo		2,400			2,400
	Office Setup	1.00	ls	1,169	800	2,500		4,469
	Office - Cleaning	6.00	mo	571	150			721
	Water - Drinking	6.00	mo		900			900
	Water - Construction	6.00	mo		1,500			1,500
	Electricity - Generator Rental and Consumption	6.00	mo		6000			6,000
	Telephone /Internet - Equipment	1.00	ls		1,500			1,500
	Telephone / Internet - Bills	6.00	mo			600		600
	Cell Phones	21.00	mo			1,785		1,785
	Rubbish -Boxes	6.00	mo			3,000		3,000
	Sanitary - Storage Tanks / Hookup	6.00	mo			1,500		1,500
	Temporary Toilets / Handwash Stations	6.00	mo			2,100		2,100
	Oxygen/Acetelyne	6.00	mo		450			450
	Signs - Temporary	3.00	ea		900			900
	Site Fence	900.00	lf			5,400		5,400
	Small Tools	7,300.00	mhs		10,950			10,950
	Photos	6.00	mo		240			240
	Supplies - Office	6.00	mo		1,800			1,800
	Supplies - Field Engineer	6.00	mo		600			600
	Postage	6.00	mo		600			600
	Furniture - Office	1.00	LS		750			750
	Computer	6.00	mo		2,400			2,400
	Copy Machine	6.00	mo		1,800			1,800
	Printing Shop Drawings	6.00	mo		240			240
	Engineering Services	1.00	ea			750		750
	Safety Supplies	7,300.00	mhs		10,950			10,950
	Drug Tests	10.00	ea			350		350
	Punch List	2.00	wk	1,169	500			1,669
	Clean Up Final	1.00	ls	1,169	500			1,669
	Permits - Dust Control	1.00	ea		795			795
	Dust Control Training	2.00	ea		310			310
	Security Device	6.00	mo			6,000		6,000
	19010 General Expense	**1.00**	**ls**	**240,260**	**47,035**	**23,985**	**20,230**	**331,510**
	Direct Cost Totals	**1**	**LS**	**413,799**	**284,232**	**312,331**	**106,931**	**1,117,293**
	BONDS / TAXES/ INSURANCE							89,482
	PROJECT FEE							105,024
	Indirect Total							**194,506**
	Add Alternates							

	HDPE Drop Connection to Manhole #5							8,724
	Recoat Existing Pipe Within Valve Vault							5,158
	Add Alternate Sub-Total							**13,882**
	Contractor's Contingency - (5%)							**66,284**
	Manganaro Lift Station Sub-Total							**$1,391,965**
	Allowances							
	Shawnee Odor Control System	1	LS					75,113
	Temporary Pumping Capacity	1	LS					36,318
	ADA Compliance Sidewalk / Curb Replacement	1	LS					33,486
	Perimeter Wall	1	LS					40,000
	Allowances Sub-Total							**184,917**
	Owner's Allowance (Unforeseen Conditions) - (10%)							**157,688**
	Project Total w/ Allowances and Contingency							**1,734,570**

EXHIBIT D
TECHNICAL SPECIFICATIONS

Chandler + Arizona
Where Values Make The Difference

City of Chandler

Manganaro Lift Station Improvements

City Project No. WW1504-201

Wilson Engineers Project No. 15-001

TECHNICAL SPECIFICATIONS

Issued for Construction

March 2016

9633 S. 48th Street
Suite 290
Phoenix, AZ 85044
480-893-8860

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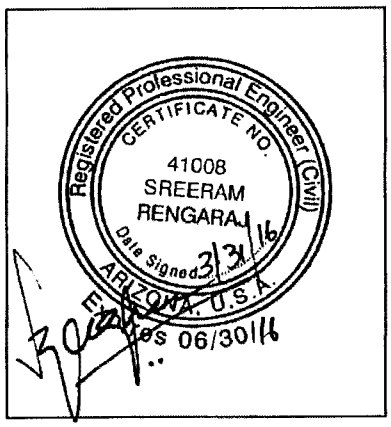
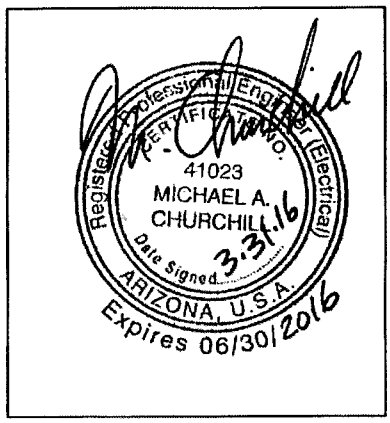
TECHNICAL SPECIFICATIONS
FOR
CITY OF CHANDLER
MANGANARO LIFT STATION IMPROVEMENTS
PROJECT NO. 15-001
ISSUED FOR CONSTRUCTION





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02100 SITE PREPARATION
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02318 CRUSHED STONE AND GRAVEL
02319 RIPRAP
02371 FILTER FABRIC FOR RIPRAP CHANNELS
02480 LANDSCAPE
02500 ASPHALT PAVEMENT
02532 MANHOLE FRP INSERT
02771 CONCRETE CURBS, GUTTERS, AND SIDEWALK
02810 IRRIGATION SYSTEM

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DIVISION 9

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09910 SPECIAL FINISHES

DIVISION 10

10425 SIGNS

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DIVISION 15 MECHANICAL

15050 PIPING SYSTEMS
15051 BURIED PIPING INSTALLATION
15052 EXPOSED PIPING INSTALLATION
15061 DUCTILE IRON PIPE FOR WASTEWATER SERVICE
15064 COPPER PIPE
15070 HDPE PRESSURE PIPE
15114 FLEXIBLE CHECK VALVES
15120 PIPING SPECIALTIES AND ACCESSORIES

DIVISION 16

16000	GENERAL ELECTRICAL REQUIREMENTS
16010	ELECTRICAL BASIC REQUIREMENTS
16050	BASIC MATERIALS AND METHODS
16060	ELECTRICAL DEMOLITION
16111	CONDUITS
16123	600 VOLT CLASS CABLE
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DIVISION 17

17000	INSTRUMENTATION
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SECTION 01010

SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. The Scope of Work under this Contract consists of the installation of a magnetic flow meter and bypass piping inside a concrete vault at the Manganaro Lift Station site located in the ADOT Right Of Way (ROW.) Work will also include rehabilitation of the lift station wet well and two of the adjacent manholes.

B. The CONTRACTOR shall be responsible for site and personnel safety during all phases and all aspects of construction.

1.2 DESCRIPTION OF OWNER'S PROJECT

A. The overall Project will consist of the following. The Work includes, but is not limited to, the following structures and facilities:
   1. Addition of lift station discharge flow meter with isolation valves.
   2. Installation of electrical and communication conduits and wiring for new flow meter element and transmitter.
   3. Expansion of existing concrete valve vault to house new flow meter and bypass.
   4. Installation of new FRP grating for entire vault.
   5. Repair of existing protective coating within the lift station wet well based upon wall and coating inspection.
   6. Removal and replacement of all pump discharge piping and supports within the wet well and replacement of all pump guide rails and guide rail supports.
   7. Removal of existing abandoned odor control piping and concrete pad.
   8. Re-routing of existing potable water line to odor control unit.
   9. Rehabilitation of Manhole No. 5 including base repair based on coating inspector recommendations, and the installation of an FRP insert with cone, collar and cover.
   10. Rehabilitation of Manhole No. 6 base and coating based upon inspection. Repair on Manhole No. 6 will require flow-through plugs and pipes.
   11. The CONTRACTOR shall keep the Lift Station in continuous operation with a minimum of two pumps operating at any given time. Short duration shutdowns may be accommodated with prior approval from the City and the ENGINEER. No bypass pumping is anticipated during the construction of this project.
   12. Demolition and reconstruction of portions of the lift station perimeter wall,

removal and reinstallation of sliding gate and electrical fixtures.

13. Secure and fence off the Temporary Construction Easement (TCE) area for staging and reinstall parking, striping and landscaping to its original condition.
14. Provide all temporary systems (traffic, safety, etc.) during construction as needed.
15. Asphalt paving and landscape restoration to its original condition.
16. All notifications to governmental and public agencies.
17. Application for and securing of all permits.
18. Prepare as-built Contract Documents to accurately reflect the final state of construction. Prepare and maintain Construction Schedules. Provide one year warranty on all warranted materials and labor.
19. All other miscellaneous work as specified in the Contract Documents

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01012

LIFT STATION OPERATION DURING CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. The CONTRACTOR will be performing Work at a lift station site. As a result, the CONTRACTOR shall take whatever precautions are necessary to ensure that the conveyance of incoming sewer flows is not interrupted and that there is no wastewater backup into the City's sewage collection system or discharge to the environment. These precautions include but are not limited to protecting piping, utilities, roads, and structures that are to remain and are not to be modified or replaced. Any temporary facilities required to keep flow conveyance shall be provided by the CONTRACTOR at his own expense. Upon completion of the Work, all temporary facilities and materials shall be removed from the site.

B. All Work shall be completed in a manner which will result in minimum disruption to the operation of the existing facilities.

C. The CONTRACTOR shall not operate any equipment, valves, etc. that will affect the lift station operation. CONTRACTOR shall coordinate any required adjustments or shut-downs with the ENGINEER and OWNER. The CONTRACTOR shall witness and assist with all startups following any of the CONTRACTOR'S Work in the respective area to ensure proper operation of the modified or rehabilitated process.

   1. CONTRACTOR'S means and methods shall be implemented such that the conveyance of sewer flows is in continuous satisfactory operation during the entire construction period. Only shutdowns listed in this Specification Section will be allowed. Shutdowns shall be scheduled and conducted by the CONTRACTOR such that it occurs during periods of low flow volume. In performing the Work shown and specified, CONTRACTOR shall plan and schedule the Work to meet both the constraints outlined in this Section and lift station operating requirements.

D. CONTRACTOR has the option of providing additional temporary facilities that can eliminate a constraint provided it is done without additional cost to the OWNER, presents no safety hazards, and provided that all requirements of these specifications are fulfilled. CONTRACTOR shall obtain ENGINEER'S approval prior to installing temporary facilities. Temporary facilities shall have same amount of reliability, redundancy, and automation currently available.

E. CONTRACTOR is responsible for coordinating all shutdowns with the ENGINEER. CONTRACTOR shall whenever possible, combine discrete

shutdown procedures into a single shutdown when the duration of the shutdowns or the Work requirements allow. The intent of combining procedures is to minimize the impacts upon plant operations and processes by limiting the number of shutdowns required.

F. CONTRACTOR shall not shut off or disconnect any operating system. All lift station equipment operation and shutdowns shall be executed by the OWNER, unless otherwise noted.

G. CONTRACTOR shall be responsible for supplying all temporary pipelines, valves, pumps, meters, spare parts, temporary electrical power and controls, and any other appurtenances required for the installation and operation of temporary bypass lines, pumping systems, blowers, or conveyance systems required to maintain onveyance of sewer flows during construction activities. All temporary facilities shall be tested prior to taking an existing system offline. CONTRACTOR shall submit to the ENGINEER for review and approval, the design of all temporary lines, conveyance systems, proposed temporary equipment, etc., at least 30 days prior to planned commencement of the Work. Equipment performance information shall be included with the submittal.

H. Unless otherwise specified, the CONTRACTOR shall dewater the lift station wet well, connected piping and Manhole No. 5. The CONTRACTOR shall be responsible for washing down and cleaning the lift station wet well and Manhole No. 6. It is the responsibility of the CONTRACTOR to remove all washdown, cleaning and storm water that accumulates in the Work areas. CONTRACTOR shall be responsible for removing this material and disposing of it off-site.

I. The Potable Water System is to be protected at all times to keep the odor control system in service when the lift station is operational.

J. Paving operations shall not commence as deemed necessary for overall completion by agreement between the ENGINEER and CONTRACTOR.

K. Electrical Distribution, Instrumentation and Communication System: Any shutdowns related to electrical connections shall be coordinated with the lift station shutdown schedule.

L. Extensive coordination is required for the Work to be conducted in and around the facility. CONTRACTOR shall refer to Specification Section 01310, Progress Schedule, for further information regarding sequencing of construction.

M. The CONTRACTOR shall note that the lift station and temporary bypass station will be collecting and pumping wastewater at all times during the construction of

the Project. Gases such as H2S will be present in the atmosphere in and around numerous processes. CONTRACTOR shall plan Work accordingly.

1.2 GENERAL CONSTRAINTS

A. The following Sections describe the proposed shutdown schedule, where applicable, for lift station and manholes which are to be taken out of service. The operational status of new or existing units other than the designated units shall not be interrupted by the CONTRACTOR during the specified time period. New units may only be used after the specified testing is completed and the units are accepted for use by the ENGINEER, in writing.

B. The following constraints shall be applied to all equipment and appurtenant utility systems at the plant site.
   1. Access to Site: An unobstructed traffic route shall be maintained at all times.
   2. Potable, Non-Potable and Fire Water Systems: The existing potable, non-potable and fire water system shall be kept in operation at all times, unless otherwise specified.
   3. Draining Process Pipes and Conduits:
      a. The force main shall be drained into Manhole No. 5. No uncontrolled spillage of a pipe's contents shall be allowed.
      b. The lift station shall be drained as much as possible by using the existing pumps. Any washdown and leftover water shall be pumped to Manhole No. 5 with sump pumps and/or trash pumps.
      c. Any spillage shall be brought to the ENGINEER'S attention immediately in writing. CONTRACTOR shall remove spillage by sump pump or other method such as Vactor truck, as approved by the ENGINEER.
   4. Dead End Valves or Pipe: CONTRACTOR shall provide blind flanges on all valves or pipes which dead-end a line on a temporary or permanent basis. Blind flanges shall be braced and blocked, as required or as directed by the ENGINEER in the field.
   5. Power, Light, and Communication Systems: Electrical power, lighting service and communication systems shall be maintained in uninterrupted operation in all areas.
   6. Dead End Valves or Pipe: CONTRACTOR shall provide blind flanges or MJ Plugs on all valves or pipes which dead-end a line on a temporary or permanent basis. All dead end lines shall be braced and blocked and MJ Plugs shall also be restrained.

1.3 SHUTDOWNS

A. General
   1. A shutdown shall be defined as a portion of the normal operation of the lift station that has to be suspended or taken out of service in order to perform the specified Work. For each shutdown, CONTRACTOR shall prepare a list of labor, materials, and equipment needed to perform tasks, an estimate of the

time required, and a written description of steps required to complete all tasks. The list, the estimate, and written procedures shall be submitted to the ENGINEER for review 30 calendar days prior to the proposed start date of the shutdown. CONTRACTOR shall also request in writing from the ENGINEER, approval for each shutdown a minimum of 14 calendar days prior to the proposed shutdown date. No shutdown shall be initiated until the list of materials and labor is verified by the ENGINEER on site at least one week prior to the proposed start date. One meeting shall be held per shutdown after ENGINEER'S review of the information on written procedures and at least three weeks prior to proposed shutdown. A second meeting shall be held for verification of list of materials and labor.

2. The Work required herein and any other Work required by the ENGINEER will require a prolonged shutdown of the lift station and Manhole No. 5. The installation and startup of a temporary bypass pump station will require the interruption of raw sewage conveyance from Manhole No. 6 to downstream of the Manganaro Lift Station. This interruption shall::
   a. Occur during low flow volumes on a regular working day.
   b. Be limited to 4-hours or less of total interruption.
3. CONTRACTOR shall have on hand and located in close proximity to the Work area all tools, equipment, spare parts and materials, both temporary and permanent, necessary to complete each Work category without interruption. An adequate number of personnel shall be scheduled for each shutdown, so that Work shall be accomplished within the specified time frame. Prefabrication of all piping and other assemblies shall be completed, to the greatest degree possible, prior to any shutdowns. The ENGINEER shall be satisfied that the CONTRACTOR has complied with these requirements, to the fullest extent possible, before shutdowns will be authorized.
4. If CONTRACTOR'S procedures cause an unscheduled shutdown of the facilities, CONTRACTOR shall perform Work as necessary to immediately reestablish satisfactory operation. CONTRACTOR shall notify the ENGINEER, in writing, immediately of an unscheduled shutdown. Unscheduled shutdowns and/or interruptions of facility operations that result in fines levied by the Arizona Department of Environmental Quality, or Maricopa County shall be the responsibility of the CONTRACTOR if it is demonstrated that the CONTRACTOR was negligent in his Work or did not exercise proper precautions in the conduct of his Work.
5. Scheduled shutdowns during the period of the CONTRACTOR'S Work will be as shown in Paragraph 1.6 of this Specification. All Work requiring the lift station to be out of service shall be performed during the scheduled shutdowns shown. It should be noted that the OWNER'S personnel shall continue to perform administrative, operational, and maintenance functions during shutdowns.
6. Shutdown of Electrical Systems: CONTRACTOR shall lock out and tag circuit breakers and switches operated by the OWNER and check cables and wires to be sure that they are de-energized to ground potential before Work begins. Upon completion of the Work, CONTRACTOR shall remove the

locks and tags and notify the ENGINEER that the facilities are available for use.

7. When temporary equipment is in operation, the CONTRACTOR shall provide temporary instrumentation wiring to operate temporary equipment to keep the lift station in operation (i.e., level sensors signals for pump stations). The instrumentation wiring and temporary equipment operation logic shall be submitted to and approved by the ENGINEER.

1.4 RELATED SECTIONS

A. Section 01010, Summary of Work.

B. Section 01310, Progress Schedule.

1.5 SEQUENCING OF WORK

A. General:
   1. The CONTRACTOR is responsible for identifying all other critical sequencing items and is also responsible for scheduling the Work.
   2. The list below shows a suggestion of Work sequence. The CONTRACTOR shall submit a detailed Work sequence. The Work sequence plan shall be reviewed and approved by the ENGINEER at least 14 days prior to commencement of Work.

B. Suggested Work Sequence:
   1. Set Staging area and access to Manganaro Lift Station Site.
   2. Remove perimeter wall.
   3. Remove concrete slab and abandoned odor control piping.
   4. Excavate west of existing valve vault around Manhole No. 6.
   5. Salvage Manhole No. 6 cone, collar and cover.
   6. Install and start bypass pump station.
   7. Dewater and clean lift station and Manhole No. 5.
   8. Remove west wall of existing valve vault.
   9. Remove 16" discharge piping.
   10. Extend vault.
   11. Install new piping and flow meter.
   12. Rehabilitate lift station.
   13. Rehabilitate Manhole No. 5.
   14. Remove temporary bypass pump station.
   15. Install flow-through plugs and piping inside Manhole No. 6.
   16. Inspect and rehabilitate Manhole No. 6.
   17. Remove flow-through plugs and piping.
   18. Reinstall Manhole No. 6 cone, collar and cover.
   19. Rebuild perimeter wall.
   20. Return site, staging area, access road to original conditions.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01013

ENGINEERING SERVICES

PART 1 - GENERAL

1.1 SUMMARY

A. The Work to be accomplished under these Contract Documents has been designed for the OWNER by a registered Professional Engineer retained by the OWNER for this purpose. It is understood that normal engineering for the purpose of interpretation of the Contract Documents is provided by the OWNER. Should any services of the ENGINEER be required to assist in the corrections of errors or omissions in construction by the CONTRACTOR, or services of the ENGINEER be required because of changes in structure or equipment where the CONTRACTOR has requested approval of substitute methods or materials, those services will be provided by the ENGINEER at the standard hourly rates previously negotiated with the OWNER and shall be paid for by the CONTRACTOR. Other services shall be described further in this Section.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 ENGINEERING SERVICES

A. The ENGINEER shall be reimbursed by the CONTRACTOR for the ENGINEER'S additional services to the Project through no fault of the OWNER or ENGINEER including, but not limited to, the following conditions:
   1. Additional Shop Drawing review(s) by the ENGINEER as described in Section 01300, Submittals.
   2. Additional site visits, investigations, inspections, design work, and/or reports by the ENGINEER which are required due to damages to existing facilities or completed Work caused by the CONTRACTOR in his performance, the CONTRACTOR'S negligence, or the CONTRACTOR'S Work which is rejected as defective or as failing to conform to the Contract Documents.
   3. All retesting required due to the failure of the CONTRACTOR'S Work to meet the requirements of the Contract Documents shall be at the CONTRACTOR'S expense. All standby and travel time by the OWNER'S testing lab or ENGINEER due to CONTRACTOR'S inability to be prepared for testing at the agreed upon time or inability of CONTRACTOR to meet performance requirements shall be at the CONTRACTOR'S expense. An

hourly rate of three times the direct labor cost, but not less than $125/hour, will be charged to the CONTRACTOR for every hour of engineering or testing lab personnel time, plus the cost of any retesting on a per test basis.

B. The ENGINEER shall bill the OWNER for additional Engineering Services performed as described in these Documents. The OWNER shall withhold payment for this from the CONTRACTOR'S final payment. A change order shall be executed deleting the amount due from the Contract sum and final payment.

END OF SECTION

SECTION 01040

COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. The CONTRACTOR will be required to coordinate his activities with the pertinent utilities, OWNER'S staff, subcontractors, and equipment suppliers in order not to delay the CONTRACTOR'S Project schedule and to minimize the disruption to system operation throughout the construction period.

1.2 RELATED SECTIONS

A. Section 01300, Submittals.

1.3 SEQUENCING AND SCHEDULING

A. CONTRACTOR shall submit to the ENGINEER and OWNER a construction schedule in accordance with Section 01310, Progress Schedule.

B. The CONTRACTOR shall be responsible for coordinating in a timely manner with pertinent utility companies to avoid conflicts with their facilities.

C. The CONTRACTOR shall receive approval of the construction schedule prior to commencement of Work.

D. The CONTRACTOR shall be responsible for coordinating Work among all subcontractors as necessary.

E. The CONTRACTOR shall be responsible for all construction coordination necessary so that the Project may remain on schedule.

F. The CONTRACTOR shall coordinate the following with the OWNER and ENGINEER:
   1. Bypass pumping.
   2. Traffic control (if any.)
   3. Staging area and site access.
   4. Temporary odor control.
   5. Testing.
   6. Inspections.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01050

FIELD ENGINEERING/SURVEYING

PART 1 - GENERAL

1.1 SUMMARY

A. The CONTRACTOR shall survey and provide construction baseline and fulfill construction staking requirements and responsibilities as specified in the General Conditions. Survey shall be based on City of Chandler Benchmark No. 10A (NAVD 88 Elevation = 1186.52.)

B. The CONTRACTOR shall provide competent, qualified personnel and materials required to perform all construction layouts staking of the Work and will protect and preserve the established reference points and will make no change or relocations without the prior written approval of the OWNER.

C. The CONTRACTOR will report to the OWNER whenever any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations. The CONTRACTOR will replace and accurately relocate all reference points so lost, destroyed, or moved.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01090

REFERENCE STANDARDS/ABBREVIATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section lists many of the construction industry organizations, professional and technical associations, societies and institutes, and government agencies issuing, promoting, or enforcing standards to which references may be made in the Contract Document, along with the abbreviations commonly used for those references. Also included are certain general requirements for the use of industry standards specified and for application of the standards in quality control.

1.2 USE OF REFERENCE STANDARDS

A. Work specified by reference to the published standard or specification of a government agency, technical association, trade association, professional society or institute, testing agency, or other organization shall conform to, or surpass the minimum standards of quality for materials and workmanship established by the designated standard or specification.

B. Where so specified, products or workmanship shall also conform to the additional prescriptive or performance requirements included within the Contract Documents to establish a higher or more stringent standard of quality than that required by the referenced standard.

C. Where the specific date or issue of the standard is not included with the reference to the standard, the edition, including all amendments published and available on the first published date of the Invitation to Bid, shall apply.

D. Where two or more standards are specified to establish quality, the product, and workmanship shall conform to or surpass the requirements of both.

E. In case of conflict between referenced standards, the more stringent shall apply.

F. Where both a standard and a brand name are specified for a product in the Contract Document, the proprietary product named shall conform to or surpass the requirements of the specified reference standard. The listing of a trade name in a Contract Document shall not be construed a warranting that such product conforms to the respective reference standard.

G. Copies of Standards:

1. Copies of applicable referenced standards have not been bound in this Contract Document.
2. Where copies of standards are needed by the CONTRACTOR for superintendence and quality control of the Work, obtain a copy or copies directly from the publication source and maintain in an orderly manner at the job site, available to the CONTRACTOR'S personnel, subcontractors, OWNER, and ENGINEER.
3. Submittals: Submit for approval the requests to use products conforming to printed standards or publications with a different publication date from that effective under the Contract. Clearly indicate the changes in product or workmanship quality involved in the proposed change, if any, and reasons for the request.

1.3 ABBREVIATIONS

A. Abbreviations for trade organizations and government agencies. The following is a list of construction industry organizations and government agencies to which references may be made in the Contract Document, with abbreviations used.

AA	Aluminum Association
AAMA	American Architectural Manufacturers Association
AAMA	Architectural Aluminum Manufacturers' Association
AASHTO	American Association of State Highway and Transportation Officials
ABPA	Acoustical and Board Products Association
ACI	American Concrete Institute
ADA	Americans With Disabilities Act
ADEQ	Arizona Department of Environmental Quality
ADHS	Arizona Department of Health Services
AFBMA	Anti-Friction Bearing Manufacturers' Association
AGA	American Gas Association
AGC	Associated General Contractors
AGMA	American Gear Manufacturers' Association
AHC	Architectural Hardware Consultant
AI	Asphalt Institute
AIA	American Institute of Architects
AIA	American Insurance Association
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALS	American Lumber Standards
AMCA	Air Moving and Conditioning Association
AMG	Arizona Masonry Guild
ANSI	American National Standards Institute
APA	American Plywood Association
API	American Petroleum Institute

AREA	American Railway Engineering Association
ARI	Air Conditioning and Refrigeration Institute
ARMA	Asphalt Roofing Manufacturers Association
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc.
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWI	Architectural Woodwork Institute
AWPA	American Wood Preservers' Association
AWPB	American Wood Preservers Bureau
AWPI	American Wood Preservers' Institute
AWS	American Welding Society
AWSC	Aerican Welding Society Code
AWI	Architectural Woodwork Institute
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers' Association
BIA	Brick Institute of America
CBMA	Certified Ballast Manufacturers' Association
CDA	Copper Development Association
CGA	Compressed Gas Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturer's Institute
CMAA	Crane Manufacturers' Association of America
CRA	California Redwood Association
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standards
CSI	Construction Specifications Institute
CTI	Cooling Tower Institute
FGMA	Flat Glass Manufacturer's Association
FIA	Factory Insurance Association
FM	Factory Mutual
FS	Federal Specification
FTI	Facing Tile Institute
GA	Gypsum Association
HI	Hydraulic Institute
HMI	Hoist Manufacturers' Institute
ICBO	International Conference of Building Officials
ICEA	Insulated Cable Engineers' Association
IEEE	Institute of Electrical and Electronics Engineers, Inc.

SECTION 01143

COORDINATION WITH OWNER'S OPERATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The intent of this Section is to provide CONTRACTOR a sequence to perform the Work in such a manner that continuous, uninterrupted wastewater service is maintained operational throughout the construction period.

B. CONTRACTOR'S means and methods shall be implemented such that the existing wastewater service shall remain in continuous satisfactory operation during the entire construction period. Work shall be so scheduled and conducted by CONTRACTOR such that it shall not create potential hazards to the public. In performing the Work shown and specified, CONTRACTOR shall plan and schedule the Work to meet both the constraints outlined in this Section and Drawings.

C. Work not specifically covered in Section 01010, Summary of Work, or in the following paragraphs may, in general, be done at anytime during normal Work hours during the Contract period.

D. CONTRACTOR has the option of providing additional temporary facilities that can eliminate a constraint, provided it is done without additional cost to the OWNER, presents no safety hazards, and provided that all requirements of these Specifications are fulfilled.

E. CONTRACTOR shall be responsible for coordinating all bypass operations with the OWNER and ENGINEER. Refer to specification section 02145, Diversion of Sewage Flow and Dewatering, for further requirements to bypass wastewater service.

F. CONTRACTOR shall not disconnect any wastewater system, unless approved by the ENGINEER, in writing.

G. CONTRACTOR shall be responsible for supplying all temporary pumps, forcemains, valves, meters, fencing, any other appurtenances, and labor required for the installation and operation of temporary bypass lines, security or conveyance systems required to maintain wastewater service during construction activities. CONTRACTOR shall submit to the ENGINEER, for approval, the layout design for all temporary lines or conveyance systems at least 30 days prior to the commencement of the Work.

H. The CONTRACTOR shall not be allowed to demolish the existing wastewater service, until the temporary bypass operation is in place.

1.2 BYPASS OPERATION

A. General:

1. The bypass operation shall be defined as a portion of the normal operation of a wastewater service that has to be bypassed in order to perform the specified Work. For each bypass, CONTRACTOR shall compile an inventory of labor and materials required to perform tasks, an estimate of the time required, and a written description of steps required to complete all tasks. The inventory, the estimate, and written procedures shall be submitted to the ENGINEER for review 30 calendar days prior to the proposed start date of the bypass. CONTRACTOR shall also request, in writing from the ENGINEER, approval for each bypass a minimum of 10 calendar days prior to the proposed shutdown date. No bypass shall be initiated until the inventory of materials and labor is verified by the ENGINEER on-site at least one week prior to the proposed start date.
2. The Work required herein and any other Work required by the ENGINEER that may interrupt the normal facility operations shall be accomplished at such times that will be convenient to the OWNER.
3. CONTRACTOR shall also have on hand and located in close proximity to the Work area, all tools, equipment, spare parts and materials, both temporary and permanent, necessary to complete each Work category without interruption. Adequate numbers of personnel shall be scheduled for each bypass operation, so that the Work shall be accomplished within the specified time frame. Prefabrication of all forcemains, pump systems, and other assemblies shall be completed, to the greatest degree possible, prior to any bypass operation. The ENGINEER shall be satisfied that CONTRACTOR has complied with these requirements, to the fullest extent possible, before the bypass / shutdown operation will be authorized.
4. If CONTRACTOR'S procedures cause an unscheduled shutdown or unsatisfactory condition, as determined by the ENGINEER or OWNER, of the wastewater service, CONTRACTOR shall perform Work as necessary to immediately re-establish satisfactory operation. CONTRACTOR shall notify the ENGINEER, in writing, immediately of any unscheduled shutdown or unsatisfactory condition. CONTRACTOR shall permit OWNER'S personnel to work with CONTRACTOR'S personnel, as required, to maintain the wastewater service in continuous satisfactory operation. Unscheduled shutdowns or interruptions of continued safe and satisfactory operation of the wastewater service that result in fines levied by the U.S. Environmental Protection Agency, Arizona Department of Environmental Quality, or the Maricopa County Environmental Services Department shall be the responsibility of CONTRACTOR if it is demonstrated that CONTRACTOR was negligent in the Work or did not exercise proper precautions in the conduct of the Work.

1.3 OVERTIME

A. All overtime work by CONTRACTOR necessary to conform to the requirements of this Section shall be performed by CONTRACTOR at no additional cost to the OWNER and shall be performed in accordance with the General Conditions. CONTRACTOR shall make no claims for extra compensation as a result thereof.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 BY-PASS DESCRIPTION

A. Bypass pumping is not anticipated during the construction of this project. The CONTRACTOR shall keep the Lift Station in continuous operation with a minimum of two pumps operational at any given time. Short duration shutdowns may be accommodated with prior approval from the OWNER and the ENGINEER. All Maintenance of Plant Operation (MOPO) plans shall be submitted by the CONTRACTOR a minimum of 30 calendar days for review and approval by the OWNER and the ENGINEER.

END OF SECTION

SECTION 01201

PRE-CONSTRUCTION CONFERENCE

PART 1 - GENERAL

1.1 SUMMARY

A. Date, Time and Location: Conference will be held after execution of the Contract and before construction is started at the site. The ENGINEER will fix the date, time and location of the meeting.

B. The ENGINEER shall prepare agenda, preside at meeting, and prepare and distribute a transcript of proceedings to all parties.

C. The CONTRACTOR shall provide data required, contribute appropriate items for discussion, and be prepared to discuss all items on agenda.

1.2 REQUIRED ATTENDANCE

A. The CONTRACTOR and major subcontractors.

B. The OWNER'S Representative.

C. The ENGINEER.

D. Representatives of government agencies having any degree of control or responsibility, if available.

E. Representatives of utility companies having any degree of control or responsibility, if available.

1.3 AGENDA

A. Agenda will include, but will not necessarily be limited to, the following:
   1. Designation of responsible personnel.
   2. The subcontractors.
   3. Contract time.
   4. Coordination and cooperation with other contractors.
   5. Progress Schedule.
   6. Processing of Shop Drawings and distribution of Submittals.
   7. Processing of field decisions and Change Orders.
   8. Requirements for copies of Contract Documents.
   9. Insurance in force.

10. Schedule of Values.
11. Processing and Schedule of Payments.
12. Use of premises.
13. The CONTRACTOR responsibility for safety and first aid procedures.
14. Security.
15. Housekeeping.
16. Field offices.
17. Record Drawings.
18. Letter of Notice to Proceed.
19. Operation and Maintenance Manuals.
20. Meetings.
21. Temporary utilities.
22. Permits.
23. Emergency telephone numbers.
24. Any other Project related items.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01202

PROGRESS MEETINGS

PART 1 - GENERAL

1.1 GENERAL

A. Date and Time:
   1. Regular weekly meetings for the duration of construction or as designated by ENGINEER.
   2. Other Meetings: On call.

B. Place: ENGINEER'S field office or mutually agreed upon location.

C. ENGINEER shall prepare agenda, preside at meetings, and prepare and distribute a transcript of proceedings to all parties.

D. CONTRACTOR shall provide data required and be prepared to discuss all items on agenda.

1.2 MINIMUM ATTENDANCE

A. CONTRACTOR, subcontractors and suppliers as required, representatives present for each party shall be authorized to act on their behalf.

B. ENGINEER.

C. Others as appropriate.

1.3 AGENDA

A. Agenda will include, but will not necessarily be limited to, the following:
   1. Transcript of previous meeting.
   2. Progress since last meeting.
      a. CONTRACTOR.
      b. Subcontractors.
   3. Planned progress for next period.
   4. Shop Drawings.
   5. Problems, conflicts, and observations.
   6. Change Orders.
   7. Applications for Payment.
   8. Quality standards and control.

9. Schedules, including status of off-site fabrication and delivery schedules. Corrective measures required.
10. Coordination between parties.
11. Safety concerns.
12. Other business.
13. Next meeting date.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 - GENERAL

1.1 SUMMARY

A. The CONTRACTOR shall include a completed transmittal form for all submittals. Transmittal forms will be furnished to CONTRACTOR by ENGINEER at the pre-construction conference. Submittals shall be sent to the ENGINEER. CONTRACTOR shall deliver and pick up submittals from ENGINEER'S office located at 9633 S. 48th Street, Suite 190, Phoenix, AZ 85044, between the hours of 7:00 a.m. and 4:00 p.m.

1.2 SECTION INCLUDES

A. Shop Drawings.

B. Material and equipment record.

C. Samples.

D. Operation and Maintenance (O&M) Manuals.

E. Progress Schedule.

F. Progress reports.

G. Daily reports.

H. Testing results.

I. Pre-construction video.

J. Construction photographs.

K. Record Drawings.

L. Spare parts lists.

M. List of spare parts furnished.

1.3 DATA REFERENCE SYMBOLS AND DESCRIPTIONS

A. The submittal data required for Shop Drawings and operations manuals shall contain, but not necessarily be limited to, that data and material as defined by the coded legend set forth below. The submittal data required shall be as indicated and specified under various headings of the Specifications.

1. Letters of Certification of Compliance on materials, equipment, etc.
2. Samples.
3. Final Certified Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
4. Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, lists of erection details, and list of spare parts supplied with equipment.
5. Shop Detail Drawings showing individual sub- assemblies and fabricated pieces with material specifications and other applicable data.
6. Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency.
7. Schematic and wiring diagrams of power, control, and piping systems. A detailed description of operation shall be included for each diagram to describe all modes of operation of the system indicated. Where the integrated system requires interlocking and control of other components in normal operation, these components shall be included in the description of operation.
8. General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals.
9. Service data sheets showing design performance, utility requirements, etc., as applicable to the specific duty for which the equipment is furnished.
10. Certified head and capacity curves for pumps. Impeller size furnished and maximum size available shall be noted on these data sheets.
11. Curves and/or data for overall range of operation from minimum to maximum capacity or load, showing capacity or load, utilities motive medium required, total or incremental differential head, and other pertinent information applicable to the equipment or its component assemblies.
12. Materials of construction of all components.
13. Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.
14. Stuffing box sizes; packing sizes; specifications and arrangement; and mechanical seal details, specifications, etc., if furnished in equipment.
15. Bearing manufacturer's standard identification and/or interchangeable number for all anti-friction bearings in the equipment proper and its accessory items.
16. Material gradation, design mix, job mix formula, and/or material analysis.
17. Concrete reinforcement drawings, details, and calculations. Reinforcement drawings shall be redrawn by the CONTRACTOR to allow for clarity and scale necessary for easy review by the ENGINEER.

18. Competed equipment data sheets.

B. Each Shop Drawing submittal shall include a complete hard copy of the relevant specification section. Each and every paragraph of the Specification Section shall be clearly marked to indicate whether the requirements for equipment and/or services in the Specification Section are met. If clarifications are needed to any of the paragraphs in the Specification Section, they shall be addressed next to the paragraph as such and explained further with any additional information necessary. If any exceptions and/or deviations are proposed to any of the Specifications, they shall be clearly noted as such in the submittal and an explanation of any deviation and/or exception shall be provided. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected.

1.4 SHOP DRAWINGS

A. A minimum of 2 copies of Shop Drawings are required for submittal. Each submittal shall also include one electronic copy of submittal in the latest version of Adobe Acrobat (PDF Extension). Electronic copies shall be sent via e-mail to the ENGINEER. In the event that the electronic copy is too large to e-mail the CONTRACTOR shall provide the electronic copy on a CD. Electronic copies will not be returned. Disposition of the Shop Drawings will be in accordance with the following schedule:

Action by ENGINEER	Retained by ENGINEER	Returned to CONTRACTOR	No. Required for Resubmittal
No Exceptions Noted	1	1	0
Exceptions Noted	1	1	0
Revise and Resubmit	1	1	2
Rejected	1	1	2
No Action Taken	1	1	0

B. The ENGINEER shall return Shop Drawings to the CONTRACTOR within 21 days of receipt by the ENGINEER.

C. One copy of returned Shop Drawings shall be marked with red line comments.

D. Only one copy of "Revise and Resubmit", "Rejected", and "No Action Taken" Shop Drawings will be stamped.

E. If the CONTRACTOR requires additional copies of "No Exceptions Noted", "Exceptions Noted", or "No Action Taken" Shop Drawings, additional copies shall be included in original submittal.

F. The CONTRACTOR may request submittals be reviewed up to two times for each equipment or construction material item, regardless of manufacturer or supplier, by the ENGINEER. For additional reviews, CONTRACTOR will reimburse the ENGINEER for additional labor as specified in Section 01013, Engineering Services.

G. The CONTRACTOR will be held responsible for any delay in progress of the Work due to resubmittal of Shop Drawings. Time for completion of the Contract will not be extended due to the CONTRACTOR'S failure to promptly submit complete and acceptable Shop Drawings, product data, and samples.

H. Do not execute Work required by Shop Drawings until accepted Shop Drawings are received from the ENGINEER.

I. Before submitting Shop Drawings for review, the CONTRACTOR shall check Shop Drawings for accuracy, ascertain that all Work contiguous with and having bearing on other Work shown on Shop Drawings is accurately drawn, and that Work shown is in conformity with Contract requirements. The CONTRACTOR is responsible for all submittals from subcontractors and suppliers.

J. All such Drawings and details, when submitted, must bear the stamp of approval of the CONTRACTOR, bearing checked data, as evidence that such Drawings and details have been checked by him. Said "stamp" shall clearly state that the CONTRACTOR has checked the Drawings and, by his signature, he so certifies. Any Drawings submitted without such executed stamp of approval, or whenever it is evident (despite the stamp) that the Drawings have not been checked, they will be returned to the CONTRACTOR for resubmission and will not be considered. In such event, it will be deemed that the CONTRACTOR has not complied with this provision and the CONTRACTOR shall bear risk of all delays to the same extent as if no Drawings or details had been submitted.

K. The CONTRACTOR shall prepare composite Drawings and installation layouts, when required to solve tight field conditions. Such Drawings shall consist of dimensioned plans and elevations, and must give complete information particularly as to size and location of sleeves, inserts, attachments, openings, conduits, ducts, boxes, structural interferences, etc. These composite Drawings and installation layouts shall be coordinated in the field by the CONTRACTOR and his subcontractors for proper relationship to the work of other trades, based on field conditions, and shall be checked and approved by them before submission to the ENGINEER for his final review. The CONTRACTOR shall have competent technical personnel readily available for such coordinating and checking, as well as for supervision of field installation of work as per the Drawings and installation layouts, which have been previously determined by him to be correct and carry the ENGINEER'S review stamp.

L. Submission of Shop Drawings (in either original submission or when resubmitted with corrections) constitute evidence that the CONTRACTOR has checked all information thereon, and that he accepts and is willing to perform the Work as shown in a workmanlike manner and in accordance with best standard practice.

M. Cost of any changes in construction due to improper checking and coordination by the CONTRACTOR shall be paid for by the CONTRACTOR, and the CONTRACTOR shall be responsible for all additional costs, including coordination.

N. Shop Drawings shall clearly delineate the following information:
   1. ENGINEER'S name and Project number; Project name and address.
   2. Drawing title, number, date, and scale.
   3. Names of CONTRACTOR, Subcontractor, and fabricator.
   4. Working and erection dimensions.
   5. Arrangements and sectional views.
   6. Necessary details, including complete information for making connections with other work.
   7. Kinds of materials and finishes.
   8. Show descriptive names of materials and equipment, classified item numbers, and locations at which materials or equipment are to be installed in the Work. Use same reference identification as shown on Contract Drawings.

O. If Shop Drawings show variations from Contract Documents because of standard shop practice or other reasons, make specific mention of such variations in a separate memo attached to information listed in Paragraph 1.3.B of this Section.

P. Shop drawing review will be general. It shall not relieve the CONTRACTOR of responsibility for accuracy of such Shop Drawings, nor proper fitting, construction of Work, furnishing of materials, or Work required by Contract Documents and not indicated on Shop Drawings. Shop drawing review shall not be construed as approving departures from Contract Documents.

Q. Review of Shop Drawings and schedules shall not relieve the CONTRACTOR from responsibility for any violation indicated on such Drawings or schedules of local, County, State, or Federal laws, rules, ordinances, or rules and regulations of commissions, boards, or other authorities or utilities having jurisdiction.

R. When product data, consisting of manufacturer's printed literature, is required to be submitted to the ENGINEER, it shall be submitted in original form. Any fading type of reproduction will not be accepted. Pertinent information shall be indicated and irrelevant information shall be crossed out.

S. Action taken by ENGINEER shall apply to entire submittal. ENGINEER shall not approve portions of a submittal while disapproving other portions.

T. Resubmitted submittal shall contain entirety of information to review.

1.5 MATERIAL AND EQUIPMENT RECORD

A. The CONTRACTOR shall maintain an up-to-date record of all materials and equipment furnished by him and any subcontractors to be incorporated in the Work.
   1. The ENGINEER will furnish the CONTRACTOR a master of the materials and equipment form. The CONTRACTOR shall maintain the records on reproductions of this form in the field office.

B. The CONTRACTOR shall provide the following information on these forms:
   1. The Specification Paragraph and Section Number where material or equipment are called for.
   2. Date ordered.
   3. Date required.
   4. The CONTRACTOR'S purchase order number.
   5. Supplier's purchase order number.
   6. Date promised.
   7. Date received.
   8. Supplier's name and address.
   9. Remarks.
   10. Shop Drawings and samples with approval date.
   11. Physical dimensions and ratings.
   12. Where submittal sheet describes items in addition to that item being submitted, the submitted item shall be clearly marked on the sheet and superfluous information shall be crossed out.

C. Three copies of the materials and equipment record shall be submitted to the ENGINEER with each Application for Payment. If the current record has not been submitted, the Application shall not be reviewed and shall be returned to the CONTRACTOR as incomplete.

D. The CONTRACTOR shall permit free access to these records, including information on items recently received and not yet posted to the record by the ENGINEER or authorized representative of the OWNER at any time.

1.6 SAMPLES

A. Deliver no material to the building site prior to receipt of the ENGINEER'S written approval. Furnish materials equal in every respect to approved samples and execute Work in conformity therewith. Samples shall be provided with respective Shop Drawings.

B. The approval or acceptance of samples will not preclude the rejection of any material upon the discovery of defects in same prior to the Final Acceptance of the completed Work.

C. After a material has been approved, no change in brand or make will be permitted unless satisfactory written evidence is presented to and approved by the ENGINEER that the manufacturer cannot make scheduled delivery of approved material, or that material delivered has been rejected and substitution of suitable material is an urgent necessity, or that other conditions are apparent which indicate approval of such substitute materials to be in best interest of the OWNER. CONTRACTOR shall provide complete Shop Drawings for replacement product.

D. All samples of materials requiring laboratory tests shall be submitted to laboratory for testing not less than 90 days before such materials are required to be used in the work. Submit all other samples for approval within 30 days after signing of the Contract.

E. Submit samples in duplicate, except where greater or lesser number is specifically required by these Specifications. Submittal shall be made only by the CONTRACTOR, unless he has authorized his subcontractor to submit them and has notified the ENGINEER to this effect.

F. Each sample shall be accompanied by a Shop Drawing form and an itemized transmittal form. The transmittal shall contain list of samples, Project, CONTRACTOR, manufacturer, brand, quarry, quality, etc.; also Project number, Specifications reference, ASTM number (if any), and material being furnished. Enclose copies of transmittal with samples. Any deviation from Contract requirements shall be so stated in the transmittal.

G. Label each sample by a securely attached label giving the Project, CONTRACTOR, subcontractor or supplier, manufacturer's name, product trade name and number, material type, Specification Section and Paragraph reference etc.; also Project name and number and ASTM number (if any).

H. Samples shall be of adequate size to permit proper evaluation. The samples submitted shall show the full range of colors, textures and dimensions, and other variable characteristics expected. Samples of different items that must match or whose finish relates shall be delivered at the same time to facilitate coordination.

I. Samples which are rejected by the ENGINEER must be resubmitted as soon as possible after notification of rejection, and shall be marked "Resubmitted Sample" in addition to other information required.

J. The right is reserved to require submission of samples of any material, any material lists, or any information whether or not specifically specified in the Specifications.

1.7 OPERATION AND MAINTENANCE MANUALS

A. Two hard copies and one electronic copy in PDF format of an Operations and Maintenance (O&M) Manual containing the following items, in addition to any instructions packed with the equipment, are required for each individual item of equipment:
   1. Specifications.
   2. Drawings.
   3. Description of each individual item of equipment.
   4. Manufacturer name, model number, and serial numbers.
   5. Name address and phone number of both the manufacturer's customer service department and the local manufacturer's representative.
   6. Installation instructions.
   7. Operation and maintenance instructions, including lubrication schedule and lubricant specification.
   8. Parts list and part numbers.
   9. Additional data to be included in the manual shall be as required in these Specifications.
   10. Temporary storage recommendations.
   11. Warranty information.

B. O&M Manuals are to be submitted to the ENGINEER upon delivery of the equipment to the site. Overall Project substantial completion will not be scheduled until all manuals are approved. Training shall not be scheduled until O&M Manuals are approved. Training shall not be scheduled until 30 days following delivery of approved O&M Manuals to the OWNER. Training shall be scheduled based on draft O&M Manuals upon approval of ENGINEER.

C. The respective manuals for the individual items of equipment shall be combined into bound volumes covering the complete operating installation with individual equipment items tabled separately. Information for equipment subassemblies not manufactured by the major supplier shall also be included with the respective equipment item.

D. Upon completion of the installation of each item of equipment, the CONTRACTOR shall provide As-Built Drawings of the local control panel to be added to the O&M Manual, as well as set-up parameters such as those required for calibration, etc.

E. O&M Manuals shall be submitted in 3-ring binders meeting the following criteria:

1. Binders shall be Wilson Jones Custom View Organization, D-Ring, white, non-stick, back mounted, binder models 362-13W, 386-14W, 386-34W, 386-44W, 386-49W, or 386-54W; or approved equal.
2. Binder cover insert shall be created using a Microsoft word template supplied by ENGINEER. Modifications to the template shall be approved by the ENGINEER prior to submission of the O&M Manuals. The binder cover insert shall include the Specification number and title as presented within the Contract Documents, manufacturer name, year of purchase, year and month that equipment was placed into operation.
3. Binder spine insert shall be created using a Microsoft word template supplied by ENGINEER. Modifications to the template shall be approved by the ENGINEER prior to submission of the O&M Manuals. The spine insert shall include the Specification number and title as presented within the Contract Documents, manufacturer name, year of purchase, year and month that equipment was placed into operation. Spine insert shall read top to bottom.

1.8 PROGRESS SCHEDULE

A. Progress Schedule as defined in Section 01310, Progress Schedule.

1.9 DAILY REPORTS

A. The CONTRACTOR will provide to the ENGINEER a daily report on a form provided by the ENGINEER indicating the Work in progress, Work completed, equipment used, numbers and category of personnel, and such other pertinent information as applicable. The daily reports shall be compiled and submitted monthly with the Application for Payment. The Application for Payment will not be reviewed and shall be returned to the CONTRACTOR as incomplete if the reports do not accompany it.

1.10 TESTING RESULTS

A. CONTRACTOR shall furnish to the ENGINEER copies of all testing results for all tests required in the Specifications.

1.11 CONSTRUCTION PHOTOGRAPHS

A. Construction photographs as defined in Section 01380, Construction Photographs.

1.12 RECORD DRAWINGS

A. Record Drawings as defined in Section 01700, Contract Closeout. The CONTRACTOR shall update Record Drawings Monthly and make available for review to the ENGINEER monthly one week prior to the Application for Payment

submittal. Failure of the CONTRACTOR to maintain updated Record Drawings can be justification for refusal of Application for Payment.

1.13 UNIT RESPONSIBILITY

A. This Section contains the required Unit Responsibility Form for the CONTRACTOR to use in documenting Work required under this Contract.

B. The Unit Responsibility Form provided in Appendix A to this Section is referenced from other Sections in the Contract Documents. The CONTRACTOR shall submit it with the applicable equipment as required in those Sections.

1.14 CONTRACTOR'S FORMS

A. This Section contains the required forms for CONTRACTOR use in documenting testing Work and other Work required under this Contract. This Section supplements, but does not supersede, specific testing requirements found elsewhere in the Contract Documents.

B. The forms listed below are included in this Section are referenced from other Sections in the Contract Documents. CONTRACTOR may utilize standard forms when authorized by ENGINEER. Forms will include, but will not necessarily be limited to, the following.

Form Designation	Title
A	Schedule of Values
B	Shop Drawings, Product Data and Sample Transmittal Schedule
C	Request for Change Order Proposal
D	Change Order Proposal
E	Request for Information
F	Request for Alteration
G	CONTRACTOR'S Daily Construction Report
H	Equipment Information Form
I	Manufacturer's Installation Certification Form
J	Equipment Test Report Form
K	Operation and Maintenance Transmittal Form
L	Manufacturer's Instruction Certification Form
M	Motor Data Form
N	Wire and Cable Resistance Test Data Form
O	Installed Motor Test Data Form
P	Dry Transformer Test Data Form
Q	Motor Control Center Test Form
R	Medium Voltage Motor Starter Test Form

S	Medium Voltage Switchgear Test Form
T	Protective Relay Test Form
U	Low Voltage Switchgear Test Form
V	Medium Voltage Load Interrupter Switch Test Form
W	Liquid-Filled Transformer Test Form
X	Automatic Transfer Switch Test Form
Y	Neutral Grounding Resistor Test
Z	Conduit and Wire Termination Sheet (not included)
AA	Loop Wiring and Insulation Resistance Test Data Form
BB	Control Circuit Piping Leak Test Form
CC	Controller Calibration Test Data Form
DD	Panel Indicator Calibration Test Data Form
EE	Recorder Calibration Test Data Form
FF	Signal Trip Calibration Test Data Form
GG	Field Switch Calibration Test Data Form
HH	Transmitter Calibration Test Data Form
II	Miscellaneous Instrument Calibration Test Data Form
JJ	Individual Loop Test Data Form
KK	Loop Commissioning Test Data Form
LL	Pipe Test Report

C. CONTRACTOR shall complete the above referenced forms prior to start-up of each piece of equipment, as listed in the Equipment and Valve Schedule. Each form shall pertain to each equipment number.

D. The CONTRACTOR shall submit to ENGINEER for approval one month after completion of start-up, 3-ring binders with tabs for each process area and include all the forms completed prior to start-up. The forms shall be further tabbed within each process area of each form designation as listed above. For example, the Chemical Facilities tab (22) shall include separate tabs for forms H, J, K, and etc. The CONTRACTOR shall submit five copies of all 3-ring binders to the ENGINEER for approval.

E. All forms are provided in Appendix B of this Section.

1.15 ADDITIONAL SUBMITTALS

A. All additional submittals as required by the Contract Documents.

1.16 SUBMITTAL NUMBERING

A. Submittals shall be numbered sequentially, beginning with 001. Resubmitted submittals shall receive the same submittal number followed by the designation .1 for the first resubmittal, .2 for the second, and so forth. For example, submittal

009 would receive the designation 009.1 and 009.2 for the first and second resubmittal, respectively.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

APPENDIX A - Unit Responsibility Form

CITY OF CHANDLER
MANGANARO LIFT STATION IMPROVEMENTS

CERTIFICATE OF UNIT RESPONSIBILITY
for Specification Section _____

_____
(Section Title)

In accordance with Paragraph 01300.1.13.A of the Contract Documents, the undersigned manufacturer accepts unit responsibility for all components of equipment furnished under Specification Section _____. We hereby certify that these components are compatible and comprise a functional unit suitable for the specified performance and design requirements.

_____
Notary Public

_____
Commission Expiration Date

Seal:

_____
Name of Corporation

_____
Address

By: _____
Duly Authorized Official

_____
Legal Title of Official

Date: _____

APPENDIX B - Contractor's Forms

SCHEDULE OF VALUES

Sheet _____ of ___

Section No._____

Item Description	Material	Labor	Equipment	Total

SHOP DRAWINGS, PRODUCT DATA AND SAMPLE SUBMITTAL SCHEDULE

CONTRACTOR _____
Project Name _____
Project No. _____ Date _____ Page ___ of_____

Item No.	Description	Specification Section Number	Date To Be Submitted	Approval Needed By	Date Submitted	Date Reviewed	Transmittal Number

REQUEST FOR CHANGE ORDER PROPOSAL

Date: _____

CONTRACTOR _____

_____

_____

Project Name _____

Project No. _____

Change Order No. _____

NOTICE TO CONTRACTOR: Please submit a Change Order Proposal for the proposed modifications to the Contract Documents as described below. If acceptable, a Change Order will be issued to authorize the work. THIS IS NOT A CHANGE ORDER FOR AUTHORIZATION TO PROCEED WITH THE WORK AS DESCRIBED!

SCOPE OF WORK:

OWNER ____

CHANGE ORDER PROPOSAL

Date _____

Subject: Project Name _____

Project No._____

Change Order No._____

Dear Sir:

Certain items of extra work have been found necessary which are not covered by the Contract for the above referenced Project. Therefore, we submit the following amounts as the basis of compensation for such extra work:

JUSTIFICATION:

The Contract completion time will be (increased)(decreased) ____ consecutive calendar days.

Total Cost of Extra Work Covered by Above:	$_____
Previously Approved Extra Work:	$_____
Original Contract Amount	$_____
TOTAL:	$_____

By: _____

Title:_____

CONTRACTOR: _____

CITY OF CHANDLER
OWRF/AWRF LIFT STATION
REQUEST FOR INFORMATION

CONTRACTOR_____
Requested By_____
Subject_____
Spec. Section_____
Drawing References_____
Date Reply Needed_____

RFI# _____
Directed to _____
Date Received _____
Date Transmitted _____
Date Reply Received _____
Date Reply Transmitted _____

INFORMATION NEEDED:

Date _____ Signature _____

REPLY:

Date_____ Signature_____

CITY OF CHANDLER
OWRF/AWRF LIFT STATION
REQUEST FOR ALTERATION

CONTRACTOR_____
Requested By_____
Subject_____
Spec. Section_____
Drawing References_____
Date Reply Needed_____

RFA# _____
Directed to _____
Date Received _____
Date Transmitted _____
Date Reply Received _____
Date Reply Transmitted _____

REQUESTED ALTERATION:

Date _____ Signature _____

REPLY:

Date _____ Signature _____

CONTRACTOR _____

_____

_____

CONTRACTOR'S DAILY CONSTRUCTION REPORT

Project Name _____

Project No. _____ Report No. _____

Date _____

CONTRACTORS WORK FORCE:		SUBCONTRACTORS WORK FORCE:		EQUIPMENT ON SITE:	In Use	Not in Use
Administrative		Mechanical		Cranes		
Supervisors		Electrical		Loaders		
Carpenters		Instrumentation		Dozers		
Iron Workers		Sitework		Scrapers		
Operators		Masonry		Compactors		
Finishers		Roofing		Compressors		
Welders		Rebar		Welders		
Electricians		Foundation		Graders		
Laborers		Painting		Trucks		
				Backhoe		

Work Performed: _____

Material and Equipment Delivered: _____

Remarks: _____

By: _____

Title: _____

CITY OF CHANDLER
OWRF/AWRF LIFT STATION
EQUIPMENT INFORMATION FORM

Name: _____ Date: _____

EQUIP #: _____ Desc: _____

COP #: _____ Type: _____

Manuf: _____ Locat: _____

Model #: _____ Vendor: _____

Serial #: _____ Doc. Ref: _____

DWG. Ref: _____ Assoc. Equip: _____

Size: _____ HP: _____

GPM: _____ PH/DC: _____

Temp: _____ Volts: _____

PSI: _____ Amps: _____

CFM: _____ RPM: _____

Output: _____ Power Ser: _____

Range: _____ Frame: _____

Order #: _____ Encl: _____

Electrical Data: _____

Mechanical Data: _____

Frequency	Week #	Work To Be Done

MANUFACTURER'S INSTALLATION CERTIFICATION FORM

Contract No.: _____ Specification Section: _____

Equipment Name: _____

CONTRACTOR: _____

Manufacturer of Equipment Item: _____

The undersigned manufacturer of the equipment item described above hereby certifies that he has checked the installation of the equipment and that the equipment, as specified in the Contract Documents, has been provided in accordance with the manufacturer's recommendations, and that the trial operation of the equipment item has been satisfactory.

Comments: _____

_____

_____

_____

_____ _____

Date Manufacturer

_____

Signature of Authorized Representative

_____ _____

Date CONTRACTOR

_____

Signature of Authorized Representative

EQUIPMENT TEST REPORT FORM

NOTE: This example equipment test report is provided for the benefit of CONTRACTOR and is not specific to any piece of equipment to be installed as a part of this project. The example is furnished as a means of illustrating the level of detail required for the preparation of equipment test report forms for this project.

CITY OF CHANDLER
OWRF/AWRF LIFT STATION

_____ CONTRACTOR

EQUIPMENT/SYSTEM TEST REPORT

Equipment Name: _____
Equipment Number: _____
Specification Ref: _____
Location: _____
System: _____

	CONTRACTOR		ENGINEER	
	Verified	Date	Verified	Date
PREOPERATIONAL CHECKLIST				
Mechanical				
Lubrication.	_____	_____	_____	_____
Alignment.	_____	_____	_____	_____
Anchor bolts.	_____	_____	_____	_____
Seal water system operational.	_____	_____	_____	_____
Equipment rotates freely.	_____	_____	_____	_____
Safety guards.	_____	_____	_____	_____
Valves operational.	_____	_____	_____	_____
Hopper purge systems operational.	_____	_____	_____	_____
Sedimentation tank/hopper clean.	_____	_____	_____	_____
O&M Manual information complete.	_____	_____	_____	_____
Manufacturer's installation certificate complete.	_____	_____	_____	_____

	CONTRACTOR Verified	CONTRACTOR Date	ENGINEER Verified	ENGINEER Date
Electrical (circuit ring-out and high-pot tests)				
Circuits:				
Power to MCC __.	_____	_____	_____	_____
Control to HOA.	_____	_____	_____	_____
Indicators at MCC:				
Red (running).	_____	_____	_____	_____
Green (power).	_____	_____	_____	_____
Amber (auto).	_____	_____	_____	_____
Indicators at local control panel.	_____	_____	_____	_____
Wiring labels complete.	_____	_____	_____	_____
Nameplates:				
MCC.	_____	_____	_____	_____
Control station.	_____	_____	_____	_____
Control panel.	_____	_____	_____	_____
Equipment bumped for rotation.	_____	_____	_____	_____
Piping Systems				
Cleaned and flushed:				
Suction.	_____	_____	_____	_____
Discharge.	_____	_____	_____	_____
Pressure tests.	_____	_____	_____	_____
Temporary piping screens in place.	_____	_____	_____	_____
Instrumentation and Controls				
Flowmeter FE_____ calibration	_____	_____	_____	_____
Calibration Report No._____				
Flow recorder FR_____ calibrated against transmitter.	_____	_____	_____	_____
VFD speed indicator calibrated against independent reference.	_____	_____	_____	_____
Discharge overpressure shutdown switch calibration.	_____	_____	_____	_____
Simulate discharge overpressure shutdown.	_____	_____	_____	_____

	CONTRACTOR Verified	CONTRACTOR Date	ENGINEER Verified	ENGINEER Date

EQUIPMENT/SYSTEM PERFORMANCE TESTS

Mechanical

Motor operation temperature satisfactory.	_____	_____	_____	_____
Pump operating temperature satisfactory.	_____	_____	_____	_____
Unusual noise, etc?	_____	_____	_____	_____
Pump operation: 75 gpm/50 psig	_____	_____	_____	_____

Measurement:

Flow _____

Pressure _____ Test gage number _____

Alignment hot.	_____	_____	_____	_____
Dowelled in.	_____	_____	_____	_____

Remarks: _____

_____

_____

Electrical

Local switch function:				
Runs in *HAND*	_____	_____	_____	_____
No control power in *OFF*	_____	_____	_____	_____
Timer control in *AUTO*	_____	_____	_____	_____
Overpressure protection switch PS_____ functional in both *HAND* and *AUTO*_	_____	_____	_____	_____
Overpressure protection switch PS_____ set at 75 psig	_____	_____	_____	_____
PLC 2500 set at 24-hour cycle, 25 min *ON*	_____	_____	_____	_____

Equipment/System Performance Test Completed

Contractor _____ Date _____

Equipment/System Performance Test Accepted

Engineer _____ Date _____

OPERATION AND MAINTENANCE TRANSMITTAL FORM

Date:_____ Submittal No.: _____

To: Contract No.: _____

_____ Spec. Section: _____

_____ Submittal Description: _____

_____ From: _____

Attention: _____ _____

Checklist	CONTRACTOR		ENGINEER	
	Satisfactory	N/A	Accept	Deficient
1. Table of Contents				
2. Equipment forms				
3. Manufacturer information				
4. Vendor information				
5. Safety precautions				
6. Operator pre-start				
7. Start-up, shutdown, and post shutdown procedures				
8. Normal operations				
9. Emergency operations				
10. Operator service requirements				
11. Environmental conditions				
12. Lubrication data				
13. Preventive maintenance plan and schedule				
14. Troubleshooting guides and diagnostic techniques				
15. Wiring diagrams and control diagrams				
16. Maintenance and repair procedures				
17. Removal and replacement instructions				
18. Spare parts and supply list				
19. Corrective maintenance man-hours				
20. Parts identification				
21. Warranty information				
22. Personnel training requirements				
23. Testing equipment and special tool information				

Remarks: _____

_____
CONTRACTOR'S Signature

MANUFACTURER'S INSTRUCTION CERTIFICATION FORM

Contract No:_____Specification Section: _____ Equipment Name: _____

_____

CONTRACTOR: _____

Manufacturer of equipment item: _____

The undersigned manufacturer certifies that a service engineer has instructed the plant operating personnel in the proper maintenance and operation of the equipment designated herein.

Operations Check List (check appropriate spaces)

Start-up procedure reviewed.	_____
Shutdown procedure reviewed.	_____
Normal operation procedure reviewed.	_____
Others: _____	_____
_____	_____

Maintenance Check List (check appropriate spaces)

Described normal oil changes (frequency).	_____
Described special tools required.	_____
Described normal items to be reviewed for wear.	_____
Described preventive maintenance instructions.	_____
Described greasing frequency.	_____
Others: _____	_____
_____	_____

_____ _____
Date Manufacturer

_____
Signature of Authorized Representative

_____ _____
Date Signature of OWNER'S Representative

_____ _____
Date Signature of CONTRACTOR'S Representative

MOTOR DATA FORM

Equipment Name_____

Equipment No.(s) _____

Site Location _____

Nameplate Markings

Mfr _____ Mfr Model _____ Frame _____ HP___
Volts _____ Phase _____ RPM _____ Service factor ___
FLA _____ LRA _____ Freq _____ Amb temp rating _____degrees C
Time rating _____ Design letter _____
(NEMA MG1-10.35) (NEMA MG-1.16)

KVA code letter _____ Insulation class _____

The following information is required for explosionproof motors only:

A. Approved by UL for installation in Class _____, Div _____

B. UL frame temperature code _____; Group _____ Atmosphere _____
(NEC Tables 500-2 and 500-2(b))

The following information is required for all motors 1/2 horsepower and larger:

A. Guaranteed minimum efficiency _____
(Section 11000)

B. Nameplate or nominal efficiency _____

Data Not Necessarily Marked on Nameplate

Type of enclosure _____ Enclosure material_____

Temp rise _____degrees C (NEMA MG1-12.41,42)

Space heater included?_____ Yes _____ No; if Yes, _____watts _____volts

Type of motor winding overtemperature protection, if specified: _____

Use the space below to provide additional information on other motor modifications, if specified:

_____

_____

WIRE AND CABLE RESISTANCE TEST DATA FORM

Wire or Cable No.:_____ Temperature, °F _____

Location of Test	Insulation resistance, megohms
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

INSTALLED MOTOR TEST DATA FORM

Motor Equipment Number _____ Date of test _____

Equipment Driven _____

MCC Location _____ Ambient temp _____ °F

Resistance:

Insulation resistance phase-to-ground megohms:

Phase A _____, Phase B _____, Phase C _____

Current at Full Load:

Phase _____ Current, amps _____

Phase _____ Current, amps _____

Phase _____ Current, amps _____

Thermal Overload Device: Manufacturer/catalog # _____ Amperes ____

Circuit breaker (MCP) setting: _____

Motor Nameplate Markings:

Mfr _____ Mfr type _____ Frame _____ HP_____

Volts _____ Phase _____ RPM _____ **Service factor _____

Amps _____ Freq _____ Ambient temp rating _____ °C

Time rating _____ **Design letter _____
(NEMA 1-10.35) (NEMA MG-1.16)

Code letter _____ Insulation class _____

**Required for 3-phase squirrel cage induction motors only.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

DRY TRANSFORMER TEST DATA FORM

Equipment No. _____ Temperature _____

Location _____

Winding: Primary _____ Secondary_____

A. INSULATION-RESISTANCE TEST:
The test shall be made with a megohmmeter at the test voltage for a period of 1 minute.

Voltage rating	Test voltage	Test results (megohms) Phase	Phase
0-600	1000	A-GRD ____	A-B ____
601-5000	2500	B-GRD ____	B-C ____
5000+	5000	C-GRD ____	C-A ____

Resistance readings less than the manufacturer's recommended value or less than 10 megohms shall be brought to the attention of the ENGINEER.

B. DIELECTRIC-ABSORPTION TEST:
The test shall be made with a megohmmeter at the test voltage for a period of 10 minutes.

1. TEST RESULTS: (megohms)

Phase	Phase
A-GRD ____	A-B _____
B-GRD ____	B-C _____
C-GRD ____	C-A _____

2. POLARIZATION INDEX:

$$\frac{\textit{10 minute reading}}{\textit{1 minute reading}} = \textit{polarization index}$$

(from Paragraph "A" above)

Phase	Phase
A-GRD ____	A-B ____
B-GRD ____	B-C ____
C-GRD ____	C-A ____

Polarization index values less than two shall be brought to the attention of the ENGINEER.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

MOTOR CONTROL CENTER TEST FORM

Equipment No. _____ Ambient room temperature _____

Location _____

A. MECHANICAL CHECK:

1. All bolted connections either bus to bus or cable to bus shall be torqued to the manufacturer's recommendations.

B. ELECTRICAL TESTS:

1. Measure insulation resistance of each bus section phase to phase and phase to ground for one minute using a megohmmeter at 1000 volts.

Test results (megohms)	
Phase	Phase
A-GRD _____	A-B ___
B-GRD _____	B-C ___
C-GRD _____	C-A ___

2. Set the circuit breaker in the starter unit to comply with the requirements of NEC, Article 430-52 and Table 430-152.

3. Motor overload heater elements shall be sized and installed based on the actual nameplate full load amperes of the motor connected to the starter.

CERTIFIED _____ Date_____

CONTRACTOR'S Representative

WITNESSED _____ Date_____

OWNER'S Representative

MEDIUM VOLTAGE MOTOR STARTER TEST FORM

Equipment No. _____

Location _____

Room Temperature _____

A. The protective devices shall be set in accordance with the specification before the tests are performed.

1. Measure contact resistance (micro-ohms)
   Phase: A_____ B_____ C _____

   Contacts shall be replaced if resistance exceeds 50 micro-ohms.

2. Perform an insulation resistance test (1000 volts DC for 1 minute).

Phase	A	B	C	
Pole to ground	___	___	___	megohms
Across open pole	___	___	___	megohms
Pole to pole	AB_____	BC_____	CA_____	megohms

3. Perform minimum pickup voltage tests on trip and close coils.

4. Motor RTDs shall be tested by using a hot oil bath. The temperature at which the sensor trips shall be recorded for each RTD.

5. The Contactor shall be tripped by operation of each protective device.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

MEDIUM VOLTAGE SWITCHGEAR TEST FORM

Equipment No. _____

Location _____

Room Temperature _____

A. The protective devices shall be set in accordance with the specification before the tests are performed.

1. Measure contact resistance (micro-ohms)
   Phase: A____ B____ C _____

   Contacts shall be replaced if resistance exceeds 50 micro-ohms.

2. Perform an insulation resistance test (1000 volts DC for 1 minute).

Phase	A	B	C	
Pole to ground	__	__	__	megohms
Across open pole	__	__	__	megohms
Pole to pole	AB__	BC__	CA__	megohms

3. Perform minimum pickup voltage tests on trip and close coils.

4. Verify the instrument transformer ratios. Check the transformer's polarity electrically.

5. The Contactor shall be tripped by operation of each protective device.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

PROTECTIVE RELAY TEST FORM

Location _____

Switchgear Breaker No. _____

Protective Relay Description _____

A. The protective relays shall be tested in the following manner:

1. Each protective relay circuit shall have its insulation resistance tested to ground.

2. Perform the following tests on the specified relay setting:

a. Pickup parameters on each operating element.

b Timing test shall be performed at three points on the time dial curve.

c. Pickup target and seal-in units.

B. The results shall be recorded and signed by CONTRACTOR. A copy shall be provided to the ENGINEER.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

LOW VOLTAGE SWITCHGEAR TEST FORM

Equipment No. _____

Location _____

Room Temperature _____

A. The protective devices shall be set in accordance with the specification before the tests are performed.

1. Measure contact resistance (micro-ohms)

   Phase: A_____ B_____ C_____
   Contacts shall be replaced if resistance exceeds 50 micro-ohms.

2. Perform an insulation resistance test (1000 volts DC for 1 minute).

Phase	A	B	C	
Pole to ground	___	___	____	megohms
Across open pole	___	___	___	megohms
Pole to pole	AB ___	BC ___	CA ___	megohms

3. Minimum pickup current shall be determined by primary current injection.

4. Long time delay shall be determined by primary injection at 300% pickup current.

5. Short time pickup and time delay shall be determined by primary injection of current.

6. Instantaneous pickup current shall be determined by primary injection.

7. Trip unit reset characteristics shall be verified.

8. Auxiliary protective devices, such as ground fault or under voltage relays, shall be activated to ensure operation of shunt trip devices.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

MEDIUM VOLTAGE LOAD INTERRUPTER SWITCH TEST FORM

Equipment Number _____

Location _____

Date _____

1. Measure switch blade resistance (micro-ohms).

   Phase: A_____ B_____ C_____

Contacts shall be replaced if resistance exceeds 50 micro-ohms.

2. Perform an insulation resistance test (1000 volts DC for 1 minute).

Phase	A	B	C
Pole to ground	__	__	__ megohms
Across open pole	__	__	__ megohms
Pole to pole	AB__	BC __	CA __ megohms

The results shall be recorded and signed. A copy shall be provided to the ENGINEER.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

LIQUID-FILLED TRANSFORMER TEST FORM

Equipment Number _____

Location _____

Date/Weather Conditions _____

A. Perform the "Insulation-Resistance Test" and "Dielectric Absorption Test" using Dry Transformer Test Data Form.

B. Perform an applied voltage (low frequency dielectric) test in accordance with ANSI C57.12.90, Paragraph 10.5, Applied Voltage Test. Applied voltage levels shall be 75% of recommended factory test levels or recommended test levels of ANSI C57.12.00, Table 5.

C. Insulating oil shall be sampled and shall be laboratory tested for the following:

1. Dielectric strength.
2. Acid neutralization.
3. Interfacial tension.
4. Color.
5. Power factor.

D. Perform a turns ratio test between the windings for all tap positions.

E. The temperature and pressure switches shall be tested using a hot oil bath and air pump.

F. The results shall be recorded and signed by CONTRACTOR and ENGINEER. A copy shall be provided to the ENGINEER. Any readings which are abnormal to ANSI industry standards shall be reported to the ENGINEER.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

AUTOMATIC TRANSFER SWITCH TEST FORM

Equipment Number _____

Location _____

Date _____

1. Perform an insulation resistance test (1000 volts DC for 1 minute):

	Phase		
	A	B	C
Pole to ground	___	___	___ megohms
Pole to pole	AB___	BC___	CA___ megohms

2. Perform the following operations and initial:

   a. Manual transfer _____

   b. Loss of normal power; ___sec delay

   c. Return to normal power; ___sec delay

   The results shall be recorded and signed. A copy shall be provided to the ENGINEER.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

NEUTRAL GROUNDING RESISTOR TEST

Equipment No.: _____

Location: _____

Date: _____

A. The pickup and time delay setting on the ground fault relay shall be set in accordance with Division 16 Specifications.

1. The transformer neutral insulation resistance shall be measured with and without the grounding resistor connected to insure no parallel ground paths exist.

2. The protective relay pickup current shall be determined by injecting test current into the current sensor. The pickup current should be within ten percent of the dial setting. Record the dial setting and actual pickup tie.

3. The relay timing shall be tested by injecting 150% and 300% of pickup current into the current sensor. The relay timing shall be in accordance with the manufacturer's published time-current characteristic curves. Record the relay timing at 150% and 300% of pickup current.

4. The circuit interrupting device shall be operated by operating the relay.

B. The results shall be recorded and signed by the CONTRACTOR and ENGINEER.

CERTIFIED _____ Date _____
CONTRACTOR'S Representative

WITNESSED _____ Date _____
OWNER'S Representative

LOOP WIRING AND INSULATION RESISTANCE TEST DATA FORM

Loop No.:_____

List all wiring associated with a loop in table below. Make applicable measurements as indicated after disconnecting wiring.

			Continuity Resistance[1]		Insulation Resistance[2]			
Wire No.	Panel Tie	Field TB	Cond./ Cond.	Cond./ Shield	Shield/ Gnd.	Shield/ Cond.	Cond./ Gnd.	Shield/ Shield
A	____	____	--	(A/SH)	____	____	____	____
B	____	____	(A/B)	--	____	____	____	____
C	____	____	(A/C)	--	____	____	____	____
D	____	____	(A/D)	--	____	____	____	____
etc	____	____						

1 Continuity Test. Connect ohmmeter leads between wires A and B and jumper opposite ends together. Record resistance in table. Repeat procedure between A and C, A and D, etc. Any deviation of ±2 ohms between any reading and the average of a particular run indicates a poor conductor, and corrective action shall be taken before continuing with the loop test.

2 Insulation Test. Connect one end of a 500 volt megger to the panel ground bus and the other sequentially to each completely disconnected wire and shield. Test the insulation resistance and record each reading.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

CONTROL CIRCUIT PIPING LEAK TEST FORM

Loop No.:_____

List tubing associated with loop in table below. Make applicable measurements after isolating any air consuming pilots from circuit.

Tube No.	Tubing Equivalent Length of 1/4-Inch Copper[1]	Test Period (seconds)	Permitted Pressure Drop (psi)[2]	Measured Pressure Drop (psi)
A	_____	_____	_____	_____
B	_____	_____	_____	_____
C	_____	_____	_____	_____
D	_____	_____	_____	_____
Etc.	_____	_____	_____	_____

[1] Convert actual tubing and air motor volume to equivalent 1/4-inch copper tubing.

[2] Pressure drop shall not exceed 1 psi per hundred feet 1/4-inch tubing per 5 seconds.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

CONTROLLER CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make and Model No.: _____ Serial No.: _____

Input: _____ Process Variable (PV) Scale: _____

Output: _____ Output Scale: _____

PV Scale Calibration

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0	_____	_____	_____	_____
50	_____	_____	_____	_____
100	_____	_____	_____	_____

% Deviation Allowed: _____

Connect output to PV for following tests:

	Set Point (SP) Indicator Accuracy		Output Meter Accuracy			Controller Accuracy		
SP	PV Reading	Expected % Dev.	Actual Reading	Expected Reading	Actual % Dev.	Output	Output	% Dev.
(0%)	_____	_____	_____	_____	_____	_____	_____	_____
(50%)	_____	_____	_____	_____	_____	_____	_____	_____
(100%)	_____	_____	_____	_____	_____	_____	_____	_____

%Dev. Allowed: _____ % Dev. Allowed: _____ % Dev. Allowed: _____

CERTIFIED _____ Date _____
CONTRACTOR'S Representative

WITNESSED _____ Date _____
OWNER'S Representative

PANEL INDICATOR CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make and Model No.:_____ Serial No.:_____

Input:_____

Scale:_____ Range: _____

PV Scale Calibration

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0	_____	_____	_____	_____
50	_____	_____	_____	_____
100	_____	_____	_____	_____

% Deviation Allowed:_____

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

RECORDER CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make and Model No.: _____ Serial No.: _____

Input: _____ Chart: _____

Scale: _____ Range: _____

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0	_____	_____	_____	_____
50	_____	_____	_____	_____
100	_____	_____	_____	_____

% Deviation Allowed: _____

CERTIFIED _____ Date _____
CONTRACTOR'S Representative

WITNESSED _____ Date _____
OWNER'S Representative

SIGNAL TRIP CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make and Model No.: _____ Serial No.: _____

Input: _____

Scale: _____ Range: _____

Set Point(s): _____

After setting set point(s), run signal input through entire range and calculate deadband.

Set Point	Incr. Input Trip Point	Decr. Input Trip Point	Calc. Deadband	Required Deadband
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

CERTIFIED _____ Date _____
CONTRACTOR'S Representative

WITNESSED _____ Date _____
OWNER'S Representative

FIELD SWITCH CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make and Model No.:_____ Serial No: _____

Input:_____

Range:_____

Set Point(s):_____

Simulate process variable (flow, pressure, temperature, etc.) and set desired set point(s). Run through entire range of switch and calculate deadband.

Set Point	Incr. Input Trip Point	Decr. Input Trip Point	Calc. Deadband	Required Deadband
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

TRANSMITTER CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make and Model No.: _____ Serial No.: _____

Input: _____

Output: _____

Range: _____ Scale: _____

Simulate process variable (flow, pressure, temperature, etc.) and measure output with appropriate meter.

% of Range	Input	Expected Output	Actual Output	% Deviation
0	_____	_____	_____	_____
50	_____	_____	_____	_____
100	_____	_____	_____	_____

% Deviation Allowed: _____

CERTIFIED _____ Date _____
CONTRACTOR'S Representative

WITNESSED _____ Date _____
OWNER'S Representative

MISCELLANEOUS INSTRUMENT CALIBRATION TEST DATA FORM

(For instruments not covered by any of the preceding test forms, CONTRACTOR shall create a form containing all necessary information and calibration procedures.)

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

INDIVIDUAL LOOP TEST DATA FORM

Loop No.:_____

Description: (Give complete description of loop's function using tag numbers where appropriate.)

P&ID No.: (Attach copy of P&ID.)

a. Wiring tested:

b. Instrumentation tubing/piping tested:

c. Instruments calibrated:

d. List step-by-step procedures for testing loop parameters. Test loop with instruments, including transmitters and control valves, connected and functioning. If it is not possible to produce a real process variable, then a simulated signal may be used with the ENGINEER'S approval.

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

LOOP COMMISSIONING TEST DATA FORM

Loop No.:_____

a. Loop tested:
(Attach Test Form 17007-J)

b. Controlled or connected equipment tests confirmed:

c. Give complete description of loop's interface with process.

d. With associated equipment and process in operation, provide annotated chart trace of loop response to changes in set points for verification of performance. This chart should demonstrate 1/4-amplitude damping as output adjusts to set point change. Show set points, starting and finishing times on chart, as well as any other pertinent data.

Connect 2-pen recorder to process variable (PV) and to controller output. Use 1 inch/second chart speed.
Pen 1 - PV - Connections:
Pen 2 - Output - Connections:

CERTIFIED _____ Date_____
CONTRACTOR'S Representative

WITNESSED _____ Date_____
OWNER'S Representative

CITY OF CHANDLER
OWRF/AWRF LIFT STATION

PIPE TEST REPORT

CONTRACTOR: _____ DATE: _____

PIPING SYSTEM: _____

LOCATION: _____

REF. DRAWING NO.: _____

PIPE MATERIAL	PIPE JOINT	PIPE SIZE	TOTAL LENGTH TESTED	TEST PRESSURE	TEST TIME	ALLOW LOSS

ALLOWABLE LOSS FORMULA: _____

TYPE OF TEST: WATER _____ AIR _____ OTHER _____

TIME TEST STARTED: _____ STARTING TEST PRESSURE: _____

TOTAL TIME: _____ ACTUAL LOSS: _____

ACCEPTED: _____ REJECTED: _____

COMMENTS: _____

_____

_____

CONTRACTOR REPRESENTATIVE : _____
(NAME) (DATE)

ENGINEER REPRESENTATIVE: _____
(NAME) (DATE)

END OF SECTION

SECTION 01310

PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 GENERAL

A. To assure completion of the Work within the contract times established, all activities of the CONTRACTOR shall be scheduled and monitored by use of a Critical Path Method (CPM) Schedule. The CONTRACTOR shall provide a CPM Schedule for Work done under this Contract in accordance with the requirements of this Section and Article 2.6 of the General Conditions.

B. The CONTRACTOR shall employ or retain services of at least one person experienced in CPM Scheduling for the duration of the Contract. This person shall cooperate with the ENGINEER and shall update the CONTRACTOR'S schedule as required by these Specifications.

C. A preliminary detailed CPM Schedule for the entire Project in bar chart forms shall be submitted to the ENGINEER for review at the Pre-construction Conference or within 10 days of receiving the Notice to Proceed (whichever occurs first). The bar chart shall be referenced to time and include the starting and completion dates of all for the Project activities (both on-site operations and major procurement).

D. The CONTRACTOR shall submit, at the Pre-construction Conference or within 10 days after receiving Notice to Proceed (whichever occurs first), a projection of estimated monthly payments through the life of the Contract. Initial projections shall be correlated with and provided at the same time as the Schedule of Values (see Article 2.7 of the General Conditions for requirements). Projections shall be updated when requested by the ENGINEER.

E. As described in Article 2.7.A of the General Conditions and specified herein, the CONTRACTOR shall submit, at the Pre-construction Conference or within 10 days after receiving Notice to Proceed (whichever occurs first), the schedule of Shop Drawing and sample submittals. CONTRACTOR shall correct all schedules returned for revision and resubmission, taking into account comments made by OWNER and ENGINEER and shall resubmit any schedule if directed by ENGINEER.

1.2 DEFINITIONS

A. Unless otherwise noted, terms shall be defined for this Project as follows:

1. Activity - means a component step or operation in the construction of Work.
2. Event - means a point in time during construction of the Work.
3. Network or Network Diagram - means a flow diagram which is a symbolic representation of activities and events that must be performed in accordance with the Contract and which shows the order and interdependence of activities and the sequence in which Work is to be accomplished as planned by the CONTRACTOR.
4. Earliest Start Date - means the earliest date on which an activity can start.
5. Earliest Finish Date - means the latest date on which an activity can finish without changing the Contract Duration.
6. Latest Start Date - means the latest date on which an activity can start without changing the Contract Duration.
7. Latest Finish Date - means the latest date on which an activity can finish without changing the Contract Duration.
8. Latest Free Start Date - means the latest date on which an activity can start without affecting the scheduling of any other activities.
9. Latest Free Finish Date - means the latest date on which an activity can finish without affecting the scheduling of any other activities.
10. Total Float - means the number of calendar days by which an activity can be delayed without necessarily extending a pertinent Contract Time. Total Float is by definition at least equal to Contract Float.
11. Contract Float - If the schedule anticipates early completion of all or any part of the Work, Contract Float is the number of calendar days between CONTRACTOR'S anticipated date for early completion of all or any such part of the Work and the corresponding specified Contract Time.
12. Free Float - means the amount of time in calendar days by which an activity can be delayed without affecting the scheduling of any other activity.
13. Duration - means the amount of time in consecutive calendar days required to perform an activity from the date on which Work commences on the activity to the date on which the activity is complete.
14. Milestone - means a significant event such as date of Notice to Proceed, Substantial Completion, Final Completion and specified mandatory completion dates when portions of the Work or site are to be turned over to the OWNER or other contractors.
15. Critical Path - means the continuous sequence of activities and events throughout the network that comprises the longest time path through the network from start to finish.
16. Critical Activity - means an activity which cannot be delayed without altering the Contract Times.
17. Mandatory Date - means the date specified for completion of a Work activity or when other contractors must be permitted to start Work.
18. Sub-network - means a network relating to a particular phase, portion or subdivision of the Work.
19. Arrow Method - means that method of network diagram construction in which activities are represented by arrows.

20. Lag - means the amount of time between the commencement of an activity and the commencement of an activity which immediately follows it, expressed in the number of calendar days.
21. Lag Factor - means the amount of time between the commencement of an activity and the commencement of an activity which immediately follows it, expressed as a percentage of the duration of the first activity.

1.3 SUBMITTALS

A. All CPM Schedules (both original and revisions) submitted to the ENGINEER shall be provided both electronically (CD format) and on hard copy (four copies). Each CPM Schedule submittal shall bear CONTRACTOR'S stamp or written indication of approval as representative to OWNER that CONTRACTOR has determined or verified all data on that CPM Schedule, and that CONTRACTOR and the subcontractors and suppliers have reviewed and coordinated the sequences in that CPM Schedule with the requirements of the Work.

B. At the Pre-construction Conference, the CONTRACTOR shall submit to the OWNER and ENGINEER sufficient descriptive information about the CPM software the CONTRACTOR has chosen to employ to comply with the requirements of this Section.

C. Neither the OWNER'S or ENGINEER'S review of a CPM Schedule, nor a statement of "Resubmittal Not Required," will relieve the CONTRACTOR from responsibility for complying with the Contract Times and those sequences of Work indicated in or required by the Contract Documents, or completing any Work omitted from that Progress Schedule within the Contract Times. The CONTRACTOR shall make appropriate adjustments or corrections in a CPM Schedule returned as "Revise and Resubmit" and shall submit to the ENGINEER the corresponding CPM Schedule resubmittal as required herein. CPM Schedule re-submittals shall use the same revision number followed by the letters "A," "B," etc., as applicable.
   1. CONTRACTOR shall submit to ENGINEER with the first Application for Payment, the initial updated Progress Schedule, and any other updated schedules (i.e., Shop Drawing Submittal, Sample Submittal, or Monthly Estimated Payment Schedules). CONTRACTOR shall correct all schedules returned for revision and resubmission, taking into account comments made by OWNER and ENGINEER and shall resubmit any schedule if directed by ENGINEER. The final revision of the schedule shall be the As Planned Schedule from which subsequent schedules revisions shall be developed and used by CONTRACTOR when making proposals or claims for adjustments in Contract Time or Contract Price.
   2. Early dates in the Progress Schedule shall be based on proceeding with all or part of the Work exactly on the date when the corresponding Contract Time commences to run. Late dates shall be based on completing all or part of the Work exactly on the corresponding Contract Time, regardless of whether

CONTRACTOR anticipates early completion. If sequences of Work are imposed by the Contract Documents, the progress schedule shall show in detail CONTRACTOR'S approach to conforming to those sequences.

3. Progress Schedule revisions submitted shall: (a) adequately depict CONTRACTOR'S current approach to remaining Work, (b) report on progress or schedule recovery actions, (c) facilitate evaluation of progress payments, and (d) accurately depict the progress and sequence of the Work to date.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 MONTHLY PROGRESS REPORTS

A. On the first working day (or as otherwise scheduled) of each month, the CONTRACTOR shall meet with the ENGINEER and present, in duplicate, a report of his operations during the preceding month, including actual starting and ending dates on activities shown on the network diagram. Where such starting or ending dates were delayed beyond those required by the CPM schedule, the CONTRACTOR shall describe the action he is taking to regain lost time, and state the anticipated completion dates of subsequent activities affected by the delayed items. He shall also point out known or anticipated delays on continuing activities and outline the action he is taking to regain lost time, or avoid future delays, and state the anticipated completion dates of subsequent activities affected by the delayed items. On the basis of the reports presented at the meeting, the CONTRACTOR will develop a revised mathematical analysis, bar chart, and narrative report, and will furnish eight copies thereof to the ENGINEER no later than the fifth working day of the month. The updated bar chart shall detail one-month window in the CPM Schedule. Each activity covering Work at the site shall reflect the Work of a specific crew, span 15 business days or less, and indicate which CPM Schedule Activity includes the same Work. Activities covering Submittals and the procurement of items of materials or equipment shall segregate the time required for preparation of submittals, review and return of submittals, and fabrication and delivery, as applicable, and shall not combine items furnished by separate suppliers (first and second tiers).

B. Updated mathematical analyses shall include the information included in the initial submittal and the following additional information:
   1. Actual start date of activities that have been started by calendar date.
   2. Actual finish date of activities that have been completed by calendar date.
   3. Actual number of days worked on activities that have been completed.
   4. Percentage completion of activities that have been started.
   5. Actual dates on which attained milestones were achieved.

6. Additions or deletions of activities or events since the previous report.
7. Changes in sequence or estimated duration of activities.
8. Where progress along any path is behind schedule such that activities lying on the path are delayed by an amount greater than their initial Total Float, the Total Float shall show as a negative value.

C. The updated bar chart shall be a revision of the initial accepted bar chart based upon the updated mathematical analysis and shall show changes from the initial bar chart.

D. The updated narrative report shall be based upon the initial narrative report and shall describe in detail any revisions, either current or forecast, to information submitted with the initial narrative reports, together with a description of current and anticipated problems and delaying factors affecting progress of the Work, their impact on progress of the Work, and an explanation of corrective actions taken or proposed. The narrative shall, at a minimum, compare current Late Dates vs. Contract Times and Milestone Times; provide sufficient detail to allow objective verification of the progress of the Work; identify the assumptions made and activities affected in incorporating Work involved in Change Orders; describe actual or potential delays and their extent, related causes and the steps taken or anticipated to mitigate their impact; and itemize any revisions, and their bases, made in CPM Schedule Activities and sequences.

3.2 REPORTS

A. CPM Schedule reports shall include cost updates, written narratives, graphic bar tabular printouts, and graphic bar charts, in both detailed and summary format.

B. Tabular printouts shall show one activity per line along with appropriate data for the purpose intended including various combinations of the following:
   1. Activity ID.
   2. Activity description.
   3. Preceding and succeeding activity IDs and descriptions.
   4. Original duration (in calendar days).
   5. Revised duration (in calendar days).
   6. Days remaining (in calendar days).
   7. Percent complete.
   8. Earliest start date (by calendar date).
   9. Earliest finish date (by calendar date).
   10. Latest start date (by calendar date).
   11. Latest finish date (by calendar date).
   12. Actual start date (by calendar date).
   13. Actual finish date (by calendar date).
   14. Total float.
   15. Free float.

C. Activities shall include in addition to the construction activities, the submittal, review and approval of samples, manufacturers' data, and Shop Drawings, the procurement of materials and equipment, installation and testing.

D. Bar charts will be required for summary purposes to compare actual progress with baseline As-Planned Schedule.

E. The narrative report shall describe in detail, but not be limited to, the CONTRACTOR'S proposed methods of carrying out each phase or portion of the Work together with the number of personnel, number of shifts, hours per shift, work week, and the number, size and type of major pieces of construction equipment required for the Work. The report shall include a charge showing the CONTRACTOR'S estimated monthly earnings and accumulated earnings.

F. Except where directed in writing by the OWNER, the CONTRACTOR shall promptly take appropriate action to recover schedule whenever the CONTRACTOR fails to achieve a Contract Time or Milestone Time, or perform Activities within the Late Dates in the most current revision of the CPM Schedule, or the CONTRACTOR'S progress falls behind that required to comply with that Contract Time, Milestone Time or Late Dates. The CONTRACTOR shall submit with the Application for Payment following recognition of the problem a schedule recovery plan describing the cause of schedule slippage or delayed progress and the actions taken to correct them within the shortest reasonable time.

1. Appropriate schedule recovery actions may include, but not be limited to, assignment of additional labor, subcontractors, or construction equipment, Work during other than normal working hours (subject to the requirements of Article 8 of the General Conditions), expediting of submittals or deliveries, or any combination of any of them. Overlapping or re-sequencing of activities to increase activity concurrence shall be appropriate only if properly substantiated in the schedule recovery plan.
2. The CONTRACTOR'S failure, refusal or neglect to: (a) submit a schedule recovery plan furnishing sufficient and convincing evidence that the CONTRACTOR can recover schedule within the shortest reasonable time acceptable to the OWNER, or (b) take appropriate schedule recover action, shall be reasonable evidence that the CONTRACTOR is not prosecuting the Work with all due diligence and shall give sufficient basis to the OWNER to demand adequate, written assurance of performance under the General Conditions, withhold from any payment an amount based on the OWNER'S estimate of the liquidated damages that would become due because of the actual or anticipated late completion, and in the OWNER'S sole discretion, order alternate schedule recovery actions.
3. An extension in Contract Time or an increase in Contract Price arising from delays which postpone, extend or in any other manner alter the schedule or completion of all or part of the Work will not be granted unless the CONTRACTOR, through an analysis of a schedule reflecting data as of the

date prior to the origination of the delay, as designated in Paragraph 3.04 A.4 demonstrations that conditions justifying extensions in Contract Time or increases in Contract Price as provided in Articles 12 and 13 of the General Conditions, have been met, and that analysis by the CONTRACTOR is verifiable by objective evaluation.

4. A version of the As-Planned Schedule shall accurately show (a) all Work progress (by the cut-off date) and any delays and any other significant events experienced before the cut-off date, and (b) any changed in Activities and sequences agreed upon in previously authorized Change Orders considering the proper records and all valid data provided under the requirements of Paragraphs 3.2.F.2 and 3.2.F.3, respectively. Any such As-Planned Schedule shall purposely exclude all Activity and sequencing changes initiated by the CONTRACTOR that affect Work after the cut-off date (whenever incorporated into any contemporaneous CPM Schedule Revisions under the requirements of Paragraph 3.2.F.1 or otherwise), until the timing and sequences suggested by those changes actually take place.

G. The ENGINEER may refuse to recommend any part of the payment if, in the ENGINEER'S judgment, the CONTRACTOR'S failure, refusal or neglect to provide the required CPM Schedule information precludes a proper evaluation of the CONTRACTOR'S progress. The OWNER may withhold a set-off from any payment recommended by the ENGINEER, if in the OWNER'S judgment, the CONTRACTOR'S failure, refusal or neglect to provide the required CPM Schedule information precludes a proper evaluation of whether the CONTRACTOR is prosecuting the Work, or any separable part of the Work, with all due diligence or not.

END OF SECTION

SECTION 01380

CONSTRUCTION PHOTOGRAPHS

PART 1 - GENERAL

1.1 SUMMARY

A. Pre-construction Video:
   1. The CONTRACTOR shall furnish a pre-construction video in accordance with Article 10, Paragraph 10.1 of the General Conditions.

B. Ground Level Construction Photographs:
   1. The CONTRACTOR shall furnish progress photographs of the Project in accordance with Article 10, Paragraph 10.2 of the General Conditions and as specified herein.
   2. In addition to the construction photograph requirements identified in Article 10, Paragraph 10.2 of the General Conditions, the CONTRACTOR shall provide high quality digital photographs on CDs and on hard copy. The electronic file format shall be .jpg, .gif, or tiff. If the current photographs (both standard and digital) do not accompany the application, it shall not be reviewed and shall be returned to the CONTRACTOR as incomplete. At least 100 photographs shall be taken per each Application of Payment.
   3. Provide interior and exterior photographs of each buried structure prior to burial. Provide a minimum of four internal views and four external views of each structure. One view shall be provided of each wall, detail, floor, and top of structure.
   4. Place the following information on the back of each print and on the front for digital photographs in typewritten print:
      a. Date photograph was taken.
      b. Title of Project.
      c. OWNER'S Project number.
      d. Description of view shown in photograph.
   5. The CONTRACTOR shall furnish adjustable, hard-back photo album covers for each set for storage of the photos. Photo albums shall be labeled as to Project title.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PROCEDURES

A. The ground level construction photographs shall be of aesthetic composition and shall depict the progress of the Work from the beginning of construction through and including the finished product and shall include, but not be limited to, the items listed in Section 01010, Summary of Work.

B. Ground level construction photographs shall be submitted monthly with the Application for Payment. The Application for Payment shall not be reviewed and shall be returned to the CONTRACTOR as incomplete if the currently due photographs have not been submitted.

END OF SECTION

SECTION 01400

QUALITY CONTROL

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Section 01300, Submittals.

B. Section 01640, Materials and Equipment.

1.2 QUALIFICATIONS

A. Installation of materials and equipment shall be performed in a workmanlike manner by mechanics skilled in their particular trade.

B. The determination for the performance qualification is the responsibility of CONTRACTOR and each welder or welding operator shall be qualified by tests using equipment, procedures and a base metal and electrode or filler wire from the same compatible group number that will be encountered in the applicable procedure. Welders or welding operators who make acceptable procedure qualification test welds will be considered performance qualified for the welding procedures used. Performance qualification shall be determined in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. Welders and welding operators qualified by another employer may be accepted as permitted by ANSI B31.1. ENGINEER shall be notified 24 hours in advance as to the time and place of tests and, wherever practical, the tests shall be performed at the Work site. ENGINEER shall be furnished a listing of the names and identification symbol as noted on the performance qualification test records to be used to identify the work performed by the welder or welding operator who after completing a welded joint shall identify it as his work by applying his assigned symbol for permanent record.

1.3 REGULATORY REQUIREMENTS

A. Unless indicated or specified otherwise, all materials and workmanship for the mechanical trades shall conform to the editions of the various standards, codes, manuals and specifications in effect on the date of advertisement for bids.

1.4 CERTIFICATIONS

A. Submittals of certifications of compliance from the CONTRACTOR or manufacturer required as specified for equipment in these documents shall be submitted to the ENGINEER as specified in Section 01300, Submittals.

1.5 FIELD TESTING

A. All testing called for in the Specifications shall be the responsibility of the CONTRACTOR, including soils and concrete tests. All retesting required due to the failure of the CONTRACTOR'S Work to meet the requirements of the Contract Documents shall be at the CONTRACTOR'S expense. All standby the testing lab due to the CONTRACTOR'S lack of readiness for testing at the agreed upon time shall be at the CONTRACTOR'S expense. Contractor shall ensure that test reports are sent to the ENGINEER in a timely fashion, within two work days of the completion of each test.

1.6 SUPERVISION OF INSTALLATION BY MANUFACTURER

A. As required in the individual equipment specifications, an experienced, competent, and authorized factory representative of the equipment and pipe material manufacturer shall visit the site of the work and inspect, check, adjust if necessary, and approve the equipment and pipe installation, and shall be present when the equipment and pipe is tested or placed in operation. The equipment or pipe material supplier's representatives shall revisit the job site as often as necessary until any trouble is corrected and the equipment and pipe installation and operation is satisfactory to ENGINEER. The equipment and pipe supplier's representatives shall furnish to ENGINEER, through CONTRACTOR a written report certifying that the pipe and equipment (1) has been properly installed and lubricated; (2) is in accurate alignment; (3) is free from any undue stress imposed by connecting piping or anchor bolts; (4) equipment has been operated under full load conditions and that it operated satisfactorily; and (5) pipe has been tested with satisfactory results.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 DEMONSTRATION

A. The CONTRACTOR shall demonstrate as, specified in Section 01650, STARTING SYSTEMS, to the satisfaction of the ENGINEER, OWNER, and manufacturer's representative, that all newly installed equipment operates in a satisfactory manner and that all pipe is installed per the manufacturer's recommendations and meets the requirements of the contract documents.

END OF SECTION

SECTION 01412

STORMWATER POLLUTION PREVENTION PLAN AND PERMIT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Comply with the terms and conditions of Arizona Pollutant Discharge Elimination System (AZPDES) administered by the Arizona Department of Environmental Quality (ADEQ). Under provisions of that permit, CONTRACTOR is designated as permittee and responsible for providing necessary material and for taking appropriate measures to minimize pollutants in stormwater runoff from the Project. Obtain a DeMinimus Discharge Permit from ADEQ for any discharge that is to Waters of the U.S., and comply with the requirements of the permit.

B. The Contract Price shall include all material, labor, and other permits and incidental costs related to:
   1. Preparing, updating, and revising the Storm Water Construction Pollution Prevention Plan (SWPPP).
   2. Installing and maintaining all structural and nonstructural items chosen by CONTRACTOR to comply with the construction SWPPP.
   3. Cleanup and disposal costs associated with cleanup and repair following storm events or CONTRACTOR-caused spills on the Project.
   4. Implementing and maintaining Best Management Practices to comply with the OWNER'S storm water code.
   5. Preparing the Notice of Intent and Notice of Termination shall be covered by the AZPDES General Permit for Arizona.
   6. Obtain and comply with DeMinimus Permit, if such permit is required.

C. Coordinate the requirements under this Section with Section 02315, Earthwork, Excavation, and Backfill, permit requirements. All necessary SWPPP controls and practices must be implemented prior to commencement of any construction activity.

1.2 SUBMITTALS

A. Submit, at least two days prior to the initial start of construction on the Project, completed and signed Notice of Intent forms to the State of Arizona at the following addresses:
   1. Storm Water Program-Water Permits Section/NOI
      Arizona Department of Environmental Quality
      1110 West Washington, 5415B-3
      Phoenix, AZ 85007

B. Submit to the OWNER, no later than 30 days, before submitting to the State agency the following:
   1. Notice of Intent (NOI) to be covered by the AZPDES General Permit for Arizona, including certifications of signature.
   2. SWPPP for the Project, including certification of signature. Storm Water Plan shall include CONTRACTOR'S proposed temporary means for storm water control during all phases of construction and include storm water pumping/retention plans. This submittal shall be coordinated with CONTRACTOR'S Excavation Plan Submittal, specified in Section 02315, Earthwork, Excavation, and Backfill.
   3. A manual has been prepared by the Maricopa County Flood Control District to aid in CONTRACTOR'S preparation of the SWPPP. This manual, "Drainage Design Manual for Maricopa County Arizona, Volume III, Erosion Control" is available at the Flood Control District Office, 2801 West Durango Street, Phoenix, Arizona. The complete Construction General Permit is in the December 8, 1999, Federal Register available at local libraries and is also available from the ADEQ website at www.adeq.state.az.us/environ/water/ permits/download/constgp.pdf.

C. Submit to the OWNER, as part of the Construction SWPPP, a construction site inspection report that includes the following:
   1. Inspection scope.
   2. Inspector qualifications.
   3. Observations of SWPPP non-compliance and corrective steps taken.
   4. Certificate of Compliance with SWPPP and the AZPDES General Permit for Storm Water Discharge in the event of no incidents. Reports shall be submitted each quarter, at a minimum, throughout the Contract duration.

D. Submit to the OWNER, upon Project completion, the Notice of Termination (NOT) of coverage under AZPDES General Permit.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01414

EARTHMOVING AND DUST CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

A. CONTRACTOR shall obtain all Earthmoving Permits and any other permits required for earthmoving and dust generating operations related to the Work, as required by the Maricopa County Air Pollution Control Regulations.

B. CONTRACTOR shall not cause or allow any dust generating operation, earthmoving operation, use of property, or any other operation which causes fugitive dust emissions that exceed the 20% visible emission opacity limit in Rule 300 of Maricopa County's Air Pollution Control Regulations.

C. If requested by the OWNER, ENGINEER, or Maricopa County representative, CONTRACTOR shall conduct opacity observations for visible emissions of fugitive dust in accordance with techniques specified in USEPA Reference Method 9.

D. In addition to Earthmoving Permits, CONTRACTOR shall obtain an approved Dust Control Plan from Maricopa County. At a minimum, the Dust Control Plan shall include the following information:
   1. Name(s), address(es), and phone number(s) of the person(s) responsible for the preparation, submittal, and implementation of the Dust Control Plan and responsible for the dust generating operations.
   2. A site plan that describes the total area of land surface to be disturbed (in acres); the operations and activities to be performed on the site; actual and potential sources of fugitive dust emissions; and the delivery, transportation, and storage areas for the site (including types of materials stored and appropriate size of material stock piles).
   3. Description of the Reasonably Available Control Measures (RACM) to be applied during all periods of dust generating operations at all actual and potential sources of fugitive dust.
   4. Description of dust suppressants to be applied, including product specifications; method, frequency, and intensity of application; type, number, and capacity of application equipment; and certifications related to the suppressant's appropriate and safe use.
   5. Description of specific surface treatment(s) or RACM used to control material track-out where unpaved or access points join paved surfaces.
   6. Description of at least one alternative RACM for each actual and potential fugitive dust source shall be designated as a contingency measure.

E. CONTRACTOR shall post a copy of all Earthmoving Permits as well as the approved Dust Control Plan, in a conspicuous location at the Work site and provide a copy of each to the ENGINEER.

F. CONTRACTOR shall maintain a daily written log that records the actual application or implementation of the RACMS described in the approved Dust Control Plan. CONTRACTOR shall maintain this written log and supporting documentation on-site and shall make available for review on request by ENGINEER, OWNER, or Maricopa County representative. CONTRACTOR shall retain copies of the Dust Control Plan, RACM implementation records, and all supporting documentations for a minimum of three years.

G. CONTRACTOR, at a minimum, shall provide all necessary equipment and materials to apply sufficient dust suppressants (e.g., water, etc.), properly clean (sweep, etc.) all track-out areas, and provide adequate physical stabilizations (e.g., gravel, recycled asphalt, etc.) to meet all requirements of the Earthmoving Permit and approved Dust Control Plan. CONTRACTOR shall use these methods to control fugitive dust generation from all CONTRACTOR operations on all CONTRACTOR areas including, but not limited to:
   1. Construction areas.
   2. Vehicle and equipment parking areas.
   3. Material storage areas.
   4. Office and trailer areas.
   5. Haul and access roadways.
   6. Track-out areas.
   7. All other areas where CONTRACTOR shall be working, storing, or parking vehicles, equipment, and materials.

H. CONTRACTOR shall pay all fines issued to the OWNER by the USEPA, ADEQ, or Maricopa County due to violation of CONTRACTOR'S Earthmoving Permit and Dust Control Plan.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01451

TESTING LABORATORY SERVICES FURNISHED BY OWNER

PART 1 - GENERAL

1.1 DESCRIPTION

A. The CONTRACOR shall be responsible for all testing listed in this Section for Quality Assurance or the OWNER will employ and pay for an independent testing laboratory to perform the Quality Control Services.

B. Inspection, sampling, and testing shall be as specified in the individual Sections. These include, but are not limited to:
   1. Section 02200, Earthwork.
   2. Section 02318, Crushed Stone and Gravel.
   3. Section 02500, Asphalt Pavement.
   4. Cast-In-Place Concrete.

C. All standby and travel time by the testing lab due to the CONTRACTOR'S lack of readiness for testing at the agreed upon time shall be at the CONTRACTOR'S expense.

D. CONTRACTOR shall pay for:
   1. Tests made for CONTRACTOR'S convenience.
   2. Repeat tests required because of CONTRACTOR'S negligence or repeated failure, three or more tests for the same item, to meet Contract Document requirements.

E. The testing laboratory is not authorized to approve or accept any portion of the Work; rescind, alter, or augment the requirements of the Contract Documents; or perform any duties of CONTRACTOR.

1.2 QUALIFICATIONS OF LABORATORY

A. Where applicable, the testing laboratory will meet "Recommended Requirements for Independent Laboratory Qualification", latest edition, published by American Council of Independent Laboratories, and the basic requirements of ASTM E329 "Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction".

B. Testing equipment used by the laboratory will be calibrated at maximum 12 month intervals by devices of accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.

1.3 LABORATORY DUTIES

A. The Testing Laboratory shall:
   1. Cooperate with CONTRACTOR and provide qualified personnel promptly on notice.
   2. Perform specified inspections, sampling, and testing of materials and methods of construction; comply with applicable standards; and ascertain compliance with requirements of Contract Documents.
   3. Promptly notify ENGINEER and CONTRACTOR of irregularities or deficiencies of Work that are observed during performance of services.
   4. Promptly submit five copies of reports of inspections and tests to ENGINEER, including:
      a. Date issued.
      b. Project title and number.
      c. Testing laboratory name and address.
      d. Date of inspection or sampling.
      e. Record of temperature and weather.
      f. Date of test.
      g. Identification of product and Specification Section.
      h. Location in Project.
      i. Type of inspection or test.
      j. Results of tests and observations regarding compliance with Contract Documents.
   5. Perform additional tests and services as required by OWNER.

1.4 CONTRACTOR'S RESPONSIBILITIES

A. CONTRACTOR shall:
   1. Cooperate with laboratory personnel and provide access to Work and to manufacturer's operations.
   2. Provide to laboratory preliminary representative samples of materials to be tested, in required quantities.
   3. Furnish copies of product test reports.
   4. Provide to the laboratory the preliminary design mix proposed for concrete and other material mixes that require testing by the testing laboratory.
   5. Furnish labor and facilities:
      a. To provide access to Work to be tested.
      b. To facilitate inspections and tests.
   6. Notify laboratory and ENGINEER sufficiently in advance of operations to allow for assignment of personnel and scheduling of tests.
   7. Arrange with laboratory and pay for additional samples and tests required for CONTRACTOR'S convenience.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01500

CONSTRUCTION FACILITIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Temporary utilities required during construction.

B. Temporary construction facilities, including field offices.

C. Requirements for security and protection of facilities and property.

D. Requirements for access to the Work.

E. Temporary controls for protection of environment.

F. Project sign.

1.2 SUBMITTALS

A. Temporary Utility Submittals:
   1. Electric power supply and distribution plans.
   2. Temporary water supply and distribution plans.
   3. Copies of approvals of local utility companies for CONTRACTOR'S intended temporary utility plans.

B. Temporary Construction Submittals:
   1. Access roads and parking area plans.
   2. Storage building plans, including gravel surfaced area.
   3. Fencing and protective barrier locations and details.
   4. Staging area plan and notification of any obstructions encountered during mobilization.

1.3 STAGING AREA

A. Use the area designated for CONTRACTOR'S temporary facilities as shown on Drawings. All construction vehicles shall stay off the main entrance.

B. Notify ENGINEER of obstructions not shown or not readily apparent by visual inspection of the staging area. Do not remove obstructions without OWNER'S prior consent.

1.4 TEMPORARY UTILITIES

A. Costs after Substantial Completion:
   1. Upon acceptance of the Work or a portion of the Work defined and certified as substantially complete by ENGINEER, and OWNER commences full-time successful operation of the facility or portion thereof, the OWNER will bear the cost for utilities used for OWNER'S operation. CONTRACTOR shall continue to pay for temporary utilities used until Final Acceptance of the Work, except as provided herein.

B. Electric Power:
   1. The CONTRACTOR shall make arrangements with Salt River Project for obtaining temporary electric power service, metering equipment, and pay all costs for the electric power used during the Contract period, except as specifically provided for utilities used by the OWNER on portions of the Work designated in writing by the ENGINEER as substantially complete.
   2. Temporary electric power installations shall meet construction safety requirements of OSHA, State, and other governing agencies.

C. Water:
   1. The OWNER will furnish, without charge, reasonable quantities of construction water required by the CONTRACTOR in performance of the Work under the Contract. However, the CONTRACTOR shall provide all facilities necessary to convey the water from the OWNER-designated source to the points of use in accordance with the requirements of the Contract Documents.
   2. The CONTRACTOR shall not make connection to or draw water from any water system without first obtaining permission from the OWNER or the authority having jurisdiction over the use of the said water system. For each water system connection, the CONTRACTOR shall first attach to the water system a valve and a meter. The size and type of valve and meter shall be acceptable to OWNER or jurisdictional authority.
   3. Before Final Acceptance of the Work, all temporary connections to the said water system shall be entirely removed. All affected improvements shall be restored to their original condition or better, to the satisfaction of the ENGINEER and to the OWNER or jurisdictional authority.
   4. All potable water used by CONTRACTOR'S employees, subcontractor's employees and the temporary construction facilities during construction shall be furnished by the CONTRACTOR and shall be bottled water or water furnished in approved metal dispensers. Notices shall be posted conspicuously throughout the site warning temporary piped water may be contaminated.

D. Temporary Fire Protection:

1. The CONTRACTOR shall provide all facilities and equipment necessary to maintain fire protection or provide temporary fire protection for the Manganaro Lift Station Improvement Project Site in accordance with the requirements of the 2000 International Fire Code.

E. Sanitation:
   1. Provide and maintain sanitary facilities for CONTRACTOR'S employees and subcontractors' employees that comply with regulations of local and State health departments.
   2. Provide chemical toilets of suitable types and maintain them in a sanitary condition at all times conforming to code requirements and acceptable to health authorities. They shall be of watertight construction so that no contamination of the area can result from their use. The CONTRACTOR shall make arrangements for frequent emptying of toilets. Upon completion of Work, CONTRACTOR shall remove toilets and restore area to original condition.
   3. Use of surrounding businesses' existing sanitary facilities by construction personnel will not be allowed.

1.5 PROJECT SIGN

A. Submit a layout drawing for approval showing the location, size, and color of logos and lettering.

B. The sign shall be maintained in good condition until completion of the Contract, at which time the sign shall become the property of the OWNER.

C. The CONTRACTOR and his subcontractors may erect signs for information and direction. No commercial or advertising signs will be allowed on the site of the Work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SECURITY

A. The CONTRACTOR shall provide security to prevent unauthorized persons from entering the construction site and a secured storage area for materials and equipment.

B. The CONTRACTOR shall safely guard all work, materials, equipment, and property from loss, theft, damage, and vandalism. The CONTRACTOR'S duty to

safely guard property shall include the OWNER'S property and other private property from injury or loss in connection with the performance of the Contract.

C. The CONTRACTOR shall make no claim against the OWNER for damage resulting from trespass.

D. Party responsible for security shall make good all damage to property of the OWNER and others arising from failure to provide adequate security.

E. If existing fencing or barriers are breached or removed for purposes of construction, the CONTRACTOR shall provide and maintain temporary security fencing equal to the existing in a manner satisfactory to the ENGINEER and OWNER.

F. Security measures taken by the CONTRACTOR shall be at least equal to those usually provided by the OWNER to protect his existing facilities during normal operation.

G. Maintain security program throughout construction until Final Acceptance and occupancy precludes need for the CONTRACTOR'S security program.

H. All costs for security as specified in this Section shall be borne by the CONTRACTOR.

I. CONTRACTOR hereby acknowledges and agrees to limit access to the site to those persons cleared by OWNER. CONTRACTOR expressly acknowledges OWNER'S right to deny or limit entry to the site to any person(s) that OWNER deems to be a security risk.

3.2 TEMPORARY CONSTRUCTION FACILITIES

A. Access Roads:
   1. CONTRACTOR shall access the staging area and construction site through a designated construction access route as described in the Temporary Access Easement created by the OWNER for this Project. Maintain access route in good condition until no longer needed. Construction access route shall be returned to its original conditions after construction work is complete. Returning access road to original condition may include but are not limited to: cleaning, painting, asphalt paving, striping, curbing, landscape and irrigation. Construction traffic shall use the designated construction access road to enter and exit the staging and work area. Construction traffic shall not use any of the businesses' parking roads and areas other than as described in the Temporary Access Easement and Temporary Construction Easement.

B. Storage Yard:

1. Construct temporary storage yard within designated TCE area for the storage of products that are not subject to damage by weather conditions. Materials such as pipe, reinforcing, and structural steel shall be stored on pallets or racks, off the ground, and in a manner to allow ready access for inspection and inventory. Temporary gravel surfacing of storage yards must be approved by the ENGINEER.
2. Erect or provide temporary storage buildings of various sizes needed to protect mechanical and electrical equipment and other materials, as recommended by manufacturers of such equipment and materials.
   a. Provide environmental control systems that meet recommendations of manufacturers of equipment and materials stored in the buildings.
   b. Buildings shall be of sufficient size.
   c. Arrange or partition buildings to provide security for their contents and ready access for inspection and inventory.
   d. At or near completion of the Work, temporary storage buildings shall be dismantled, removed from the site, and remain the property of the CONTRACTOR.
3. Store combustible materials (paints, solvents, fuels, etc.) in a well ventilated building remote from other buildings.

C. Fencing and Barricades:
   1. Barricades: Provide barricades as necessary to prevent unauthorized entry to construction areas, both inside and outside of fenced area. Also provide barricades to protect existing facilities and adjacent properties from potential damage. Locate barriers to enable access by facility operators and property owners. Provide temporary fencing while working in and around the perimeter area without the existing perimeter wall (ex., between removal and replacement of perimeter wall, during grading operations adjacent to the perimeter area without fence, etc.). Provide tarp-covered fences with a minimum of 88% blockage.

3.3 EXAMINATION OF EXISTING FACILITIES

A. General:
   1. After the Contract is awarded and before the commencement of Work, CONTRACTOR and ENGINEER shall make a thorough examination of TCE areas to be utilized by CONTRACTOR to establish current conditions, and all existing buildings, structures, and other improvements in the vicinity of the Work, as applicable, which might be damaged by construction operations.
   2. Periodic examinations of existing buildings, structures, and other improvements in the vicinity of the Work shall be made jointly by authorized representatives of the CONTRACTOR, ENGINEER, and the OWNER. The scope of the examination shall include cracks in structures, settlement, leakage, and similar conditions.

3. Records in triplicate of all observations shall be prepared by the CONTRACTOR and each copy of every document shall be signed by the authorized representative of the OWNER and of the CONTRACTOR. Photographs, as requested by the OWNER, shall be made by the CONTRACTOR and signed in the manner specified above. One signed copy of every document and photograph will be kept on file in the office of the ENGINEER.
4. These records and photographs are intended for use as indisputable evidence in ascertaining whether and to what extent damage occurred as a result of the CONTRACTOR'S operations, and are for the protection of the adjacent property owners, the CONTRACTOR, and the OWNER.

3.4 SAFETY REQUIREMENTS

A. General:
1. CONTRACTOR shall do whatever work is necessary for safety and be solely and completely responsible for conditions of the job site, including safety of all persons (including employees) and property during the Contract period. This requirement shall apply continuously and not be limited to normal working hours.
2. Safety provisions shall conform to Federal and State Departments of Labor Occupational Safety and Health Act (OSHA), and other applicable Federal, State, County, and local laws, ordinances, codes, requirements set forth herein, and regulations that may be specified in other parts of these Contract Documents. Where these are in conflict, the more stringent requirement shall be followed. CONTRACTOR shall become thoroughly familiar with governing safety provisions and shall comply with the obligations set forth therein.
3. CONTRACTOR shall develop and maintain for the duration of the CONTRACT a safety program that will effectively incorporate and implement required safety provisions. CONTRACTOR shall appoint a qualified employee who is authorized to supervise and enforce compliance with the safety program.
4. ENGINEER'S duty to conduct construction review of the CONTRACTOR'S performance is not intended to include a review or approval of the adequacy of CONTRACTOR'S safety supervisor, safety program, or safety measures taken in, on, or near the construction site.
5. As part of safety program, CONTRACTOR shall maintain at its office or other well known place at the job site, safety equipment applicable to the Work as prescribed by the governing safety authorities, and articles necessary for giving first-aid to the injured. Establish procedures for the immediate removal to a hospital or a doctor's care of persons who may be injured on the job site.
6. CONTRACTOR shall do all work necessary to protect the general public from hazards, including, but not limited to, surface irregularities or unramped

grade changes in pedestrian sidewalk or walkway, trenches, excavations, open manholes or open wetwells. Barricades, lanterns, and proper signs shall be furnished in sufficient amount to safeguard the public and the Work.

7. Construct and maintain satisfactory and substantial temporary chain-link fencing, solid fencing, railing, barricades, steel plates, as applicable, at all openings, obstructions, or other hazards in streets, sidewalks, floors, roofs, and walkways. Such barriers shall have adequate warning lights as necessary or required for safety.
8. Comply with adjacent business owners' and OWNER'S safety rules while on adjacent business owners' and OWNER'S property.
9. If death or serious injuries or damages are caused, the accident shall be reported immediately by telephone or messenger to the ENGINEER and OWNER. In addition, CONTRACTOR shall promptly report in writing all accidents whatsoever arising out of, or in connection with, the performance of the Work whether on or adjacent to the site, giving full details and statements of witnesses.
10. If claim is made by anyone against CONTRACTOR or any subcontractor on account of accident, CONTRACTOR shall promptly report the facts in writing, giving full details of the claim.

B. Traffic Safety and Access:

1. Comply with rules and regulations of the City, State, and County authorities regarding closing or restricting the use of public streets or highways. No public or private road shall be closed except by written permission of the proper authority. Assure the least possible obstruction to traffic and normal commercial pursuits.
2. Where traffic will pass over backfilled trenches before they are paved, maintain top of trench to allow normal vehicular traffic to pass over. Provide temporary access driveways where required. Cleanup operations shall follow immediately behind backfilling.
3. When flagmen and guards are required by regulation or when deemed necessary for safety, furnish them with approved orange-wearing apparel and other regulation traffic control devices.
4. Traffic control procedures and devices used on all local rights-of-way shall meet the requirements of the applicable current laws and regulations for traffic control.
5. Notify the fire department, police department and obtain required permits before closing any street or portion thereof. Notify said departments when the streets are again passable for emergency vehicles. Do not block off emergency vehicle access to consecutive arterial crossings or dead-end streets in excess of 300 linear feet without written permission from the fire department. Conduct operations with the least interference to fire equipment access, and at no time prevent such access.

6. CONTRACTOR shall leave its night emergency telephone number or numbers with the police department, so that contact may be made easily at all times in case of barricade and flare trouble or other emergencies.
7. Maintain postal service facilities in accordance with the requirements of the U.S. Postal Service. Move mailboxes to temporary locations designated by the Service, and on completion of Work in each area replace them in their original location and in a condition satisfactory to the Service.

C. Fire Prevention:
   1. Perform all Work in a fire safe manner. Furnish and maintain on the site adequate firefighting equipment capable of extinguishing incipient fires. Comply with applicable Federal, local, and State fire prevention regulations. Where these regulations do not apply, follow applicable parts of the National Fire Prevention Standard for Safeguarding Building Construction Operations (NFPA No. 241).

D. Protection of Work and Property:
   1. General:
      a. CONTRACTOR shall employ such means and methods necessary to adequately protect public property and property of the OWNER against damage. In the event of damage to such property, immediately restore the property to a condition equal to its original condition and to the satisfaction of the ENGINEER,OWNER and adjacent business owners of said property, and bear all costs therefore.
      b. Protect stored materials and other items located adjacent to the proposed Work.
   2. Finished Construction:
      a. General Construction Contractor shall assume the responsibility for protection of finished construction and shall repair and restore any and all damage to finished work to its original or better condition.
      b. Prevent wheeling of loads over finished floors, either with or without plank protection, except in rubber-tired wheelbarrows, buggies, or dollies. Protect finished floors and concrete floors exposed as well as those covered with composition tile or other applied surfacing. All finished floors shall be protected from stains due to spillage of oil, paint, or any other construction-related materials. Any such stains that are allowed to occur shall be removed, if necessary by removing and replacing the floor, at the CONTRACTOR'S expense.
      c. At such time temporary facilities and utilities are no longer required for the Work, notify ENGINEER of intent and schedule for their removal. Remove temporary facilities and utilities from the site as CONTRACTOR'S property and leave the site in such condition as specified, as shown on the Drawings, or as directed by the ENGINEER.

d. In unfinished areas, leave the site evenly graded, seeded, or planted as necessary, in a condition that will restore original drainage and with an appearance equal to or better than original.

3.5 ENVIRONMENTAL CONTROLS

A. General:
1. The CONTRACTOR, in executing the Work, shall maintain affected areas within and outside project boundaries free from environmental pollution that would be in violation of Federal, State, or local regulations.
2. Do not impair operation of existing sewer systems. Prevent construction material, pavement, concrete, earth, volatile and corrosive wastes, and other debris from entering sewers, pump stations, or other sewer structures. Maintain original site drainage wherever possible.

B. Waste Material Disposal:
1. Excess excavated material not required or suitable for backfill, and other waste material, must be disposed of in licensed landfills. The CONTRACTOR shall submit the proposed haul route(s) for each site intended to be used.
2. Unacceptable disposal sites include, but are not limited to, sites within a wetland or critical habitat and sites where disposal will have a detrimental effect on surface water or groundwater quality.
3. In lieu of the foregoing, CONTRACTOR may make his own arrangements for disposal subject to submission of proof that the owner(s) of the proposed site(s) has a valid fill permit issued by the appropriate governmental agency. Submit intended haul route plan, including a map of the proposed route(s). Provide watertight conveyance for liquids, semi-liquids, or saturated solids that tend to bleed during transport.
4. Maintain areas covered by the Contract and affected public properties free from accumulations of waste, debris, and rubbish caused by construction operations. Remove excavated materials from the site.
5. Cleaning and disposal shall comply with local ordinances and pollution control laws. Do not burn or bury rubbish or waste materials on the project site. Do not dispose of volatile wastes such as mineral spirits, oil, chemicals, or paint thinner in storm or sanitary drains. Disposal of wastes into streams or waterways is prohibited. Provide acceptable containers for collection and disposal of waste materials, debris, and rubbish.

C. Air Pollution Control:
1. CONTRACTOR shall comply with Maricopa County's requirements regarding dust control.
2. Minimize air pollution likely to occur from construction operations by wetting down bare soils during windy periods, requiring proper combustion emission control devices on construction vehicles and equipment, and by

shutdown of motorized equipment not in use. Trash burning will not be permitted on the construction site.

3. Operations of dumping rock and of carrying rock away in trucks shall be conducted to cause a minimum of dust. Give unpaved streets, roads, detours, or haul roads used in the construction area a dust-preventive treatment, or periodically water to prevent dust. Strictly adhere to applicable environmental regulations for dust prevention.

D. Noise Control:
   1. Minimize noise by executing work using appropriate construction methods and equipment. Provide acoustical barriers so noise emanating from tools or equipment will not exceed legal noise levels.
   2. Submit plans to mitigate construction noise impacts and to comply with noise control ordinances including method of construction, equipment to be used, and acoustical treatments.
   3. If piles are required, use spudding or drilling techniques to penetrate through fill and overburden. Penetrate intermediate hard layers to minimize noise impact by minimizing the number of pile driver hammer blows. Use only pile driver hammers with mufflers capable of reducing noise, and use barriers or shielding techniques to comply with applicable noise criteria.

E. Pest and Rodent Control:
   1. Comply with local health requirements for pest and rodent control. Cooperate with agencies and companies authorized to spray or provide other treatments to prevent insect outbreaks.
   2. Maintain closures of means of entry into finished buildings by rodents. Inspect for rodents during cleaning, remove debris, and treat infested areas to OWNER'S satisfaction.

END OF SECTION

SECTION 01640

MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. The CONTRACTOR shall furnish all materials and equipment and perform all operations required to completely install and place in operation the various mechanical apparatus and systems indicated on the Drawings and as specified herein. It is not the intention to mention herein each and every item required. However, all installations shall be complete and operable in the methods intended. These general equipment requirements apply, in general, to all equipment. They shall supplement the detailed Equipment Specifications, but in case of conflict, the Equipment Specifications shall govern.

1.2 RELATED SECTIONS

A. Section 01300, Submittals.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials and equipment shall be of new, of first quality and best grade, essentially the standard catalog products of reputable manufacturers, and shall be of the type, size, and capacity, and for the type of service specified. It is the intent of these Specifications that the highest quality equipment shall be provided for the intended service. Units proposed shall be carefully matched to the particular hydraulic and mechanical requirements for each installation, and the CONTRACTOR shall submit complete hydraulic and mechanical data for approval of the ENGINEER. Where two or more units of the same class of equipment are required, these units shall be the products of a single manufacturer; however, the component parts of the system need not be the products of the same manufacturer unless otherwise specified.

1. Materials and Workmanship. Materials used in the manufacture of the equipment shall be of the best quality used for the purpose in commercial practice. Materials shall be suitable for service conditions. Iron castings shall be tough, close-grained gray iron free from blowholes, flaws, or excessive shrinkage, and shall conform to ASTM A48. Except where otherwise specified, structural and miscellaneous fabricated steel used in items of equipment shall conform to the Standards of the American Institute of Steel Construction. All structural members shall be considered as subject

to shock or vibratory loads. Unless otherwise specified, all steel which will be submerged, all or in part, during normal operation of the equipment shall have a minimum nominal thickness of 1/4-inch. Equipment shall be installed in accordance with the recommendations of the manufacturer and the best standard practice for each type of equipment.

2. Approval of Materials, Equipment, and Shop Drawings. Detailed Shop Drawings shall be prepared for the equipment to be furnished under this Project. General Drawings for equipment will not be acceptable. Approval of equipment under this provision shall not be construed as authorizing any deviations from the Specification unless the attention of the ENGINEER has been directed to the specific deviation.
   a. The decision of the ENGINEER on any questions concerning the acceptability of materials, equipment, or installation shall be final and binding. The Shop Drawing material required for the various submittals shall be in accordance with the coded legend set forth in Section 01300, Submittals, and as indicated and specified under various headings of these specifications.
3. Nameplates: Equipment shall be furnished with nameplates of bronze, monel, or stainless steel. Aluminum will not be acceptable. Each nameplate shall include pertinent hydraulic and mechanical data. Information shown shall be permanently stamped or cast into each nameplate and shall include the manufacturer's name and model number.
4. ASME Stamp: Where materials and equipment are specified to be constructed in accordance with the standard of the American Society of Mechanical Engineers Code for Unfired Pressure Vessels, the CONTRACTOR shall submit proof that the items furnished under this Section of the Specifications conform to such requirements. The ASME stamp, label, or listing will be acceptable as sufficient evidence that the items conform to these requirements and shall be provided on all pressure vessels falling within the ASME Code jurisdiction.
5. Anchor Bolts: Equipment suppliers shall furnish suitable anchor bolts of specified metallurgy for each item of equipment. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed. Two nuts shall be furnished for each bolt. Unless otherwise shown or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1-1/2-inch of grout beneath the base plant and to provide adequate anchorage into structural concrete.
6. Special Tools and Accessories: Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.
7. Standard specifications prepared by recognized organizations mentioned elsewhere shall govern except as provided otherwise by these specifications and/or its accompanying drawings. Special care shall be exercised in

requests for quotations and in orders, to refer to the standard specifications and to all modifications thereof.

8. Standard Codes, Regulations, and Specifications: Unless indicated or specified otherwise, all materials and workmanship for the mechanical trades shall conform to the editions of the various standards, codes, manuals, and specifications in effect on the date of advertisement for bids, which are referred to in the various sections herein.

PART 3 - EXECUTION

3.1 PROTECTION OF EQUIPMENT

A. General. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept thoroughly dry at all times.

B. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. All painted surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of the ENGINEER.

C. Electrical equipment, controls, and insulation shall be protected against dust, moisture, or water damage.

3.2 INSTALLATION

A. Installation of materials and equipment specified herein shall be performed in a workmanlike manner by mechanics skilled in their particular trade. Piping and equipment shall be installed square and plumb and accessible for proper operation and service. Installations shall be consistent in completeness and appearance whether enclosed or exposed. Any item which does not present a neat and workmanlike appearance shall be replaced without additional cost to OWNER.

3.3 ELECTRIC WIRING

A. The CONTRACTOR shall do all electric wiring of every type for both power supply and for instrumentation and control in accordance with the provisions specified herein, except for such items as are normally wired at their point of manufacture and so delivered, and unless specifically noted to the contrary herein. The CONTRACTOR shall erect all motors and shall mount all starters and controls, furnishing the supporting structures.

3.4 GUARANTEE

A. The CONTRACTOR shall guarantee all equipment against:

1. Faulty or inadequate design.
2. Improper assembly or erection.
3. Defective workmanship or materials.
4. Leakage, breakage, or other failure.
5. The guarantee period shall be as defined in the General Conditions.

END OF SECTION

SECTION 01650

STARTING OF SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Description:
   1. This Section contains requirements for CONTRACTOR'S performance in documenting testing Work required under this Contract. In addition, this Section contains requirements for CONTRACTOR'S starting of systems, performance testing during startup, performance testing of all mechanical, electrical, and instrumentation equipment and systems, and training. This Section supplements, but does not supersede specific testing requirements, found elsewhere in the Contract Documents.

1.2 SUBMITTALS

A. Descriptive submittals shall be made in accordance with Section 01300, Submittals. Submit for approval the following:
   1. A complete description of CONTRACTOR'S plan for documenting the results from the test program in conformance with the requirements of Paragraph 2.1.A., below, including:
      a. Proposed plan for documenting the calibration of all test instruments.
      b. Proposed plan for calibration of all instrument systems, including flow/level meters and all temperature, pressure, weight, and analysis systems.
      c. Sample forms for documenting the results of field pressure and performance tests.
   2. The credentials and certification of the testing laboratory proposed by CONTRACTOR for calibration of all test equipment.
   3. Pre-start-up check-out procedures reviewed and approved by the respective equipment manufacturers.
   4. Detailed testing plans, setting forth step-by-step descriptions of the procedures proposed by CONTRACTOR for the systematic startup and performance testing of all equipment and systems installed under this Contract.
   5. A schedule and subsequent updates, presenting CONTRACTOR'S plan for startup and performance testing the equipment and systems installed under this Contract.
   6. A schedule establishing the expected time period (calendar dates) when CONTRACTOR plans to commence performance testing of the completed systems, along with a description of the temporary systems and installations planned to allow operational testing to take place.

7. All records produced during the startup and testing program.
8. Systems or unit process or any piece of equipment shall not be started up without the approved Operation and Maintenance Manuals being turned over to the OWNER.
9. Written notice to ENGINEER a minimum of 72 hours prior to beginning of any test.

PART 2 - PRODUCTS

2.1 DOCUMENTATION

A. Documentation Plans
   1. CONTRACTOR shall develop a records keeping system to document compliance with the requirements of this Section. Calibration documentation shall include identification (by make, manufacturer, model, and serial number) of all test equipment, date of original calibration, subsequent calibrations, calibration method, and test laboratory.
   2. Equipment and system documentation shall include date of test, equipment number or system name, nature of test, test objectives, test results, test instruments employed for the test and signature spaces for the OWNER'S and ENGINEER'S witnesses. A separate file shall be established for each system and item of equipment. These files shall include the following information as a minimum:
      a. Metallurgical tests.
      b. Factory performance tests.
      c. Accelerometer recordings made during shipment.
      d. Field calibration tests[1].
      e. Field pressure tests[1].
      f. Field performance tests[1].
      g. Field operational tests[1].

      ([1] Each of these tests are required even though not specifically noted in detailed Specification Section.)

B. Test Plans:
   1. CONTRACTOR shall develop test plans detailing the coordinated, sequential testing of each item of equipment and system installed under this Contract. Each test plan shall be specific to the item of equipment or system to be tested. Test plans shall identify by specific equipment or tag number each device or control station to be manipulated or observed during the test procedure and the specific results to be observed or obtained. Test plans shall also be specific as to support systems required to complete the test work, temporary systems required during the test work, subcontractors and manufacturers' representatives to be present and expected test duration. As a minimum, the test plans shall include the following features:

a. Step-by-step proving procedure for all control and electrical circuits by imposing low voltage currents and using appropriate indicators to affirm that the circuit is properly identified and connected to the proper device.
b. Calibration of all analysis instruments and control sensors.
c. Performance testing of each individual item of mechanical, electrical, and instrumentation equipment. Performance tests shall be selected to duplicate the operating conditions described in the Contract Documents.
d. System performance tests designed to duplicate, as closely as possible, operating conditions described in the Contract Documents.

2. Test plans shall contain a complete description of the procedures to be employed to achieve the desired test environment.
3. As a condition precedent to receiving progress payments in excess of 75% of the Contract amount, or in any event, progress payments due to CONTRACTOR eight weeks in advance of the proposed date the CONTRACTOR intends to begin any testing work (whichever occurs earliest in the Project Schedule), CONTRACTOR shall have submitted all test plans required for the systematic field performance and operational tests for all equipment and systems installed under this Contract. Once the ENGINEER has reviewed and approved CONTRACTOR'S test plans, CONTRACTOR shall reproduce the plans in sufficient number for CONTRACTOR'S purposes and an additional 3 copies for delivery to the ENGINEER. No test work shall begin until the CONTRACTOR has delivered the specified number of final test plans to the ENGINEER.

C. Testing Schedule: CONTRACTOR shall provide a startup and testing schedule setting forth the sequence contemplated for performing the test work. The schedule shall be a CPM format, plotted against calendar time, shall detail the equipment and systems to be tested, and shall be coordinated with CONTRACTOR'S Progress Schedule specified in Section 01310, Progress Schedule. The schedule shall show the contemplated start date, duration of the test and completion of each test. The test schedule shall be submitted no later than two weeks in advance of the date testing is to begin. The ENGINEER will not witness any testing work for the purpose of acceptance until CONTRACTOR has submitted a test schedule and the ENGINEER approves. The test schedule shall be updated weekly, showing actual dates of test work, indicating systems and equipment testing completed satisfactorily and meeting the requirements of the Contract Documents.

2.2 SYSTEM AND EQUIPMENT PERFORMANCE TESTS

A. Each item of mechanical, electrical, instrumentation equipment installed under this Contract shall be tested to demonstrate compliance with the performance requirements of the Contract Documents. Each electrical,instrumentation, mechanical, and piping system installed or modified under this Contract shall be tested in accordance with the requirements of the Contract Documents.

B. Once all equipment and systems have been tested individually, CONTRACTOR shall proceed with performance testing in accordance with the requirements of Paragraph 3.3, below, simulating actual operating conditions to the greatest extent possible. CONTRACTOR shall install temporary connections, bulkheads and make other provisions to re-circulate process fluids or otherwise simulate anticipated operating conditions. During the operational testing period, CONTRACTOR'S Quality Assurance Manager and testing team shall monitor the characteristics of each machine and system and report any unusual conditions to the ENGINEER.

PART 3 - EXECUTION

3.1 GENERAL

A. CONTRACTOR shall organize teams made up of qualified representatives of equipment suppliers, subcontractors, CONTRACTOR'S independent testing laboratory, and others, as appropriate, to efficiently and expeditiously calibrate and test the equipment and systems installed and constructed under this Contract. The objective of the testing program shall be to demonstrate, to the OWNER'S and ENGINEER'S complete satisfaction, that the structures, systems, and equipment constructed and installed under this Contract meets all performance requirements and the facility is Substantially Complete and ready for the commissioning process to commence. In addition, the testing program shall produce baseline-operating conditions for the OWNER to use in a Preventive Maintenance Program.

3.2 CALIBRATION OF FIXED INSTRUMENTS

A. Calibration of analysis instruments, sensors, gauges, and meters installed under this Contract shall proceed on a system-by-system basis. No equipment or system performance test shall be performed until all instruments, gauges, and meters to be installed in that particular system have been calibrated and the calibration work has been witnessed by the OWNER and ENGINEER.

3.3 PERFORMANCE TESTS

A. General: Performance tests shall consists of the following:
   1. Pressure or leakage tests.
   2. Electrical testing as specified in Division 16, Electrical.
   3. Wiring and piping, individual component, loop, loop commissioning and tuning testing, as specified in Division 13, Special Construction.
   4. Pre-startup check out for all mechanical equipment specified in Division 15, Mechanical. Pre-startup check out procedures shall be reviewed and accepted by the respective equipment manufacturer.

5. Individual and system tests of all mechanical, electrical, HVAC, and instrumentation equipment and systems shall demonstrate compliance with the performance requirements of the Contract Documents.

B. Performance tests for any individual system shall be performed in the order listed above. The order may be altered only on the specific written authorization of the ENGINEER after receipt of a written request, complete with justification for the change in sequence.

C. Pressure and Leakage Tests: Pressure and leakage tests shall be conducted in accordance with applicable Sections. All acceptance tests shall be witnessed by the ENGINEER. Evidence of successful completion of the pressure and leakage tests shall be the ENGINEER'S signature on the test forms prepared by CONTRACTOR.

D. Equipment Checkout: Prior to energization (in the case of electrical systems and equipment), all circuits shall be rung out and tested for continuity and shielding in accordance with the requirements of Division 16, Electrical.

E. Component Calibration and Loop Testing: Prior to energization (in the case of instrumentation system and equipment), all loops and associated instruments shall be calibrated and tested.

F. Electrical Resistance: Electrical resistance testing shall be in accordance with the requirements of Division 16, Electrical.

G. Pre-Start-up Tests: Pre-start-up tests shall include the following
   1. Alignment of equipment using reverse dial indicator method.
   2. Pre-operation lubrication.
   3. Tests in accordance with the manufacturers' recommendations for pre-start preparation and pre-operational check out procedures.

3.4 DISINFECTION

A. CONTRACTOR shall disinfect all non-potable water system, potable water system, and reclaimed water system. Disinfection shall be completed prior to bringing the specific process or component on-line. All disinfection shall be done in accordance with AWWA C-653.

B. The CONTRACTOR shall provide all chemicals, materials, equipment, and utilities to perform the disinfection.

3.5 EQUIPMENT START-UP

A. The CONTRACTOR in the presence of OWNER and ENGINEER shall place the newly installed equipment and facilities into operation and test, observe, and

adjust all items until the units are properly adjusted and operating in accordance with the requirements of the manufacturer's data and the Contract Documents. After the new equipment has been put into operation, CONTRACTOR, ENGINEER, and City Staff shall go over in detail the standard operating procedures of the equipment. The work performed by CONTRACTOR shall include, but not be limited to, the following items:

1. Testing of pumps and equipment for proper operation and verifying alignment and capacity.
2. Checking all electrical, electronic, and remotely controlled equipment for proper operation as specified under Section 01400, Quality Control.

3.6 SUPERVISION OF INSTALLATION AND START-UP BY MANUFACTURER

A. An experienced, competent, and factory-certified representative of the equipment manufacturer shall visit the site of the work and inspect, check, adjust if necessary, and approve the equipment installation and shall be present when the equipment is placed in operation. The equipment manufacturer's representative shall revisit the job site as often as necessary until any trouble is corrected and the equipment installation and operation is satisfactory to the OWNER. The equipment manufacturer's representative shall furnish to OWNER a written report certifying that the equipment:

1. Has been properly installed and lubricated.
2. Is in accurate alignment.
3. Is free from any undue stress imposed by connecting piping or anchor bolts.
4. Has been operated under full load conditions and that it operated satisfactorily.

B. A resume of each factory personnel assigned to supervise installation and train OWNER'S personnel shall be submitted to the ENGINEER for approval prior to scheduling training and installing the equipment.

3.7 TRAINING

A. The CONTRACTOR shall provide experienced, competent manufacturers' representatives to train OWNER'S personnel in operation and maintenance procedures for equipment items specified below during the start-up period at no additional cost to OWNER. The lesson plans for these sessions shall be reviewed with the OWNER and the ENGINEER in one meeting prior to initiating training. Lesson plans shall be submitted to the ENGINEER not less than one week prior to this meeting. CONTRACTOR will record the manufacturers' training sessions and provide OWNER with DVD format professional quality DVDs of the training sessions. The representatives shall present training programs and on-site demonstrations designed to fully acquaint plant personnel with all equipment features, routine scheduled maintenance procedures, alternative operational modes, emergency procedures, spare parts inventories, and demonstrate

performance requirements of the specifications. Representatives shall remain on-site to observe operation of the equipment and further advise plant personnel for a minimum number of days as specified below, unless specified otherwise in Equipment Specifications. The following table is not a complete list of equipment training. See individual Specifications for additional training.

Equipment		Additional Training Days (Day = 8 hrs minimum)
11295	Hydraulic Valves	1/2 for each valve type listed
17137	Magnetic Flowmeters	1/2

B. A complete schedule of representatives and dates for operator training shall be submitted to OWNER prior to commencement of the start-up period. This schedule shall be prepared to accommodate the plant staff's work schedules, including training on all shifts and staffs' flex time.

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT

PART 1 - GENERAL

1.1 SUMMARY

A. Tasks listed under this Section shall be completed prior to Contract closeout and approval of the CONTRACTOR'S final pay request.

1.2 RELATED SECTIONS

A. Section 01300, Submittals.

1.3 CONTRACT CLOSEOUT SUBMITTALS

A. The following documents are to be submitted as specified to the ENGINEER prior to approval of the CONTRACTOR'S final pay request:
   1. Record Drawings shall be furnished by the CONTRACTOR. One set of redlines annotated to show all changes shall be delivered by the CONTRACTOR to the ENGINEER. The Record Drawings shall reflect all changes made by Change Order, addenda, field order, work directive, and any other changes made and approved during the course of the Work.
   2. Certification of Final Completion.
   3. Evidence of Payment and Release of Labor and Material Liens as outlined in the Conditions of the Contract. These documents shall be furnished by the CONTRACTOR and all subcontractors.
   4. Release of claims as outlined in the conditions of the Contract.
   5. Copies of written warranties shall be furnished for each individual item of equipment. The names, addresses, and phone numbers of the manufacturer's representatives shall be included.
   6. Operation and Maintenance Manuals shall be furnished for each individual item of equipment as specified in Section 01300, Submittals.
   7. Evidence of Compliance with Requirements of Governing Authorities, including Certificates of Inspection.

1.4 SITE CONDITIONS

A. Prior to approval of the CONTRACTOR'S final pay request, and after Work has been completed, the CONTRACTOR shall dispose of all waste material.

B. All areas shall be restored to a condition equal to or better than the original.

1.5 MAINTENANCE AND GUARANTEE

A. The CONTRACTOR shall comply with the maintenance and guarantee requirements contained in the General Conditions.

B. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as a part of such required repair Work, and any repair or resurfacing constructed by the CONTRACTOR which becomes necessary by reason of such settlement shall likewise be considered as a part of such required repair Work, unless the CONTRACTOR shall have obtained a statement in writing from the affected private owner or public agency releasing the OWNER from further responsibility in connection with such repair or resurfacing.

C. The CONTRACTOR shall make all repairs and replacements promptly upon receipt of written order from the OWNER. If the CONTRACTOR fails to make such repairs or replacements promptly, the OWNER reserves the right to do the Work and the CONTRACTOR and his surety shall be liable to the OWNER for the cost thereof.

1.6 BOND

A. The CONTRACTOR shall provide a bond to guarantee performance of the provisions contained in Paragraph 1.5, above, and the in General Conditions.

1.7 RE-INSPECTION FEES

A. Should CONTRACTOR fail to complete and correct punch list items such that additional inspections are required by ENGINEER, CONTRACTOR shall pay ENGINEER'S standard rates per person per hour for ENGINEER'S additional services. If CONTRACTOR has any questions with regard to any items on punch list, he shall request clarification before final inspection.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01710

CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section outlines requirements for cleaning of the Project Work. This Section is complementary to the General Conditions and nothing herein shall be considered to waive any requirements of the General Conditions.

1.2 REQUIREMENTS OF REGULATORY AGENCIES

A. Safety and Insurance Standards: Maintain Project in accordance with the following safety and insurance standards:
   1. State Industrial Commission of Arizona (OSHA).

B. Fire Protection: Store volatile waste in covered metal containers and remove from premises daily.

C. Pollution Control: Conduct cleanup and disposal operations to comply with local ordinances and anti-pollution laws. Burning or burying of rubbish and waste material on the Project site is not permitted. Disposal of volatile fluid waste (such as mineral spirits, oil, or paint thinner) in storm or sanitary sewer systems or into streams or waterways is not permitted.

PART 2 - PRODUCTS

2.1 CLEANING MATERIAL

A. Use only cleaning materials recommended by manufacturer of surface to be cleaned. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 - EXECUTION

3.1 DURING CONSTRUCTION

A. During the construction period the material to be used in the Work shall be kept in an orderly manner, neatly stacked or piled.

B. Clean up frequently (at least weekly) all refuse, rubbish, scrap materials, and debris caused by operations, to the end that at all times the site of the Work shall present a neat, orderly, and workmanlike appearance. Sprinkle dusty debris with water.

C. Keep areas around the construction area clean and free of debris. Impact on surrounding businesses shall be minimal.

C. Provide for the disposal of all waste products, trash, debris, etc., and make necessary arrangement for legal disposal of same off the site. Never throw rubbish from windows or other parts of building. Lower waste materials in a controlled manner with as few handling as possible.

D. Remove all surplus material, false-work, temporary structures, including foundations thereof, plant of any description and debris of every nature resulting from operations and put the site in a neat, orderly condition.

E. Schedule cleaning operation so that dust and other contaminants resulting from cleaning process will not fall on wet, newly painted surfaces.

F. General Contractor shall provide trash gondolas or containers for use by all trades.

3.2 FINAL CLEANING

A. Use experienced workmen or professional cleaners for final cleaning. Provide adequate ventilation during use of volatile or noxious substances.

B. Besides general broom cleaning, do following special cleaning for all trades at completion of Work:

1. Remove putty stains from glass; wash, polish same inside and outside. Exercise care not to scratch glass.
2. Remove marks, stains, fingerprints, other soil, dirt from painted, decorated, or stained work.
3. Clean, polish, and wax woodwork.
4. Clean and polish hardware for removal of stains, dust, dirt, paint, and the like.
5. Remove spots, soil, paint from tile and similar Work; wash same.
6. Clean fixtures, equipment; remove stains, paint, dirt, and dust.
7. Remove temporary floor protections.
8. Remove all temporary protections at the site.
9. Clean exterior and interior metal surfaces including doors and windows of oil, stains, dust, dirt, paint and the like.
10. Clean and vacuum all carpeted areas.

C. All existing improvements inside or outside the property which are disturbed,

damaged, or destroyed by the Work under the Contract shall be restored to the condition in which they originally were or to the satisfaction of the ENGINEER.

END OF SECTION

SECTION 02050

DEMOLITIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment, and incidentals as shown on the Drawings, specified, and required for demolitions, removal and disposal Work.
   2. Included, but not limited to, are demolition and removals of existing materials, equipment, or work necessary to install the Work as shown on the Drawings, specified, and required to connect same with existing work in an approved manner. Demolition includes piping, electrical equipment, paving, manholes, and similar existing facilities.
   3. Demolitions and removals which may be specified under other Sections shall conform to requirements of this Section.
   4. Pay for all landfill disposal fees.

1.2 SUBMITTALS

A. Schedule: Submit for approval proposed methods, equipment, and operating sequences. Include coordination for shut-off, capping, temporary services, continuation of utility services, and other applicable items to ensure no interruption of OWNER'S operations.

1.3 JOB CONDITIONS

A. Protection:
   1. Perform all demolition and removal Work to prevent damage or injury to structures, occupants thereof, and adjacent features which might result from falling debris or other causes, and so as not to interfere with the use and free and safe passage to and from adjacent structures.
   2. Closing or obstructing of roadways, sidewalks, and passageways adjacent to the Work by the placement or storage of materials will not be permitted, and all operations shall be conducted with a minimum interference to traffic on these ways.
   3. Erect and maintain barriers, lights, sidewalk sheds, and other necessary protective devices.
   4. Repair damage to facilities to remain or to any property belonging to the OWNER.

B. Notification:
   1. At least 48 hours prior to commencement of a demolition or removal, notify ENGINEER, in writing, of proposed schedule therefore. OWNER will inspect the existing equipment and mark for identification those items which are to remain the property of the OWNER. Do not start removals without the permission of the ENGINEER.

C. Explosives will not be permitted.

D. Comply with NFPA 241 - Standard for Safeguarding Construction, Alterations, and Demolition Operations.

E. All operating utilities intersecting the areas of demolition shall be located and protected by the CONTRACTOR prior to commencement of Work.

1.4 EXISTING STRUCTURE CONSTRUCTION

A. CONTRACTOR shall field verify all existing conditions and notify the ENGINEER for any discrepancies before proceeding with the Work.

B. Perform the removal, cutting, drilling, etc., of existing Work with extreme care, using small tools in order not to jeopardize the structural integrity of the structure.

C. Safely shore existing construction whenever existing supports are removed to allow the installation of new Work.

D. Rebuild any existing Work which has to be removed to allow the installation of new Work.

E. Perform cutting of existing concrete and masonry with saws and core drills. Do not use jack-hammers.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. All materials and equipment removed from existing Work shall become the property of CONTRACTOR, except items designated to be re-used or salvaged. All materials and equipment marked by the OWNER to remain the property of the OWNER shall be carefully removed by CONTRACTOR, so as not to be

damaged, and shall be cleaned and stored on or adjacent to the site in a protected place specified by the ENGINEER or loaded onto trucks provided by the OWNER.

B. Dispose of all demolition materials, equipment, debris, and all other items not marked by the OWNER to remain off the site and in conformance with all existing applicable laws and regulations.

C. Surfaces of walls, floors, ceilings, or other areas which are exposed by any of the removals specified herein, and which will remain as architecturally finished surfaces shall be repaired and re-finished by CONTRACTOR with the same or matching materials as the existing adjacent surface or as may be otherwise approved by the ENGINEER.

D. Pollution Controls: Use water sprinkling, temporary enclosures, and other suitable methods to limit the amount of dust and dirt rising and scattering in the air to the lowest practical level. Comply with governing regulations pertaining to environmental protection.
   1. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.
   2. Clean adjacent structures, facilities, and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to conditions existing prior to the start of the Work.

E. Pavement Demolition:
   1. All asphalt and concrete pavement demolition shall terminate at cut edges. All edges shall be linear and have a vertical cut face.

F. All anchor bolts for removed equipment and supports and structural steel cast in concrete shall be removed 1-1/2-inches below the surface of the concrete and the depression filled with epoxy grout flush with the concrete surface. Removal procedures will provide a 90 degree angle between the existing surface and bolt hole to minimize grout spalling.

G. All concrete saw cutting indicated on the plans shall be done with appropriate equipment to produce a smooth, square cut. Cut surfaces shall be sealed as specified in Section 03251, Concrete Joints. All depressions in concrete left as a result of demolition shall be repaired as specified in Section 03300, Cast-In-Place Concrete.

H. All earthen depressions, voids, and holes which are a result of demolition shall be filled. Fill material shall be native soils compacted to a uniform density as defined in Section 02200, Earthwork, Excavation, and Backfill.

I. All areas of demolition shall be re-graded to match existing grade prior to demolition. Drainage shall be maintained away from all structures as defined in Section 02200, Earthwork, Excavation, and Backfill.

3.2 STRUCTURAL REMOVALS

A. Remove structures to the lines and grades shown on the Drawings, unless otherwise directed by the ENGINEER. Where no limits are shown on the Drawings, the limits shall be 4-inches outside the item to be installed. The removal of masonry beyond these limits shall be at CONTRACTOR'S expense and these excess removals shall be reconstructed to the satisfaction of the ENGINEER, with no additional compensation to CONTRACTOR.

B. All concrete, asphalt, reinforcement, structural or miscellaneous metals, and other items contained in or upon the demolition work shall be removed and taken from the site, unless otherwise approved by the ENGINEER. Demolished items shall not be used in backfill.

C. After removal of parts or all of masonry walls, concrete, asphalt and like work which tie into the work or existing work, the point of junction shall be neatly repaired so as to leave only finished edges and surface exposed.

D. Where new anchoring materials, including bolts, nuts, hangers, welds, and reinforcing steel, are required to attach the work to the existing work they shall be included under this Section, except where specified elsewhere.

3.3 MECHANICAL REMOVALS

A. Any changes to potable water piping and other plumbing and heating system work shall be made in conformance with all applicable codes and under the same requirements as other underground piping. All portions of the potable water system that have been altered or opened shall be pressure tested and disinfected in accordance with Section 15050, Piping Systems, and Section 15051, Buried Piping Installation, and local codes. Other plumbing piping and heating piping shall be pressure tested only.

3.4 ELECTRICAL REMOVALS AND DEMOLITION

A. Electrical removals shall consist of the removal of existing control panels, wires, and miscellaneous electrical equipment all as shown on the Drawings, specified, or required to perform the Work.

B. All existing electrical equipment and fixtures to be removed shall be removed with such care as may be required to prevent unnecessary damage, to keep existing systems in operation and to keep the integrity of the grounding systems.

C. Where shown on the Drawings or otherwise required, wiring in the underground duct or direct-burial cable system shall be removed. All such wiring shall be salvaged and stored as specified. Verify the function of all wiring before disconnecting and removing it. Ducts which are not to be reused shall be plugged where they enter buildings and made watertight.

3.5 ALTERATIONS AND CLOSURES

A. Alterations shall conform with the Contract Documents and the directions and approvals of the ENGINEER.

B. Where alterations require cutting or drilling into existing floors, walls, and roofs, the holes shall be repaired in a manner approved by the ENGINEER. Repair such openings with the same or matching materials as the existing floor, wall, or roof or as otherwise approved by the ENGINEER. All repairs shall be smoothly finished, unless otherwise approved by the ENGINEER.

C. Openings in existing concrete slabs, ceilings, masonry walls, floors and partitions shall be closed and sealed as shown on the Drawings or otherwise directed by the ENGINEER. The Work shall be keyed into the existing work in a manner approved by the ENGINEER. Reinforcing steel shall be welded to the existing reinforcing. Welding shall conform to AWS D12.1, Reinforcing Steel Welding Code. In general, use the same or matching materials as the existing adjacent surface. The finished closure shall be a smooth, tight, sealed, permanent closure acceptable to the ENGINEER.

3.6 CLEANUP

A. Remove from the site all debris resulting from the demolition operations as it accumulates. Upon completion of the Work, all materials, equipment, waste, and debris of every sort shall be removed and premises shall be left, clean, neat and orderly. Comply with requirements of Section 02200, Earthwork.

3.7 DEMOLITION ITEMS

A. The demolition items include, but are not limited to the following paragraphs. Further information is provided in the Drawings

Remove, clean sections of perimeter wall as shown in the Drawings.

B. Salvage, clean, store and reinstall west access gate, including wall-mounted gate track.

C. Remove wiring and conduits as shown in the Drawings.

D. Completely remove Manhole No. 6 cone, collar and cover.

E. Salvage, clean and store Manhole No. 6 cone, collar and cover and reinstall after completion of bypass work.

F. Remove section of existing potable water line as shown in the Drawings.

G. Remove concrete slab west of the lift station as shown in the Drawings.

H. Remove west wall of existing valve vault as shown in the Drawings.

I. Remove abandoned odor control conduits as shown in the Drawings.

J. Remove asphalt paving as required for excavation.

END OF SECTION

SECTION 02100

SITE PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. Prepare the construction site for new construction.

1.2 SECTION INCLUDES

A. Removal of existing structures.

B. Protection of certain existing trees and vegetation.

C. Clearing and grubbing.

D. Removing above grade improvements.

E. Removing below grade improvements (including stumps).

F. Installing and maintaining barricades and warning signs.

G. All other miscellaneous items of Work required for completing the site preparation.

1.3 RELATED SECTIONS

A. Section 02050, Demolitions.

B. Section 02200, Earthwork.

1.4 PROJECT CONDITIONS

A. Traffic: Conduct site-clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction.

B. Protection of Existing Improvements: Provide protection as necessary to prevent damage to existing improvements indicated to remain in place.
   1. Protect improvements on adjoining properties and OWNER'S property.

2. Restore damaged improvements to their original condition, as acceptable to OWNER.

C. Protection of Existing Trees and Vegetation:
   1. Existing vegetation in the field not scheduled for removal shall be undisturbed by the CONTRACTOR. The CONTRACTOR shall not remove from the site any plants, unless specifically approved by the ENGINEER.
   2. Protect existing trees and vegetation indicated to remain against unnecessary cutting, breaking, or skinning of roots, skinning or bruising of bark, smothering of trees by stockpiling construction materials, or excavated materials within drip line, excess foot or vehicular traffic or parking of vehicles within the drip line. Prior to initiating site clearing activities, the CONTRACTOR shall mark the limits of the disturbance areas either by placing lime, flags, or survey stakes at the limits shown on the Plans.
   3. Do not destroy vegetation which may be naturally located in the periphery of proposed disturbed areas (within a zone ±5 foot). The ENGINEER shall be notified if existing plants are located within the fringes of the construction limits. The ENGINEER shall issue instructions at that time.
   4. Adjustments may be made in the limits of construction to protect the affected plants based on a field review of the staked limits. The adjusted construction limits shall be considered the permanent construction limits for the duration of the Project. If the ENGINEER recommends that construction limits be adjusted to preserve existing plants, the CONTRACTOR, at his own option, may elect to clear the subject vegetation and re-vegetate with like-kind size and species as required herein at no additional cost to the OWNER. The CONTRACTOR shall be entirely responsible for removal, storage, and replanting of such vegetation.
   5. During the Course of the Work the CONTRACTOR shall:
      a. Water trees, shrubs, and other vegetation to remain within limits of Contract Work as required to maintain their health during the course of construction operations. Other requirements for maintaining the existing vegetation are specified herein.
      b. Provide protection for roots over 1-1/2-inches in diameter that are cut during construction operations. Temporarily cover exposed roots with wet burlap to prevent the roots from drying out; cover with earth as soon as possible.
      c. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations in a manner acceptable to the ENGINEER.
      d. Trees to be protected in place shall not be pruned unless limbs are damaged, or at the direction of the ENGINEER. Employ a licensed arborist to repair damaged trees and shrubs. Replace trees that cannot be repaired and restored to full-growth status, as determined by the arborist.
      e. Provide a temporary construction fence/barrier to protect trees and vegetation at the limits reviewed and approved by the ENGINEER. The

barrier shall be installed and remain in place for the duration of the project or as directed by the ENGINEER.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fencing: Any fencing removed as obstructions shall be restored to match existing.

B. Barricades, warning signs, and related equipment shall be placed as required.

C. Tree Protection Fence/Barrier: Shall be a commercially available product acceptable to the ENGINEER for its intended purpose. The barrier shall be similar to a nylon woven material or woven wire fence such as TENAX Nordic Snow Fence, or approved equal, with approved stakes approximately 36-inches in height. Submit material sample and Shop Drawings for barrier installation to the ENGINEER for approval prior to use.

PART 3 - EXECUTION

3.1 PREPARATION

A. Site Clearing:
   1. General: Remove trees, shrubs, grass, and other vegetation, improvements or obstructions, as required, to permit installation of new construction. Remove similar items elsewhere on-site or premises as specifically indicated. Removal includes digging out and off-site disposal of stumps and roots.
      a. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
   2. Clearing and Grubbing: Within the limits of Work, clear site of trees, shrubs, and other material, except for those indicated to be left standing.
      a. Completely remove stumps, roots, and other debris protruding through the ground surface. Stump removal and backfilling of holes is required for trees indicated on the Plans to be removed.
      b. Use only hand methods for grubbing inside drip line of trees indicated to remain.
      c. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.

d. Place fill material in horizontal layers not exceeding 6-inches loose depth and thoroughly compact each layer to a density equal to adjacent original ground.
e. No cleared or grubbed material may be used in backfills or structural embankments. Comply with requirements of Section 02200, Earthwork.

3. Removal of Improvements: Remove existing above grade and below grade improvements as indicated and necessary to facilitate new construction.
4. Disposal of Waste Material:
   a. Burning on OWNER'S Property: Burning is not permitted on OWNER'S property and surrounding areas.
   b. Removal from OWNER'S Property: Remove waste materials from OWNER'S property at no additional cost to the Project.
5. Insofar as is consistent with customary construction practices, all operations shall be performed by such method as shall result in the minimum damage to materials and construction to remain intact and in use. CONTRACTOR shall provide temporary supports and shoring as required to protect existing walls, equipment, piping, electrical conduits, etc., during periods of removal work and new construction under this Contract.
6. Designated existing structures shall be removed complete with foundations, slabs, walks, and miscellaneous items. Existing foundations outside lines of new construction shall be removed to a minimum depth of 3 feet below finished subgrade elevation and foundations within area of new construction shall be removed completely, unless otherwise shown on the Drawings. All trash, rubble, and debris shall be cleaned up, transported, and disposed of at off-site locations. Pits and other depressions shall be cleaned of all trash and decayable materials prior to backfilling, then backfilled and compacted in such a manner that no future settlement will occur.
7. All miscellaneous items not specifically mentioned or designated on the Drawings as removal items, but required for the completion of the Work, shall be removed. All such items removed shall be hauled from the site.

B. Barricades and Warning Signs:
   1. Construction sites shall be properly barricaded with appropriate warning signs affixed to prevent unauthorized access to the construction site.

3.2 TOPSOIL REMOVAL

A. Topsoil is defined as friable clay loam surface soil found in a depth of not less than 4-inches. Topsoil shall be substantially free of subsoil, clay lumps, stones, and other objects over 2-inches in diameter and without weeds, roots, and other objectionable material.

B. Strip topsoil which is satisfactory to whatever depths are encountered, and in such manner as to prevent intermingling with the underlying subsoil or other

objectionable material. Remove heavy growths of grass from areas before stripping.

1. Where trees are shown on the Drawings or as directed by the ENGINEER to be left standing, stop topsoil stripping a sufficient distance from such trees to prevent damage to the main root system.

C. Stockpile topsoil in storage piles in areas shown on the Drawings or where otherwise approved by ENGINEER. Construct storage piles to freely drain surface water. Cover storage piles, if required, to prevent windblown dust. Topsoil in excess of quantity required shall remain property of OWNER.

D. Dispose of excess topsoil as waste material off-site.

END OF SECTION

SECTION 02145

DIVERSION OF SEWAGE FLOW AND DEWATERING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This Section provides minimum requirements for temporary piping for bypass of Manhole No. 5 sewers as required to completing work and prior to acceptance.
   2. Construction work and temporary bypass piping shall not impede pedestrian access. All landscape and irrigation shall be returned to its original conditions after construction is complete.
   3. The temporary bypass forcemain shall be sized to accommodate instantaneous peak flows through the 36-inch and 8-inch gravity sewer lines coming into Manhole No. 6.

B. Requirements:
   1. CONTRACTOR shall provide all labor, materials, equipment, and supervision temporarily bypass sewage flow around the CONTRACTOR'S Work. The bypass strategy shall maintain flow to prevent wastewater backup into the City's sewage collection system or discharge to the environment.
   2. The actual design of the bypass arrangement shall be prepared by the CONTRACTOR, and shall be submitted to the OWNER and ENGINEER for review. Means and methods of accomplishing the bypassing shall be the responsibility of the CONTRACTOR.
   3. The CONTRACTOR shall have the entire bypassing system in place and tested before bypassing any sewage.
   4. The CONTRACTOR shall notify the OWNER 72 hours prior to bypassing the pipeline. The wastewater levels shall be continuously monitored with onsite staff by the CONTRACTOR.
   5. CONTRACTOR is responsible for immediate and proper cleanup should any spill occur, regardless of amount.
   6. CONTRACTOR shall connect bypass piping to the existing collection system Manhole No. 4.
   7. In the event of failure of the temporary forcemain, the contractor shall be able to repair the forcemain and return the bypass pumping in operation with 4 hours. The forcemain shall be sized with a velocity of less than 5 feet per second.
   8. The bypass pipeline shall be placed in service to bypass Manhole No. 5 in the Specification 01143, Coordination with Owner's Operations.
   9. CONTRACTOR shall provide qualified personnel, at a minimum one (1), on-site 24 hours per day to maintain the bypass pipeline.

10. CONTRACTOR shall continuously monitor hydrogen sulfide concentrations. CONTRACTOR shall provide temporary covering at each location to minimize hydrogen sulfide releases. This includes providing and installing a temporary odor control system per Specification Section 11701, Temporary Odor Control.
11. CONTRACTOR shall protect and secure bypass pumping area with chainlink fence with privacy screens with a minimum of 88% blockage.
12. CONTRACTOR shall provide, install, and maintain safety signs. CONTRACTOR shall plan for at least 10 signs measuring 14-inches by 10-inches. Signs shall be installed prior to testing the bypass pumping system.

C. Experience:
   1. CONTRACTOR shall utilize staff and/or a subcontractor that has been directly responsible for the bypass pumping of sewage flows during the completion of a similar pipeline project.

1.2 SUBMITTALS

A. Provide a detailed plan for the bypass pump operation. The plan shall include the following items:
   1. Detailed layout of temporary piping.
   2. Forcemain diameter and material data sheets.
   3. Forcemain sizing calculations.
   4. Additional temporary measures that are planned to be supplied to ensure safe and reliable bypass operation.
   5. Detailed list of items and methods utilized to repair or replace items damaged or modified due to the by-pass operation.

B. The plan shall include a detailed daily schedule and a list of daily activities that will be completed before, during, and after the bypass operation. Include all personnel that are planned to work on this.

C. Provide an emergency contact list for all of the personnel to be at the site. Include all of the OWNER's and ENGINEER's personnel. Once the emergency contact list is finalized, three (3) copies shall be printed, laminated, and placed at the job site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. CONTRACTOR shall provide temporary piping, fittings, conduits, restraints, and all other equipment to bypass sewer flow around the CONTRACTOR'S Work as required. Bypass pipeline shall be of adequate capacity and size to handle the required flows.

B. Bypass piping shall be HDPE (High Density Polyethylene) pipe with Standard PE Code Designation PE3408 as defined in AWWA C906, have a minimum Cell Classification of PE 334434C as defined in ASTM D3350, and designed using Hydrostatic Design Basis of 1,600 psi as specified in ASTM D2837. The physical properties of the polyethylene pipe shall have minimum test values as specified in ASTM D3350. Properties shall be substantiated with test data.

C. The polyethylene pipe shall be designed by CONTRACTOR in accordance with the procedures of AWWA Design Manual M55, applicable MAG standards and these Specifications. All material properties used in design calculations shall be long-term (time-corrected) values. CONTRACTOR shall be familiarized with site conditions when preparing the pipe design.

D. CONTRACTOR shall calculate the required minimum wall thickness using the following parameters:
   1. Safety Factor: N = 2.0.
   2. Internal Operating Temperature (Design): T_n = 24° C to 33° C.
   3. Working Pressure: P = 50 psi.
   4. Test Pressure: P = 80 psi.
   5. Design Factor for use in AWWA M55 eq 4-1: DF = 0.5.
   6. Allowable Deflection: As described in AWWA M55, Table 5-11.

E. CONTRACTOR shall maintain on-site sufficient equipment and materials to ensure continuous and successful operation of the bypass and dewatering systems. The CONTRACTOR shall maintain on-site a sufficient number of valves, tees, elbows, connections, tools, sewer plugs, piping, and other parts or system hardware to ensure immediate repair or modification of any part of the system as necessary.

F. All equipment shall be placed on a new plastic tarp, adequately sized, and bermed to protect against gasoline, oil, and hydraulic fluid spills.

PART 3 - EXECUTION

3.1 PROTECTION

A. In areas where flows are bypassed, all bypass flow shall be discharged to a downstream sanitary sewer manhole following a bypass plan approved by the OWNER and ENGINEER. No bypassing to ground surface receiving waters, canals, storm drains, or bypassing which results in groundwater contamination or potential health hazards shall be permitted in accordance with the General Conditions.

3.2 DAMAGES

A. The CONTRACTOR shall repair, without additional cost to OWNER, any damage that may result from his negligence, inadequate or improper mechanical or electrical failures.

END OF SECTION

SECTION 02150

SHORING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide shoring and bracing for excavations and trenching, complete.

B. Work in this Section:
   1. Provide required shoring and bracing for the excavations and trenching operations to be performed.
   2. Soil stabilizer.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Conform to governing Federal, State, and local Construction Safety Orders; secure and pay for required permits. For off-site installation of shoring and related items, conform to requirements of the public agencies having jurisdiction; obtain and pay for required permits and inspections.

B. Design of Shoring: CONTRACTOR shall retain services of a licensed Civil Engineer in the State of Arizona to design and prepare calculations for shoring methods, bracing or tie back anchoring, wall supporting systems, and other systems to be used for protection of adjacent existing structures and improvements and for earth banks; special consideration and provisions for protection of existing columns, piers, and other items to remain shall be addressed. The CONTRACTOR shall submit the shoring drawings and calculations to the ENGINEER. The CONTRACTOR shall obtain Building Department approval prior to starting construction involving shoring and pay all fees and charges. Building Department approved Drawings and calculations are for record purposes only and not for review or approval.

1.3 JOB CONDITIONS

A. Data: Drawings, boring logs, geotechnical or foundation investigation reports and like information, not included in the Contract Documents but made available to CONTRACTOR by ENGINEER or OWNER, are for information only and the ENGINEER and OWNER assume no responsibility for any conclusions CONTRACTOR may draw from such information. CONTRACTOR shall investigate and determine existing soils and site conditions under which CONTRACTOR will operate in performing the Work.

B. Protection: Provide and maintain protection to retain earth banks and to protect adjoining grades and structures from caving, sliding, erosion, or other damage. Provide suitable protection against bodily injury. Construct bulkheads and shoring to the requirements of State and local codes and regulations. Shore vertical banks or slope banks back as required for stability and safety. Erect temporary barricades placed at least 5 feet away from top of slopes and as required by shoring design, and provide temporary berms as required to prevent slope erosion from water.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Sand: Clean sand from approved source, free from approved source, free from vegetable matter, rock, and other materials deleterious to the intended use.

B. Soil Stabilizer: The CONTRACTOR shall submit to the ENGINEER as information only, written documentation pertaining to the mix and application of sodium silicate grout, or approved equal, injected to stabilize the granular soil cut face to be excavated adjacent to the existing foundations and paving. The grout mix shall meet the manufacturer's recommendations. The purpose of this grouting is to prevent undermining and loss of ground adjacent to and/or under foundations and existing paving.

PART 3 - EXECUTION

3.1 SHORING

A. Conform to the approved shoring drawings and calculations. Maintain 5 foot wide berm at top of slopes. Frequently inspect installed shoring and bracing for deflections during construction.
   1. Tie-Back Anchors: Lag, drill, grout, preload and/or test tie-back anchors or bracing, and furnish required testing equipment as recommended and approved by the ENGINEER. Perform preloading and testing under observation of the ENGINEER.
   2. Removal: Remove shoring, sheeting, or sheet piling, and detention tieback anchors as required, unless otherwise indicated or approved. Fill voids left by removals with compacted sand or pea gravel backfill.

3.2 SOIL STABILIZATION

A. The CONTRACTOR shall take all precautions necessary to prevent any soil and pavement failure before, during, and after the grouting operation. Any additional differential settlement of pavements or foundations, or any differential settlement causing cracks, offsetting joints or reduction in slope in any utilities, shall result in the CONTRACTOR replacing the damaged pavement and utilities to MAG Specifications at the CONTRACTOR'S expense.

B. The sodium silicate grouting must start at a maximum depth equal or greater than the excavation depth. The lateral extent to the grout curtain shall be determined by the CONTRACTOR to maintain the open cut face. Grouting must begin at this depth and, by means of pumping, should continue upward until the surface, or an obstruction, such as a slab or grade beam, is encountered. The grouting shall not be relied on to provide worker safety in trenches according with all OSHA and local agencies. Additional shoring or other measures may be required to provide for this safety.

END OF SECTION

SECTION 02200

EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This Section covers excavating, trenching, backfilling, and grading as indicated on the Project Drawings, together with all incidental Work in connection therewith, including sub-grade preparation and restoration, legally disposing of surplus and waste materials, and final site grading. Areas disturbed by construction shall be graded and excavated or filled in such a manner that completed items will conform to lines, grades, and elevations of surrounding area. Drawings and General Provisions of the Contract, including Division 1 Specifications.

1.2 SUMMARY

A. This Section includes the following:
   1. Preparing and grading sub-grades for slabs-on-grade, walks, pavements, and landscaping.
   2. Excavating and backfilling for the Lift Station structure.
   3. Drainage and moisture control fill course for slabs-on-grade.
   4. Sub-base course for walks and pavements.
   5. Excavating and backfilling trenches within building lines.
   6. Excavating and backfilling for underground mechanical and electrical utilities and appurtenances.
   7. Placing on-site fill material.

1.3 DEFINITIONS

A. Excavation consists of the removal of material encountered to sub-grade elevations and the reuse or disposal of materials removed.

B. Sub-grade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below sub-base, drainage fill, or topsoil materials.

C. Borrow: Soil material obtained off site when sufficient approved soil material is not available from excavations.

D. Sub-base Course: The layer placed between the sub-grade and base course in a paving system or the layer placed between the sub-grade and surface of a pavement or walk.

E. Base Course: The layer placed between the sub-base and surface pavement in a paving system.

F. Capillary Water Barrier: Course of clean sand or washed granular material placed above a water barrier sheet supporting interior concrete slab-on-grade placed to cut off upward capillary flow of pore water.

G. Unauthorized excavation consists of removing materials beyond indicated subgrade elevations or dimensions without direction by the ENGINEER. Unauthorized excavation, as well as remedial work directed by the ENGINEER, shall be at the CONTRACTOR'S expense.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, sanitary sewer manholes, curbs, mechanical, and electrical appurtenances, or other man-made stationary features constructed above or below ground surface.

I. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.

1.4 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specifications.

B. Product Data for the following:
   1. Each type of warning tape.
   2. Fill and backfill soil material.

C. Samples of the following:
   1. 20 lb representative samples of each proposed fill and backfill soil material from on-site or borrow sources.

D. Test Reports: In addition to test reports required under field quality control, submit the following:
   1. Laboratory analysis of each soil material proposed for fill and backfill from on-site and borrow sources.
   2. One optimum moisture-maximum density curve for each soil material.

1.5 QUALITY ASSURANCE

A. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction.

B. Pre-installation Conference: Before commencing earthwork, meet with representatives of the governing authorities, OWNER, ENGINEER, consultants,

Geotechnical Engineer, independent testing agency, and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least three working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.

C. Soils Testing Service: CONTRACTOR shall employ, at his own expense, an independent testing agency, certified in the State of Arizona, to perform all testing services specified herein. Selection of the testing agency is subject to ENGINEER'S approval. Submit a written description of the proposed soils testing agency giving qualifications of personnel, equipment, and other information which may be requested by ENGINEER.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the OWNER or others except when permitted in writing by the ENGINEER and then only after acceptable temporary utility services have been provided.
   1. Provide a minimum 48 hours' notice to the ENGINEER and receive written notice to proceed before interrupting any utility.

B. Soils Report: A geotechnical investigation has been completed for the project and is available for the CONTRACTOR for review. The report was completed by ATEK Engineering Consultants, LLC. The geotechnical borings within the area indicate materials in the project area that consist of clayey sand (CS) with medium plasticity. Soils have a relative firmness of firm and the cementation ranged from light to moderate and increased with depth.CONTRACTOR may perform additional geotechnical investigations as needed to properly determine the trenching activities most relevant for the pipe area. The additional geotechnical investigations shall not incur any additional costs by the OWNER.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide approved borrow soil materials from offsite when sufficient approved soil materials are not available from excavations.

B. Site Soils: Native granular soils with low expansive potentials may be used as fill material in general site grading. Selected granular materials may be used as backfill behind walls which retain earth. All materials shall be free of organics, debris, and rubble.

C. Imported Soils: Additional fill required shall be imported soils meeting the following requirements:
   1. Maximum Particle Size: 3-inches.
   2. Maximum Percent Passing No. 200 Sieve: 50.
   3. Maximum Expansive Index (ASTM D4829): 20
   4. Minimum Resistivity: 2,000 ohm-cm
   5. Maximum Chloride Content: 500 ppm.
   6. Maximum Sulfate Content: 1,000 ppm.

D. Backfill and Fill Materials: Site soils as described above.

E. Sub-base and Base Material: Maricopa Association of Governments (MAG) Specification Section 702 for Select (Sub-base) Type A or B and aggregate base (Base).

F. Engineered Fill: Site soils as described above sub-base or base materials or aggregate base course (ABC) according to MAG Standard Specification Section 702.

G. Pipe Bedding and Backfill Material:
   1. Coarse gravel bedding material per MAG section 701 six-inches below the invert of pipe.
   2. 1-sack CLSM material per MAG section 728 from invert to top of pipe.
   3. ABC material per MAG section 601, 1-foot on top of the pipe minimum.

H. Capillary Water Barrier:
   1. Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, ASTM D448, coarse aggregate Grading Size 57, with 100% passing a 1-1/2-inch sieve and not more than 5% passing a No. 8 sieve.
   2. Clean, washed natural or manufactured, and non-plastic sand.
   3. Either of the above soil materials.

I. Filtering Material: Evenly graded mixture of natural or crushed gravel or crushed stone and natural sand, with 100% passing a 1-1/2-inch sieve and 0% to 5% passing a No. 50 sieve.

J. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6-inches wide and 4 mils thick, continuously inscribed with a description of the utility.
   1. Tape Colors: Provide tape colors to utilities as follows:
      a. Red: Electric.
      b. Yellow: Gas, oil, steam, and dangerous materials.
      c. Orange: Telephone and other communications.
      d. Blue: Water systems.
      e. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect sub-grades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

B. Provide erosion control measures following the most current City of Chandler Standards to prevent erosion or displacement of soils and discharge of soil-bearing water runoff per the National Discharge Elimination System (NPDES) or airborne dust to adjacent properties and walkways.

C. Tree protection as specified on the Drawings.

3.2 DEWATERING

A. Prevent surface water and subsurface or groundwater from entering excavations, from ponding on prepared sub-grades, and from flooding Project site and surrounding area.

B. Protect sub-grades and foundation soils from softening and damage by rain or water accumulation.

3.3 EXCAVATION

A. Explosives: Do not use explosives.

B. Unclassified Excavation: Excavation is unclassified and includes excavation to required sub-grade elevations regardless of the character of materials and obstructions encountered.

C. Classified Excavation: Excavation is classified and includes excavation to required sub-grade elevations. Excavation will be classified as earth excavation or rock excavation as follows:

1. Earth excavation includes excavation of obstructions visible on surface; underground structures, utilities, and other items not indicated that we are required to be demolished and removed; together with soil and other materials encountered that are not classified as rock or unauthorized excavation.
    a. Intermittent drilling, blasting, or ripping to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation.

3.4 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of ±0.10 foot. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, installing services and other construction, and for inspections. Structure excavation, backfilling, and compaction shall be as specified in MAG Section 206.
    1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other Work.
    2. Excavation for Storage Tanks, Basins, and Mechanical or Electrical Appurtenances: Excavate to elevations and dimensions indicated within a tolerance of ±0.10 feet. Do not disturb bottom of excavations intended for bearing surface.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

B. Pavement excavation, backfilling and compaction shall be as specified in MAG Section 205.

3.6 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated slopes, lines, depths, and invert elevations.

B. Trench excavation, backfilling and compaction shall be as specified in MAG Section 601 and per design drawings.

3.7 APPROVAL OF SUBGRADE

A. Notify the ENGINEER when excavations have reached required sub-grade.

B. When the ENGINEER determines that unforeseen unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
   1. Unforeseen additional excavation and replacement material will be paid according to the Contract provisions for changes in Work.

C. Reconstruct sub-grades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the ENGINEER.

3.8 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending indicated bottom elevation of concrete foundation or footing to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position when acceptable to the ENGINEER.
   1. Fill unauthorized excavations under other construction as directed by the ENGINEER.

B. Where indicated widths of utility trenches are exceeded, provide stronger pipe which may require higher strength pipe than specified or different pipe material depending on the limits of unauthorized excavation. Special installation procedures maybe required by the ENGINEER.

3.9 STORAGE OF SOIL MATERIALS

A. Stockpile excavated materials acceptable for backfill and fill soil materials, including acceptable borrow materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 BACKFILL

A. Backfill excavations promptly, but not before completing the following:
   1. Acceptance of construction below finish grade including, where applicable, damp proofing, waterproofing, and perimeter insulation.
   2. Surveying locations of underground utilities for Record Documents.
   3. Testing, inspecting, and approval of underground utilities.
   4. Concrete formwork removal.
   5. Removal of trash and debris from excavation.
   6. Removal of temporary shoring and bracing, and sheeting.
   7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.11 UTILITY TRENCH BACKFILL

A. Place and compact bedding course on rock and other unyielding bearing surfaces and to fill unauthorized excavations. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

B. Concrete backfill trenches that carry below or pass under footings and that are excavated within 18-inches of footings. Place concrete to level of bottom of footings.

C. Provide 4-inch thick concrete base slab support for piping or conduit less than 2 feet 6-inches below surface of roadways. After installation and testing, completely encase piping or conduit in a minimum of 4-inch of concrete before backfilling or placing roadway sub-base.

D. Place and compact initial backfill of satisfactory aggregate base course material, free of particles larger than 1-inch, to a height of 12-inches over the utility pipe or conduit.
   1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

E. Coordinate backfilling with utilities testing.

F. Fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.

G. Place and compact final backfill of satisfactory granular soil material to final sub-grade.

H. Install warning tape directly above utilities, 12-inches below finished grade, except 6-inches below sub-grade under pavements and slabs.

3.12 FILL

A. The following apply to the areas within and extending 5 feet beyond the footprint of the facilities.
   1. Clear and grub the site by removing and disposing of all vegetation, debris, rubble, and remnants of former developments.
   2. Strip the area of all stockpiled fill zones, loose backfill zones, and unstable soils. During stripping observe the surface for evidence of buried debris, vegetation, or disturbed materials that shall require additional removal. If encountered, these materials should be removed. Areas steeper than 5H to

1V shall be benched and any depressions widened to accommodate compaction equipment.

3. Prepare the ground surface in fill areas and in areas cut to grade by scarifying, moisture conditioning and compacting the exposed surface soils to a depth of 8-inches.
4. Moisture condition and place all fill and backfill materials to achieve specified grades. Fill materials shall be moisture conditioned, placed, and compacted in horizontal lifts.

B. Place fill material in layers to required elevations for each location listed below.
1. Under grass, use satisfactory excavated or borrow soil material.
2. Under walks and pavements, use sub-base or base material, or satisfactory excavated or borrow soil material.
3. Under steps and ramps, use sub-base material.
4. Under building slabs, use drainage fill material.
5. Under footings and foundations, use engineered fill.

3.13 MOISTURE CONTROL

A. The moisture content of soil and base materials at the time of compaction shall be within 2% of optimum moisture content.

3.14 COMPACTION

A. Place backfill and fill materials in layers not more than 8-inches in loose depth for material compacted by heavy compaction equipment, and not more than 6-inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill materials evenly on all sides of structures to required elevations. Place backfill and fill uniformly along the full length of each structure.

C. Compact sub-grade, fill, backfill, sub-base fill, or base material to a minimum of 95% compaction of the ASTM D698 maximum dry density in each lift:

3.15 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
1. Provide a smooth transition between existing adjacent grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to conform to required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish sub-grades to required elevations within the following tolerances:
1. Lawn or Unpaved Areas: ±0.10 feet.

2. Walks: ±0.10 feet.
3. Pavements: ±1/2-inch.

C. Grading Inside Building Lines: Finish sub-grade to a tolerance of 1/2-inch when tested with a 10 foot straightedge.

3.16 SUBBASE AND BASE COURSES

A. Under pavements and walks, place sub-base course material on prepared sub-grades. Place base course material over sub-bases to pavements.
   1. See Paragraph 3.16 of this Section.
   2. Shape sub-base and base to required crown elevations and cross-slope grades.
   3. When thickness of compacted sub-base or base course is 6-inches or less, place materials in a single layer.
   4. When thickness of compacted sub-base or base course exceeds 6-inches, place materials in equal layers with no layer more than 6-inches thick or less than 3-inches thick when compacted.

B. Pavement Shoulders: Place shoulders along edges of sub-base and base course to prevent lateral movement. Construct shoulders at least 12-inches wide of acceptable soil materials and compact simultaneously with each sub-base and base layer.

3.17 FIELD QUALITY CONTROL

A. Testing Agency Services: Allow testing agency to inspect and test each sub-grade and each fill or backfill layer. Do not proceed until test results for previously completed Work verify compliance with requirements.
   1. Perform field in-place density tests according to ASTM D1556 (sand cone method), ASTM D2167 (rubber balloon method), or ASTM D2937 (drive cylinder method), as applicable.
      a. Field in-place density tests may also be performed by the nuclear method according to ASTM D2922, provided that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D1556. With each density calibration check, check the calibration curves furnished with the moisture gages according to ASTM D3017.
      b. When field in-place density tests are performed using nuclear methods, make calibration checks of both density and moisture gages at beginning of Work, on each different type of material encountered, and at intervals as directed by the ENGINEER.
   2. Footing Sub-grade: Footing sub-grades to be reviewed and approved by a representative of the Geotechnical Engineer, prior to placement of reinforcing steel.

3. Paved and Building Slab Areas: At sub-grade and at each compacted fill and backfill layer, perform at least one field in-place density test for every 2,000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
4. Foundation Wall Backfill: In each compacted backfill layer, perform at least one field in-place density test for each 100 feet or less of wall length, but no fewer than two tests along a wall face.
5. Trench Backfill: In each compacted initial and final backfill layer, perform at least one field in-place density test for each 150 feet or less of trench, but no fewer than two tests.

B. When testing agency reports that sub-grades, fills, or backfills are below specified density, scarify and moisten, or aerate, or remove and replace soil to the depth required, recompact, and retest until required density is obtained.

C. CONTRACTOR shall employ, at his own expense, an independent testing agency, certified in the State of Arizona, to perform all testing services specified herein.

3.18 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations or weather conditions.
   1. 1. Scarify or remove and replace material to depth directed by the ENGINEER; reshape and recompact at optimum moisture content to the required density.

C. Settling: Where settling occurs during the Project correction period, remove finished surfacing, backfill with additional approved material, compact, and reconstruct surfacing.
   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the OWNER'S property.

END OF SECTION

SECTION 02318

CRUSHED STONE AND GRAVEL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment, and incidentals required to furnish and install crushed stone and gravel of the types specified at locations shown on the Drawings and as directed by the ENGINEER.

1.2 QUALITY ASSURANCE

A. Conform to all applicable requirements of Section 701 of the Uniform Standard Specifications for Public Works Construction by the Maricopa Association of Government (MAG) as supplemented by the City of Chandler. Where there is a conflict between MAG Standard Specifications as supplemented by the City of Chandler and these Specifications, the provisions of these Specifications shall govern.

B. Sampling and sieve analysis shall be performed in accordance with ASTM D75 and ASTM C136.

1.3 SUBMITTALS

A. Submit for approval the following:
   1. Furnish representative samples of the crushed stone and gravel to the ENGINEER and advise of the source location.
   2. Test reports, including sieve analyses, showing material compliance with specified requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:
   1. Furnish and place crushed stone or screened gravel fill under pipe or structures where shown on the Drawings, in addition to that required under other Sections. Comply with requirements of Section 15051, Buried Piping Installation.

2. Crushed stone and gravel shall be clean, hard, sound, durable, uniform in quality, and free of any detrimental quantity of soft, friable, thin elongated, or laminated pieces, disintegrated material, organic matter, oil, alkali, or other deleterious substance.
3. The loss by abrasion in the Los Angeles abrasion machine, determine as prescribed in ASTM C131, Grading A, shall not exceed 10% by weight after 100 revolutions, nor 40% after 500 revolutions.

B. Crushed Stone:
1. Crushed stone shall consist of the product obtained by crushing rock, stone, or gravel so that at least 50% by weight of aggregate retained on the No. 4 sieve for 3/4-inch or larger maximum sizes, and 50% retained on the No. 8 sieve for maximum sizes less than 3/4-inch, shall consist of particles which have at least one rough, angular surface produced by crushing.
2. The gradation of crushed stone shall comply with ASTM D448.

C. Gravel:
1. Material designated herein as gravel shall be composed entirely of particles that are either fully or partially rounded and water-worn.
2. Crushed rock obtained by crushing rock which exceeds ASTM D448 maximum gradation sizes may be combined, provided it is uniformly distributed throughout and blended with the gravel. The quality and gradation requirements shall be as stated in this Specification.

PART 3 - EXECUTION

3.1 PLACING

A. Gravel shall be spread in layers of uniform thickness not exceeding 8-inches and shall be thoroughly compacted with suitable power driven tampers or other power driven equipment. The placing of crushed stone or gravel shall conform to applicable requirements of Section 02200, Earthwork, except as noted above.

END OF SECTION

SECTION 02319

RIPRAP

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals required to furnish and place riprap at locations shown on the Drawings and specified.
   2. Any existing riprap removed shall be replaced by CONTRACTOR at no additional cost to the OWNER.

1.2 QUALITY ASSURANCE

A. Conform to all applicable requirements of Section 703 in the Uniform Standard Specifications for Public Works Construction by the Maricopa Association of Governments (MAG) as supplemented by the City of Chandler. If there is a conflict between the MAG Standard Specifications, as supplemented by the City of Chandler, and these Specifications, the provisions in these Specifications shall govern.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Stone for riprap shall be sound and durable, free from seams and coatings, and of such characteristics that it will not disintegrate when subjected to the action of water.

B. Riprap shall conform to the applicable requirements of ADOT Standard Specification Section 913 - Bank Protection for Dumped Riprap.

C. Riprap shall be 6-inches nominal; no more than 50% shall be smaller than 6-inches and no more than 10% shall be smaller than 3-inches.

D. Stones salvaged from excavation and meeting the above requirements may be used for riprap, if approved by the ENGINEER.

PART 3 - EXECUTION

3.1 PLACING

A. Areas to receive riprap shall be cleared, fine graded, and have an application of pre-emergent weed control per the manufacturer's recommendations.

B. Minimum total thickness of the riprap layer shall be 12-inches, unless otherwise noted.

C. The stones shall be placed so that the weight of the stone is carried by the underlying material and not by the adjacent stones. On slopes, the largest of stones shall be at the bottom. Riprap shall be of proper size to form a compact solid blanket to protect the slopes. Rounded boulders or cobbles shall not be used on slopes steeper than 2:1, unless grouted.

D. Riprap shall be placed so as to conform as closely as practicable in size and character to existing riprap, if applicable.

E. Riprap may be placed in location by equipment; however, care shall be taken in placing to obtain a good gradation of materials so that the riprap will be firm and solid. Surfaces shall be leveled to the required alignment and slopes by hand placing the stone so as to fill large voids and to make the surface even.

F. Where riprap is adjacent to pavement, the elevation of the riprap shall meet the elevation of the pavement.

G. Apply a second application of pre-emergent herbicide in accordance with the manufacturer's recommendations.

H. All herbicide applications shall be done by a certified applicator licensed by the State of Arizona.

END OF SECTION

SECTION 02371

FILTER FABRIC FOR RIPRAP CHANNELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes non-woven engineering fabrics (geo-textile) for riprap channels.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. D 3786 - Test Method for Mullen Burst Strength.
   2. D 1777 - Test Methods for Fabric Dimensions.
   3. D 5261 - Test Methods for Mass per Unit Area (Weight) of Non-Woven Fabric.
   4. D 4491 - Test Methods for Water Permeability of Geo-textiles by Permittivity.
   5. D 4632 - Test Method for Grab Breaking Load and Elongation of Geo-textiles.
   6. D 4833 - Test Method for Puncture Resistance of Geo-textiles.

1.3 DEFINITIONS

A. Filter Fabric for riprap channels: Geo-textile shall be a needle punched, nonwoven fabric composed of 100 percent polyester or polypropylene filaments which are formed into a stable network such that the filaments retain their relative position. The fabric shall be inert to biological degradation and naturally encountered chemicals, alkalizes, and acids.

1.4 PROJECT CONDITIONS

A. Take field measurements to determine the exact lengths and dimension of the surfaces to receive the fabric.

1.5 SUBMITTALS

A. Product data.

B. Provide samples.

C. Quality Control Submittals:
   1. Certificates of Compliance.

2. Manufacturer's instructions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection:
   1. Furnish engineering fabrics in protective covers capable of protecting the fabric from ultraviolet rays, abrasion, and water.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. One of the following or approved equal:
   1. Trevira 011/350, by Hoechst Corporation
   2. Skaps GT-110 by Pendergrass, GA., 1-706-693-3440.

2.2 MATERIAL REQUIREMENTS

A. Physical Properties: Meet the following minimum requirements.

	ASTM	Requirement
Fabric		
Weight	D 5261	10 oz/ yd^2
Thickness	D 1777	125 mils
Apparent Opening Size	D 4751	70 (Stnd Sieve)
Grab Tensile Strength	D 4632	250 lbs
Grab Elongation	D 4632	50%
Mullen Burst Strength	D 3786	510 psi
Puncture Resistance	D 4833	130 lbs
Water Permittivity	D 4491	1.07
Water Flow Rate	D 4491	80 gpm/ft^2

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: During grading operations, take care not to disturb or scarify the sub-grade. This may require use of lightweight dozers for low strength soils such as saturated, cohesionless, or low cohesion soils. Recompact if sub-grade is scarified.

B. Prior to placement of fabric, prepare surface to smooth conditions free of debris, depressions, or obstructions that may damage the fabric.

3.2 INSTALLATION

A. Follow manufacturer's installation instructions and as complimented herein.

B. Place the geo-textile fabric smoothly without folds or wrinkles.

C. Use special care when placing the geo-textile in contact with the soil so that no void spaces occur between the geo-textile and the prepared surface.

D. Overlap the geo-textile sheets according to manufacturer's installation.

E. Provide turndowns along the longitudinal fabric edges to utilize the surrounding soil weight for anchoring the fabric. These turndowns will extend vertically beneath the riprap sub-grade and horizontally away for a distance equal to the riprap blanket thickness at a minimum.

F. Place drainage aggregate on the geo-textile as specified.

3.3 FIELD QUALITY CONTROL

A. Inspection: Before covering, the conditions of the fabric will be observed by the ENGINEER to determine that no holes or rips exist in the fabric. Repair all such occurrences by placing a new layer of fabric extending beyond the defect in all directions a distance equal to the minimum overlap required for adjacent rolls.

END OF SECTION

SECTION 02480

LANDSCAPE

PART 1 - GENERAL

1.1 SUMMARY

A. Landscaping.

B. All Work shall conform to the Maricopa Association of Government's (MAG) Uniform Standard Specifications for Public Works Construction and the City of Chandler supplements thereto, with the following modifications.

C. The extent of landscape development Work is shown on the Project Plans. Wherever a discrepancy exists between the quantities shown on the Plans and those listed in these Specifications, the quantities shown on the Plans shall prevail.

1.2 RELATED SECTIONS

A. Section 02319, Riprap.

B. Section 02810, Irrigation System.

1.3 QUALITY ASSURANCE

A. In accordance with Division 1, General Requirements.

B. Landscape Contractor Qualifications: Single firm with appropriate and current State of Arizona CONTRACTOR'S license as outlined in MAG Section 103 and a minimum of five year's experience in landscape installation and maintenance. If the low bidder does not have the appropriate license, the City reserves the right to reject their bid and award it to the lowest bidder who has the appropriate license.

C. Project Supervisor Qualifications: Individual with minimum of five year's experience in landscape installation and maintenance. On-site during all landscape operations to oversee Work in this Section.

D. Regulatory Requirements: Perform Work in accordance with all applicable codes, ordinances, and regulations required by authorities having jurisdiction over such Work. Provide for all inspections and permits required by Federal, State, and

local authorities in furnishing, transporting, and installing materials as shown or for completing the Work identified herein.

E. Source Quality Control:
   1. Ship landscape materials with Certificates of Inspection required by governmental authorities.
   2. Comply with governmental regulations applicable to landscape materials.

F. Labeling: Securely attach durable, legible labels stating in weather resistant ink the correct manufacturer, supplier, material, plant or product name to all material delivered to the site.

G. Materials shall be of standard, approved, and first grade quality in prime condition when installed. Commercially processed or packaged materials shall be delivered as specified below.

H. Plants:
   1. In accordance with Arizona Department of Agriculture regulations for nursery inspections, ratings and rules.
   2. Clearly labeled with durable, legible labels stating correct botanical name of each plant.
   3. Plants shall show evidence of compliance with the Arizona Native Plant Law.

I. Trees:
   1. Conform to sizes in Arizona Nursery Association Grower's Committee "Recommended Average Tree Specifications".
   2. Measure trees with branches and trunks in their normal position for conformance. Do not prune to obtain required sizes. Measure main body of tree for height and spread dimensions. Do not measure from branch or root tip-to-tip.

J. Samples and Tests:
   1. The ENGINEER reserves the right to analyze samples of materials for conformity to the Specifications at any time. CONTRACTOR shall furnish samples upon request by the ENGINEER. Rejected materials shall be immediately removed from the site at the CONTRACTOR'S expense. Cost of testing of materials not meeting Specifications shall be paid by the CONTRACTOR.

1.4 REFERENCE STANDARDS

A. AAN - ASNS, American Association of Nurserymen, Inc., American Standard for Nursery Stock; 1986 edition.

B. ADWR - AMA, Arizona Department of Water Resources, Active Management Area Approved Plant List; latest edition.

C. AJCHN - SPN, American Joint Committee on Horticultural Nomenclature, Standardized Plant Names; 2nd edition, 1942.

D. ANA, Arizona Nursery Association Grower's Committee, Recommended Average Tree Specifications; latest edition.

E. ASTM, American Society for Testing and Materials.

F. MAG, Maricopa Association of Governments Uniform Standard Specifications for Public Works Construction; latest edition.

1.5 SUBMITTALS

A. In accordance with Division 1, General Requirements.

B. Submittal Procedures:
   1. Forward all submittals to the ENGINEER in single package within 30 days of award of Contract.
   2. Forward each submittal with Letter of Transmittal identifying name of CONTRACTOR, name of Project, items being transmitted, and action required.

C. Submittals Required:
   1. Qualifications of Landscape Contractor.
   2. Qualifications of Project Supervisor.
   3. Names and qualifications of subcontractors, if applicable.
   4. Names and addresses of suppliers.
   5. Construction Schedule: Submit anticipated construction schedule at start of Project.
   6. Decomposed Granite: Two 5 lb bags containing representative sample of granite showing color, size range, and texture.
   7. Granite Riprap: Two 10 lb bags containing representative sample of granite showing color, size range, and texture.
   8. Schedule of pre-emergent herbicide application dates.
   9. Soil test results and recommendations.
   10. Testing and Inspection Service: OWNER will employ and pay for a qualified independent geotechnical testing and inspection laboratory to perform soil testing and inspection service during earthwork operations.
   11. Material specifications for soil amendments, conditioners, fertilizers, and mulches.

12. Maintenance Manuals: Complete type written instructions to OWNER for proper care, feeding, and maintenance of landscape.
13. As-Built Drawings: In accordance with Division 1, General Requirements.

D. Each Shop Drawing Submittal shall include a hard copy of the relevant Specification Section and shall be clearly marked to indicate whether the requirements for equipment and/or services in the Specification Section are met by writing "accept" or "deviate" next to each Paragraph. If clarifications are needed to any of the Paragraphs in the Specification Sections due to deviations, they shall be addressed next to the Paragraph as such and explained further with any additional information necessary. If any exceptions and/or deviations are proposed to any of the Specifications, they shall be clearly noted as such in the Submittal, and an explanation of any deviation and/or exception shall be provided. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

1.6 DELIVERY, STORAGE, AND HANDLING

A. General: The CONTRACTOR shall hold harmless the City of Chandler from potential claims arising from the use of City lands, acts of vandalism, or delays resulting from theft or unauthorized removal of materials or equipment from the storage yard if an on-site storage yard is allowed by the ENGINEER.

B. Delivery:
1. Regulatory Requirements: Comply with all Federal, State, and local regulations governing the transporting, storing, and handling of landscape materials, including application of herbicides, insecticides, and pesticides.
2. Packaged Material: Deliver to site in original, unopened containers labeled to show name of manufacturer or supplier, guaranteed analysis, weight, and conformance to governing regulations.
3. Plants:
   a. Do not deliver plants until site conditions are ready for planting.
   b. Do not deliver more plants than can be planted within three days.
   c. Do not prune plants prior to delivery unless approved by ENGINEER.
   d. Prepare plants for shipping and load in a manner that will not cause damage to bark, branches, foliage, plant structure, or root ball.
   e. Secure plants and provide protective covering during delivery.

C. Storage:
1. Packaged Material: Store and cover materials to prevent deterioration.

D. Plants:
   1. If planting is delayed more than six hours after delivery, set plants in shade. Protect from weather and damage.
   2. Set bare root plants in temporary planting bed and cover roots with soil.
   3. Keep roots moist until planting.

E. Handling:
   1. Handle container stock only by container.
   2. Do not remove container stock from container until planting time.
   3. Handle plants so that the root ball will not be broken or loosened.

F. Rejected Materials: Immediately remove rejected materials from the site and replace with new materials at no additional cost to OWNER.

1.7 SITE CONDITIONS

A. Examination of the Site: Review Project Plans and visit site prior to bidding. No allowances will be made after the bid for existing conditions or CONTRACTOR'S failure to verify existing conditions.

B. Coordination: Coordinate landscaping operations with other trades so that conflicts will neither exist nor delay the Work in any manner.

C. Underground Utilities: Locate and protect underground utilities in landscape areas by calling Blue Stakes. Hand excavate as required. Repair damage resulting from landscaping operations at no cost to OWNER.

D. Subgrade: CONTRACTOR will receive the site "as is" and will be responsible for the establishment of subgrades as necessary to meet the finish grades as shown on the Project Plans and details. CONTRACTOR may excavate on-site material or supply and place topsoil as necessary to establish subgrade elevations.

E. Obstructions: If rock, underground construction, or other obstructions are encountered during excavation for planting, notify the ENGINEER. New locations may be determined by the ENGINEER or instructions issued to direct removal of obstruction to a depth of not less than 6-inches below required planting depth. Proceed with Work only after approval of ENGINEER.

F. Existing Plants: All existing plants not affected by site grading or other site construction shall be protected in place. Confirm limits of Work before starting Work.

G. Existing Irrigation: Existing irrigation system shall remain in place and be kept fully operative throughout construction. New plantings near the chlorine contact basin and new entry drive will be added to the existing irrigation system.

H. Discrepancies in these conditions shall be reported to the ENGINEER and corrected prior to the start of landscaping operations.

I. Unless otherwise approved, planting is permitted during any period except those prohibited by unfavorable weather.

1.8 SEQUENCING AND SCHEDULING

A. Sequencing: Review Work described in other Sections and coordinate landscape work with other trades.

B. Scheduling: Submit Project schedule within 30 days of award of Contract and update with each Application for Payment.

1.9 ALTERNATES AND SUBSTITUTIONS

A. Alternates:
   1. In accordance with Division 1, General Requirements.

B. Substitutions:
   1. Do not make substitutions. If specified material is not available in the local market, submit proof of non-availability from three nurseries, together with request for substitution and any corresponding adjustment in Contract price in writing to ENGINEER.
   2. Substitutions will be approved by the ENGINEER on the condition that they meet the design intent of the material originally specified.
   3. Substitutions must be approved in writing by the ENGINEER prior to installation.

1.10 WARRANTY

A. All plants shall be in a healthy and thriving condition after the 90 day maintenance period for one year from date of Final Acceptance.

B. Immediately replace rejected material at no additional cost to OWNER.

C. Warranty replacement plants the same as original plants.

D. Visit site at least once every four weeks during warranty period and notify OWNER in writing of any advised changes.

E. Notify ENGINEER one week prior to end of warranty period to request final landscaping inspection. ENGINEER will conduct inspection and give CONTRACTOR notice of Work that is unacceptable and requiring correction. The CONTRACTOR shall immediately make such corrections.

PART 2 - PRODUCTS

2.1 MATERIALS

A. In accordance with Section 01640, Materials and Equipment, requirements.

B. Plants: Plants shall be in accordance with Arizona Department of Agriculture regulations for nursery inspections, ratings, and rules. All plants shall have a normal habit of growth and shall be sound, healthy, vigorous, and free of diseases, insect infestations, sun scalds, bark abrasions, or other objectionable disfigurements. The ENGINEER shall be the sole judge as to acceptability.

1. Plants Required: The species, sizes, and approximate quantity required are shown on the Plant List. Plant quantities on list are indicated for convenience. Furnish all plants necessary to complete plantings as shown on the Landscape Plan. Surplus or shortages on the Plant List shall not be used for additional claims against the OWNER.
2. Plant Sizes: The size of all plants shall correspond to that normally expected for the species and variety specified or as otherwise specified on the Plans.
3. Trees: Shall be dug and boxed at least 90 days prior to planting.
   a. Trees shall have a straight trunk through their entire height and any tree with a thin weak trunk not capable of supporting itself when planted will not be accepted.
4. Container Grown Plants: Shall have been grown in boxes, cans, pots, or tubs for a minimum of three months and a maximum of one year in similar climatic conditions and shall have sufficient roots to hold earth together intact when removed from container. In no case shall they be root bound. Containers shall be free from noxious weeds, including Bermuda grass and nut grass. The ENGINEER may remove any questionable plants from the container to inspect the root ball. The CONTRACTOR will receive no payment for plants selected for inspection; such plants being considered samples submitted for the ENGINEER'S inspection and approval.
5. Defective Materials: Any plants not conforming to the requirements specified herein shall be considered defective and shall be marked as rejected, immediately removed from the site, and replaced with new plants at the expense of the CONTRACTOR. Under no conditions will there be any substitutions of plants or sizes listed on the Plans except with the express approval of the ENGINEER.

C. Soil Amendments:
   1. Soil Sulfur: Agricultural grade sulfur containing a minimum of 95% elemental sulfur.

D. Fertilizer:
   1. Shall be Agriform 7 gram 20-10-05 fertilizer tablets or equal, installed per details.

E. Topsoil: Screened, fertile, friable soil from well drained arable land, free of heavy clay, noxious weeks, nut grass, refuse, roots or any material detrimental to plant growth. Content: clay 15% - 20%, sand 30% - 60%, silt 20% - 45% with a minimum of 5% organic matter, (natural or added). Ph no lower than 5.5 and no higher than 8.0 soluble salts shall not exceed 1,500 ppm. Plasticity index range of 3 to 10 inclusive.
   1. Imported Topsoil: Shall meet or be amended to meet topsoil requirements as described above. For each source of topsoil, a standard soils test shall be performed to determine the quantity and types of soil amendments required to meet local growing conditions for the type and variety of plants specified.
   2. Gradation shall be as follows:

Sieve Size	Percent Passing
1-	100
1/2-inch	95 - 100
No. 4	90 - 100
No. 10	70 - 100
No. 200	15 - 70
No. 500	20 - 35

F. Planting Soil:
   1. The backfill soil mixture for trees, shrubs, and cacti shall be native site soil.
   2. Other soil amendments shall be added to the backfill as determined by the soils analysis.
   3. Defective Materials: Any plants not conforming to the requirements specified herein shall be considered defective and shall be marked as rejected, immediately removed from the site, and replaced with new plants at the expense of the CONTRACTOR. Under no conditions will there be any substitutions of plants or sized listed on the Plans, except with the express approval of the ENGINEER.

G. Guying, Staking Ties, and Tree Protection Materials:
   1. Tree Stakes: Sound and knot free Lodgepole Pine or Redwood, uniformly sized 2-inches by 2-inches by 96-inches with pointed driving end, capable of at least two years in ground burial. Quantity to securely support trees as required; two minimum.

C. Plastic Pipe and Fittings:
   1. Keep pipe clean and free from debris. Sawcut pipe using square-in-saw vice to ensure a square cut. Remove burrs and shavings from cut ends.
   2. Keep ends of assembled pipe capped. Remove caps when necessary to continue assembly.
   3. Install detectable tape above mainline pipe.
   4. Use only strap type friction wrenches for threaded plastic pipe.
   5. Use primer and solvent cement. Join pipe in manner recommended by manufacturer and accepted industry standards.
   6. Cure for 30 minutes before handling and 24 hours before allowing water in pipe.
   7. Snake pipe from side to side in trench.
   8. Cross type fittings are not permitted.

D. Remote Control Valves:
   1. Flush mainline pipe before installing valve assembly.
   2. Locate valves per plan. Use wire connectors and waterproof sealant to connect control wires to valve wires. Install connectors and sealant according to manufacturer's recommendations.
   3. Install one valve per valve box. Locate at least 12-inches from and align with existing walls and edges of paved areas. Group valve assemblies together where practical.

E. Filter/Regulator:
   1. Install as detailed and as shown on Plan.

F. Drip Emitter Assemblies:
   1. Install as detailed and as shown on Plan.
   2. Flush lateral pipe before installing emitter assembly.
   3. Cut emitter outlet distribution tubing square.
   4. Use techniques and tools recommended by the manufacturer.

G. Flushing End Caps:
   1. Install at end of each drip lateral.

H. Control System:
   1. Controller Unit:
      a. Location of controller shown on plans is approximate. Coordinate final location with ENGINEER
      b. Attach wire markers to ends of control wires, inside controller unit housing. Label wires with identification number of corresponding valve.
      c. Connect control wires to corresponding controller terminal.
   2. Control Wire:

a. Bundle control wires with pipe wrapping tape at 10 feet intervals where two or more are in the same trench.
b. Provide 24-inches excess length of wire in 8-inch diameter loop at each 90 degrees change of directions, at both ends of sleeving, and at 100 foot intervals along continuous runs of wiring. Do not tie looped wiring. Coil 24-inch length of wire within each remote control valve box.
c. Install control wire as recommended by manufacturer. Multiple valves on single control wire are not permitted.
d. If control wire must be spliced, make splice with wire connectors and waterproof sealant in accordance with manufacturer's recommendations. Locate splice in valve box containing an irrigation valve assembly or in separate 6-inch round valve box.
e. Install wire parallel with PVC mainline pipe.
f. Protect wire not installed with PVC mainline pipe with continuous run of warning tape placed 6-inches above wiring.

3.4 FIELD QUALITY CONTROL

A. Construction Observations: ENGINEER will periodically visit the site and report on construction progress.

B. Notices: Give the ENGINEER the following advanced notices:
   1. Product Delivery Schedule: 48 hours.
   2. For Inspection of System Layout: 48 hours.
   3. For Inspection to Establish Substantial Completion / Start of Maintenance Period: 48 hours.
   4. For Final Acceptance: 48 hours.
   5. Upon City's Acceptance of Maintenance Responsibilities: Two weeks.
   6. Upon Expiration of Warranty Period: One week.

C. Correct items listed in ENGINEER'S report.

3.5 AS-BUILT DRAWINGS

A. Maintain on-site and separate from documents used for construction one complete set of Contract Documents as As-Built Drawings.

B. Record pipe and wiring network alterations. Record Work which is installed differently than shown on the Project Plans. Record accurate reference dimensions, measured from at least two permanent reference points, of each irrigation system backflow prevention unit, controller, valve, sleeve end, pipe, stub out, wire connections or other components.

g. Prefinished louvers, except those in doors, unless otherwise noted and acoustical ceiling panels.

4. Operating parts include moving parts of operating equipment and the following:
   a. Valve and damper operators or handles.
   b. Linkages.
   c. Sensing devices.
   d. Motor and fan shafts.
5. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), fire rating labels, equipment serial number and capacity labels, or other code-required labels or equipment name, identification, performance rating, nomenclature plates, and equipment identification plates.

1.5 DEFINITIONS

A. General: Standard coating terms defined in ASTM D16 apply to this Section.
   1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85 degree meter.
   2. Eggshell refers to low-sheen finish with a gloss range between 5 and 20 when measured at a 60-degree meter.
   3. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60 degree meter.
   4. Semi-gloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60 degree meter.
   5. Full gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60 degree meter.
   6. Buried refers to covered with earth.
   7. Exposed or exposed surfaces refers to areas visible when permanent or built-in fixtures, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
   8. Submerged refers to materials which are permanently or intermittently below the maximum water or liquid surface elevation in open top structures, unless otherwise noted or otherwise shown; materials within liquid or residual solids carrying structures that are covered, including materials on the underside of the covers, whether in contact with liquids or not, unless otherwise noted or otherwise shown; materials within an enclosed process structure, whether in contact with liquids or not.

1.6 SUBMITTALS

A. See Section 01300, Submittals, for submittal procedures.

B. Product Data: For each paint system specified. Include block fillers and primers.
   1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system,

and application. Identify each material by manufacturer's catalog number and general classification.

2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
   a. Identify manufacturer's recommended, published spreading rate, and dry film thickness of each coating material proposed for use.
   b. Indicate manufacturer's instructions on surface and special surface preparation procedures.
   c. Include the following: Mixing instructions, shelf life, method of application, recommended number of coats, drying time of each coat including prime coat, required prime coat, compatible and non-compatible prime coats, and recommended thinners when required.

C. Pipe Identification Markers: Submit product data and marker sample for each type of pipe identification required.

D. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

E. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated. Submit two paper chip samples, 3-inch by 3-inch in size.

F. Before supplying any material to the site, the painting subcontractor and the paint manufacturer's area representative shall prepare a complete schedule showing the materials proposed to be used for each treatment specified, and submit same to ARCHITECT and ENGINEER for review/approval.

G. Paint colors will be specified by the ARCHITECT for the architectural paint system specified herein, who, before any Work is done, will furnish color chips and schedule showing where the various colors shall go.

H. Qualification Data: For firms and persons specified in Paragraph 1.9 to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Engineers or Architects and Owners, and other information specified.

I. Manufacturer's Certification: Submit in accordance with Paragraph 3.8 at the completion of the Work.

1.7 REGULATORY REQUIREMENTS

A. Conform to applicable code for flame and smoke rating and VOC requirements for products and finishes.

B. Lead, heavy metals, cadmium, and chromate content of painting materials shall not exceed amount permitted by Federal, State, and local authorities.

C. Coatings for surfaces in contact with potable water or water being treated for potable use shall not impart any taste or odor to the water or result in any organic or inorganic content in excess of the maximum contaminant level established by applicable laws or regulations.

D. Comply with governing code requirements for air quality and material disposal regulations.

1.9 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.

C. Products shall be of best grade or first line.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
   1. Product name or title of material.
   2. Product description (generic classification or binder type).
   3. Manufacturer's stock number, lot number, brand code, and date of manufacture.
   4. Contents by volume for pigment and vehicle constituents.
   5. Thinning instructions.
   6. Application instructions.
   7. Coverage and surface preparation.
   8. Drying time.
   9. Cleanup requirements.
   10. Instructions for mixing and reducing.
   11. Color name and number.
   12. Material Safety Data Sheets.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45° F (7° C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.
   1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work

areas are protected from fire and health hazards resulting from handling, mixing, and application.

2. Provide fire extinguishers and post caution signs warning against smoking and open flame when working with flammable materials.

C. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing, or replacing and repainting, as approved by the ENGINEER. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

1.11 PROJECT CONDITIONS

A. Apply water-based paints only when the temperature of surface to be painted is between 50° F and 120° F (10° C and 48.9° C).

B. Apply solvent-thinned paints only when the temperature of surface to be painted is between 45° F and 120° F (7.2° C and 48.9° C).

C. Provide lighting level of 80 foot candles measured mid-height at substrate surface.

D. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85%; or at temperatures less than 5° F (3° C) above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.12 UNUSED MATERIALS

A. Furnish unused materials in unopened or opened and resealed containers for storage and identify with labels describing contents. Deliver materials to the OWNER.

1.13 EXTRA MATERIALS

A. Supply one gallon of each color; store where directed.

B. Label each container with color in addition to the manufacturer's label.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in the paint schedules.

B. Manufacturers Names: The following manufacturers are referred to in the paint schedules by use of shortened versions of their names, which are shown in parentheses:
   1. Sherwin Williams.
   2. PPG Industries, Inc. (PPG).
   3. Tnemec Co. (Tnemec).
   4. Frazee Paint.
   5. Carboline.
   6. Devoe.

2.2 PAINT MATERIALS, GENERAL

A. Paint exposed surfaces, except as indicated in Paragraph 1.4 and/or in Drawings/Specifications. If an item or surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials of surfaces whether or not the schedule indicates color(s). If the schedule does not indicate color(s) or finish(es), the ENGINEER will select from standard colors and finishes available.

B. Equipment supplied with a finished coat by the manufacturers shall be touched-up by the CONTRACTOR.

C. Paints and Coatings: Ready mixed, except field-catalyzed coatings. Prepare pigments:
   1. To a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.
   2. For good flow and brushing properties.
   3. Capable of drying or curing free of streaks or sags.

D. Metals encased in concrete shall only receive a primer compatible with the covering material.

E. Material Compatibility: Provide block fillers, primers, undercoats, and finish coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

F. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
   1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other

manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

H. Color Coding: Unless otherwise specified, all color coding of piping, ducts, and equipment shall comply with applicable standards of the following:

1. ANSI A13.1.
2. OSHA 1910.144.

I. At completion of construction activities of other trades, touch-up and restore damaged or defaced painted surfaces.

J. Architectural Color Schedule: Colors indicated are by Tnemec Company, Inc.: www.tnemec.com.
1. Shading Devices: Match existing colors at existing Administration Building located on site.
2. Exterior Hollow Metal Doors and Frames: Match existing colors at existing Administration Building located on site.

K. Colors:
1. Desert Sand (04BR) – Discharge piping.

2.3 PAINT SYSTEMS - INTERIOR AND EXTERIOR

A. Field Primed Steel and Ferrous Metal:
1. Exterior Exposure:
   a. Surface Preparation: SSPC SP6 Commercial Abrasive Blast Cleaning.
   b. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II; one coat; 4-6 mils DFT (dry film thickness).
   c. Finish Coat: Series 1075 Endura-Shield II; one coat; 3-4 mils DFT.
2. Interior Exposure:
   a. Surface Preparation: SSPC SP6 Commercial Abrasive Blast Cleaning.
   b. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II; one coat; 3-5 mils DFT.
   c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.
3. Immersion or Partial Immersion Exposure:
   a. Surface Preparation: SSPC SP10 Near-White Metal Abrasive Blast Cleaning.
   b. Prime Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.
   c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.

B. Shop and Factory Primed Steel:
1. Exterior Exposure:
   a. Field Prime Coat (over factory prime coat): Series 135 (beige) Chembuild; one coat; 3-4 mils DFT.
   b. Finish Coat: Series 1075 Endura-Shield II; one coat; 3-4 mils DFT.

2. Interior Exposure:
   a. Field Prime Coat (over factory prime coat): Series 135 (beige) Chembuild; one coat; 3-4 mils DFT.
   b. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.
3. Immersion or Partial Immersion Exposure:
   a. Surface Preparation: Brush off abrasive blast cleaning if required for recoat of the shop primer. Coating surface to be clean, dry, and free of contaminants prior to application of the field coats.
   b. Prime Coat: Series 69 H.B. Epoxoline II; one coat; 2.5-3 mils DFT.
   c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.

C. Galvanized Steel and Non-Ferrous Metals:
1. Exterior Exposure:
   a. Surface Preparation: Brush-off abrasive blast cleaning.
   b. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II; one coat; 3-4 mils DFT.
   c. Finish Coat: Series 1075 Endure-Shield II; one coat; 3-4 mils DFT.
2. Interior Exposure:
   a. Surface Preparation: Clean, dry and free of contaminants.
   b. Prime Coat: Series 135 (beige) Chembuild; one coat; 3-4 mils.
   c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.
3. Immersion or Partial Immersion Exposure:
   a. Surface Preparation: Brush-off abrasive blast cleaning.
   b. Prime Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.
   c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.

D. Ductile and Cast Iron:
1. Exterior Exposure:
   a. 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 DFT.
   b. Prime Coat: Series 69-1255 (beige) H.B. Epoxoline II; one coat; 3-5 mils DFT.
   c. Finish Coat: Series 1075 Endura-Shield II; one coat; 3-4 mils DFT.
2. Interior Exposure:
   a. Surface Preparation: Clean, dry, and free of contaminants.
   b. Prime Coat: Series 135 Chembuild; one coat; 4-6 mils DFT.
   c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 4-6 mils DFT.
3. Buried:
   a. Refer to Section 15051, Buried Piping, for polyethylene encasement.
4. Immersion:
   a. 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.
   b. Prime Coat: Series 69 H.B. Epoxoline II; one coat; 5-7 mils DFT.
   c. Finish Coat: Series 69 H.B. Epoxoline II; one coat; 5-7 mils DFT.

F. PVC/CPVC:
   1. Exterior Exposure:
      a. Surface Preparation: In accordance with a SSPC-SP2 hand tool cleaning (sand), followed by a SSPC-SP1 solvent cleaning. The surface shall be clean, dry and free of all contaminants.
      b. Prime Coat: Series 69 H.B. Epoxoline II; one coat; 3-5 mils DFT.
      c. Finish Coat: Series 1075 Endure-Shield II; one coat; 3-4 mils DFT.
   2. Interior Exposure:
      a. Surface Preparation: In accordance with a SSPC-SP2 hand tool cleaning (sand), followed by a SSPC-SP1 solvent cleaning. The surface shall be clean, dry and free of all contaminants.
      b. Finish Coat: Series 69 H.B. Epoxoline II; two coats; 3-5 mils DFT per coat.

2.5 PIPE IDENTIFICATION MARKERS

A. Manufacturers: Provide products by one of the following:
   1. Seton Name Plate Company.
   2. W.H. Brady Company.
   3. Or equal.

B. General: The size of lettering and marker shall conform to ANSI A13.1.

C. Provide brass tags for pipes under 3/4-inch outside diameter. Provide plastic pipe markers for pipes over 3/4-inch.

D. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
   1. Markers for piping up to 6-inch diameter shall be preformed to completely wrap around the pipe requiring no adhesive. Markers for pipes over 6-inch diameter shall be preformed to the contour of the pipe and attached with stainless steel spring fasteners.

E. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2-inch diameter with smooth edges.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect substrates, areas, and conditions, with the applicator present, under which painting will be performed for compliance with paint application requirements.

Verify that surfaces are ready to receive work as instructed by the product manufacturer.

1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
2. Start of painting will be construed as the applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify the ENGINEER about anticipated problems using the materials specified over substrates primed by others.

3.2 PREPARATION

A. Perform all preparation and cleaning procedures as specified herein and in strict accordance with the paint manufacturer's instructions for each particular substrate and atmospheric condition.

B. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease with clean cloths and cleaning solvents prior to mechanical cleaning. Program the cleaning and painting so that dust and other contaminants from the cleaning process will not fall in wet, newly painted surfaces.

C. Furnish sufficient drop cloths, shields, and protective equipment to prevent spray or droppings from fouling surfaces not being painted and, in particular, surfaces within storage and preparation area.

D. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

E. Surfaces: Correct defects and clean surfaces which affect Work of this Section. Remove or repair existing coatings that exhibit surface defects.

F. Marks: Seal marks which may bleed through surface finishes with barrier coat compatible with paint.

G. Impervious Surfaces: Remove mildew in accordance with paint manufacturer's recommendations.

H. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.
   1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

I. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
   1. Provide barrier coats over incompatible primers or remove and re-prime.
   4. Zinc Coated Surfaces: Remove surface contamination and oils and prepare for priming in accordance with metal manufacturer's recommendations.
   5. Plaster Surfaces to Be Painted: Allow new plaster surfaces to cure 28 days. Remove grease, dirt, loose mortar, scale or alkali powder, high alkali surfaces, and other foreign matter in accordance with paint manufacturer's recommendation. Fill hairline cracks, small holes, and imperfections with patching plaster that is compatible with paint. Make smooth and flush with adjacent surfaces. Do not use wire brushes for preparation or cleaning.
   6. Aluminum: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing.
   7. Copper: Remove surface contamination by steam or high pressure water.
   8. Ferrous Metals: Clean and remove oil, grease, dirt, loose mill scale, and other foreign substances from non-galvanized ferrous metal surfaces that have not been shop coated as outlined in Paragraph 2.3. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.
      a. Blast steel surfaces clean, as recommended by paint system manufacturer.
      b. Touch-up bare areas and shop applied prime coats that have been damaged. Wire brush, clean with solvents recommended by paint manufacturer, and touch-up with the same primer as the shop coat.
      c. For shop-primed ferrous metal surfaces, clean and prepare in accordance with manufacturer's recommendations. Feather edges to make touch-up patches inconspicuous. Prime bare steel surfaces. Provide barrier coat over entire shop primed items.
   9. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
   10. Ductile Iron Pipe: All new ductile iron pipe (DIP) intended for immersion service shall be prepared per coating manufacturer's specifications and as specified herein.
      a. Remove grease, rust scale, rust and touch-up any chipped or abraded areas on items that have been shop coated. Items intended for immersion service that have not been shop coated shall be sandblasted to "Near White Blast Cleaning" condition per SSPC SP-10 prior to receiving coating.

b. All new DIP intended for non-immersion service shall be sandblasted to "Commercial Blast Cleaning" condition per SSPC SP-6 prior to receiving coating.

J. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
   1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
   2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
   3. Use only thinners approved by paint manufacturer and only within recommended limits.

K. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
   1. Any spot measurement found below the required minimum dry film thickness shall be repainted by the CONTRACTOR in accordance with the manufacturer's instructions, at no additional cost to the OWNER.
   2. Do not apply finishes on surfaces that are not sufficiently dry. Allow each coat of finish to dry before following coat is applied, unless directed otherwise by the manufacturer.
   3. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
   4. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
   5. Install piping identification markers after painting has been completed according to the color coding schedule indicated.
   6. Paint colors, surface treatments, and finishes are indicated in the schedules located at the end of this Section.
   7. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
   8. Provide finish coats that are compatible with primers used.
   9. Finish edges, tops and bottoms of all doors the same as door faces. Both sides and all edges of doors to be finished simultaneously.
   10. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.

11. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of movable equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
12. Paint interior surfaces of ducts with a flat, non-specular black paint where visible through registers or grilles.
13. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
14. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
15. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pre-treated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
   1. The number of coats required is the same regardless of application method. Do not apply succeeding coats until the previous coat has cured, as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
      a. Apply each coat in film thicknesses as recommended by the manufacturer.
   2. Unless recommended by the manufacturer, omit primer on factory finished metal surfaces indicated to be field painted or metal surfaces that have been shop primed and touch-up painted.
   3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
   4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
   1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
   2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool, as recommended by the manufacturer for the material and texture required.
   3. Spray Equipment: Use airless spray equipment with orifice size and pressure, as recommended by the manufacturer for the material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of each coat and of the entire system as recommended by the manufacturer.

3.4 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

A. Electrical and mechanical items to be painted include the following, whether factory prefinished or not, with color selected by the ENGINEER:
   1. Exterior mechanical and electrical equipment and accessories including, but not limited to, the following:
      a. Electrical and instrument panels, motor control centers, and switch gear.
      b. Electrical conduit and accessories.
      c. Transformers.
      d. Brackets.
      e. Meter enclosures.
      f. Conduit.
      g. Components that are visible or exposed to the weather.
      h. Exhaust fans and blowers.

B. Paint interior factory finished mechanical and electrical components selected by the ENGINEER from the manufacturer's standards, including, but not limited to, the following:
   1. Piping (per color code and schedule), pipe hangers, and supports.
   2. Duct work.
   3. Duct throats behind grilles, registers, louvers, baffles, etc., shall be given one coat of flat acrylic latex (copolymer) black paint wherever visibility of the interior of the duct is allowed.
   4. Switchboards.
   5. Disconnect switches.
   6. Pumps, motors, and mechanical equipment.
   7. Gear reducers.
   8. Accessory items.
   9. Conduit and fittings (per color code and schedule).
   10. Switchgear.
   11. Panelboards.

C. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

D. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage.

Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

E. Transparent (Clear) Finishes: Use multiple coats to produce a glass smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.

F. Provide satin finish for final coats.

G. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.

H. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

J. Paint both sides and edges of plywood backboards for electrical equipment before installing backboards and mounting equipment on them.

K. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.5 FINISHING PROCESS EQUIPMENT AND FACILITIES

A. The following process equipment and facilities shall be painted according to this Specification, including, but not limited to, the following:
   1. OWRF/AWRF Lift Station: New submersible pumps, disconnects, pedestals/stands, guide rails, all above ground, buried, and immersion piping and fittings, all valves, flow meters, canopy, bollards, etc.
   2. Carbon Source Storage Facility: New metering pumps, disconnects, pedestals/stands, guide rails, all above ground, buried, and immersion piping and fittings, all valves, canopy, bollards, etc.
   3. Yard: Sign posts, bollards, paint all new above ground, buried, immersion pipe, fittings, and all above ground and buried valves.
   4. General: Paint all electrical buildings inside and out, light poles, switchgear, transformers, control panels, motor control centers, VFDs, electrical panels, electrical ducts, etc.
   5. Special Process Coatings:
      OWRF/AWRF Lift Station, Diversion Structure shall receive special coating as shown in the Plans and specified in Section 09910.

3.6 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
   1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.7 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing, or replacing and repainting, as approved by ENGINEER.

B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
   1. At completion of construction activities of other trades, touch-up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.8 FIELD QUALITY CONTROL

A. CONTRACTOR shall provide a written report from the manufacturer certifying that paint has been applied in accordance with the manufacturer's requirements

B. Provide ENGINEER with suitable testing materials in order for ENGINEER to carry out alkalinity and moisture tests prior to preparation and application.

C. Provide ENGINEER with the following testing equipment, accurately calibrated, for use by the ENGINEER prior to surface preparation and application.
   1. Tinker and Rasor Model AP/W, or equal, holiday detector, complete with necessary accessories.
   2. Microtest, Elcometer, or equal, magnetic dry film thickness gauge, type II.
   3. Wet mil paint gauge for use during application.

D. The ENGINEER reserves the right to test surfaces, film thicknesses, and paint products at any time and as often as the ENGINEER deems necessary during the period when paint is being applied.
   1. Any spot measurement found below the required minimum dry film thickness shall be repainted by the CONTRACTOR in accordance with the manufacturer's instructions, at no additional cost to the OWNER.
   2. Do not paint unsatisfactory surfaces until they have been corrected and are in accordance with paint manufacturer's recommendations.

3.9 PIPE COLOR CODING AND IDENTIFICATION SCHEDULE

A. Install plastic pipe markers in accordance with manufacturer's instructions.

B. Install tags with corrosion resistance chain.
C. Locate identification markers and tags at the following locations:
   1. At each branch and riser takeoff.
      a. At each pipe passage through a wall, floor, or ceiling.
      b. On each horizontal and vertical pipe run at 25 foot intervals.

D. Exposed, non-submerged, interior piping shall be color coded and provided with identification markers as follows, unless directed otherwise by the ENGINEER:

Exposed Pipe Labels	Background Colors	Color of Letters
Water - Potable	Light Blue	Black
Wastewater: Sanitary Wastewater	Dark Grey	White
Exposed Electrical Conduits: 120 V / 480 V / 4,160 V (no label)	Match Background Color	None
Piping: Odor Control Piping	Light Yellow	None

E. Exposed piping, as defined earlier in this Specification, shall be color coded as listed above, except submerged pipes and pipes less than 3/8-inch diameter shall be painted the same as the wall or piece of equipment to which it is attached.

F. Positive identification of the contents of a piping system shall be lettered legibly, giving the name of the contents in full or abbreviated form at no greater than 25 foot intervals between markings. Arrows shall be used to indicate direction of flow at no greater than 10 foot intervals. Contents shall be identified by additional details required by the ENGINEER, such as temperature, pressure, etc., as necessary to identify the hazard.

G. Legend shall be brief and applied close to valves or flanges and adjacent to changes in direction, branches, and where pipes pass through walls or floors.

H. Where two or more pipes run parallel, markings shall be applied in the same relative location on each as to be in vertical or horizontal line and present a neat appearance.

I. In case a pipe is in such location that it can be seen only from one direction, such as pipes near a wall, two sets of the code designation shall be applied at each location, placed in two visible quadrants with respect to normal viewing positions.

Minimum Letter Sizes	
O.D. of Pipe (inches)	Height of Letters (inches)
3/4 - 1-1/4	1/2
1-1/2 - 2	3/4
2-1/2 - 6	1-1/4
8 - 10	2-1/2
Over 10	3-1/2

END OF SECTION

SECTION 09910

SPECIAL FINISHES

PART 1 - GENERAL

1.1 SUMMARY

A. CONTRACTOR shall provide all labor, materials, equipment, services, and incidentals required to furnish and install corrosion resistant coatings as needed for repairs of the lift station wetwell and manholes No. 5 and 6.

1.2 SECTION INCLUDES

A. Corrosion resistant coating.

1.3 SUBMITTALS

A. Submit the following for approval:
   1. Letters of Certification of Compliance on materials, equipment, etc.
   2. Identify product name and number, manufacturer and local distributor name, address, and telephone number.
   3. Samples.
   4. Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus. Include detailed procedures for light repairs such as dents and scratches.
   5. Identify manufacturer's recommended, published spreading rate and dry film thickness of each coating material proposed for use.
   6. Mixing instructions, shelf life, method of application, recommended number of coats, and drying time.
   7. General bulletins and catalog cuts describing complete coating system, including all principles and fundamentals.
   8. Materials of construction of all components.
   9. Material gradation, design mix, job mix formula, and/or material analysis.
   10. Copies of the CONTRACTOR'S proposed protection procedures in each area of Work.
   11. A written certification of the applicator's qualifications to the ENGINEER for approval.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. All surface coating materials shall be delivered to the job site in original sealed containers and shall be used directly from these sealed containers.

B. All containers shall have the following labels naming title of material, manufacturer's name and stock number, contents by volume, color name and number, and application instructions.

C. All surface coating materials shall be stored in an area according to manufacturer's recommendations.

D. The storage area shall be kept neat and clean. Floors and other surfaces shall be adequately protected. Any damage caused by the CONTRACTOR to surfaces in the storage area shall be thoroughly cleaned and repaired.

E. All oily rags, waste, etc., shall be placed in a covered material container and removed by the CONTRACTOR at the end of each shift.

1.5 QUALITY ASSURANCE

A. Corrosion resistant coating manufacturer and applicator shall have at least five years' experience in production and coating applications, respectively.

B. Provide the services of a qualified manufacturer's representative at the Project site for a minimum of two trips and two, eight hour work days at the commencement of Work to advise on materials, installation, and finishing techniques.

C. Certify long-term compatibility of all coatings with all substrates.

D. Provide the services of a qualified manufacturer's representative at the Project site for a minimum of two trips and four, eight hour work days during Work and completion of the Work for inspection. Within seven calendar days after inspection by the manufacturer, the CONTRACTOR shall provide a written report from the manufacturer certifying the coatings have been applied properly and in accordance with the manufacturer's recommendations and requirements. Deficiencies in the coating system, if any, noted by the manufacturer during final inspection shall be defined in the manufacturer's report including corrective measures to be implemented by the CONTRACTOR at the CONTRACTOR'S expense. Following corrective measures by the CONTRACTOR, the manufacturer shall re-inspect the Work. Within seven days after re-inspection, provide a written report form the manufacturer certifying the coatings have been applied properly and in accordance with the manufacturer's recommendations and requirements.

1.6 WARRANTY

A. The corrosion resistant coating manufacturers shall warrant the products being supplied to the OWNER against defects for a period of five years under normal use. The warranty shall be in printed form.

PART 2 - PRODUCTS

2.1 PRODUCTS FOR COATINGS

A. Manholes nad lift station wetwell, including all concrete surfaces such as walls, baffles, columns, and floors:
   1. Sewershield 100 trowelable
      a. Final layer shall be smoothed out using a solvent per manufacturer's recommendation.
   2. Sauereisen Sewergard 210 trowelable.
   3. Or, approved equal.

2.2 MATERIALS

A. Manholes and Sanitary Sewer Structures:
   1. In places where corrosion resistant coating is used, it shall be applied in layers to a total of 125 mils dry film thickness after the concrete filler/sealer has been applied (or as required by the coating manufacturer and approved by the ENGINEER) to the concrete surfaces. In floor coatings, CONTRACTOR shall incorporate silica sand or other approved natural or synthetic grit to provide a slip-resistant surface. The additive shall be mixed in the coating compound prior to application.

PART 3 - EXECUTION

3.1 SAFETY

A. The CONTRACTOR shall perform all surface preparation and application of the coatings as described below. All surface preparation and coating application shall be in compliance with all applicable Federal, State, and local occupational safety, health, and air pollution control regulations. All safety precautions recommended by the manufacturer in printed instructions or special bulletins, and as required by applicable regulations. The CONTRACTOR shall provide forced ventilation in all areas where inadequate ventilation exists.

3.2 SURFACE PREPARATION

A. New concrete shall cure as required for an acceptable surface to apply coating system as determined by the coating manufacturer. Testing the new concrete to determine whether it is acceptable for a coating system includes capillary moisture in accordance with ASTM D4263 and further testing in accordance with ASTM F1869 if moisture is detected and ground water intrusion is suspected. The concrete shall be prepared in accordance with SSPC/NACE Preparation of Concrete. The concrete surface shall be abrasive blast cleaned in accordance with ASTM D4259 to a uniform texture of 50-60 grit sandpaper and a surface profile of 4-6 mils. When sandblasting a surface to be coated, the CONTRACTOR shall

protect all surrounding surfaces from sustaining any damage. All surfaces to be sound, clean, dry, and free of all contaminants prior to application of the coating system. Patch all holes as recommended by the coating manufacturer.

3.3 INSTALLATION

A. The corrosion resistant coating shall be applied by a coating applicator specialist qualified to apply the coating in accordance with the manufacturer's specification.

B. Do not open containers or mix components until necessary preparatory work has been completed and application work will start immediately.

C. Handling of materials before, during, and after application in such a manner as to prevent inclusion of foreign materials.

D. All interior spaces of the manholes and the sanitary sewer structures shall be coated. This includes the floor, walls, and ceiling. The joint between the existing 66-inch sewer lining and the coating system shall be made at the recommendation of the 66-inch sewer lining manufacturer.

E. Use only application methods approved by the manufacturer.

3.4 TESTING

A. CONTRACTOR shall test areas after each coat to ensure proper thickness has been achieved. If desired thickness has not been accomplished, the CONTRACTOR shall contact the manufacturer's representative for consultation before proceeding.

B. All corrosion resistant coating shall be tested with an approved electrical holiday factory test at a minimum of 15,000 volts.

3.5 CLEAN-UP

A. During progress of the Work, remove from the site all discarded materials, rubbish, cans or buckets, and rags at the end of each Work day.

B. Upon completion of the Work, clean all coating-spattered surfaces. Remove spattered coating by proper methods of washing and scraping, using care not to scratch or otherwise damage surfaces.

C. At the completion of Work of other trades, touch-up and restore all damaged or defaced coated surfaces as determined by the ENGINEER.

D. Ensure that all Federal, State, and Municipal laws and regulations are met during the disposal of coating material or any other hazardous material associated with the coating process.

END OF SECTION

SECTION 10425

SIGNS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of signs:
   1. Panel signs.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Division 15, Mechanical, Sections for labels, tags, and nameplates for mechanical equipment.
   2. Division 16, Electrical, Sections for labels, tags, and nameplates for electrical equipment.

1.3 SUBMITTALS

A. General: Submit the following according to the conditions of the Contract and Division 1, General Requirements, Specification Sections.

B. Product data for each type of sign specified, including details of construction relative to materials, dimensions of individual components, profiles, and finishes.

C. Shop Drawings showing fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, grounds, layout, reinforcement, accessories, and installation details.
   1. Provide a message list for each sign required, including large-scale details of wording and lettering layout.
   2. For signs supported by or anchored to permanent construction, provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed as a unit of Work in other Sections.
   3. Templates: Furnish full-size spacing templates for individually mounted dimensional letters and numbers.

D. Samples for verification of color, pattern, and texture selected and compliance with requirements indicated:
   1. Cast Acrylic Sheet and Plastic Laminate: Provide a sample panel not less than 8-1/2-inches by 11-inches for each material, color, texture, and pattern required. On each panel include a representative sample of the graphic image process required, showing graphic style, and colors and finishes of letters, numbers, and other graphic devices.
   2. Aluminum: Samples of each finish type and color, on 6-inch long sections of extrusions and not less than 4-inch squares of sheet or plate, showing the full range of colors available.
   3. Dimensional Letters: Provide full-size representative samples of each dimensional letter type required, showing letter style, color, and material finish and method of attachment.

1.4 QUALITY ASSURANCE

A. Sign Fabricator Qualifications: Firm experienced in producing signs similar to those indicated for this Project, with a record of successful in-service performance, and sufficient production capacity to produce sign units required without causing delay in the Work.

B. Single-Source Responsibility: For each separate sign type required, obtain signs from one source of a single manufacturer.

C. Design Concept: The Drawings indicate sizes, profiles, and dimensional requirements of signs and are based on the specific types and models indicated. Sign units by other manufacturers may be considered provided deviations in dimensions and profiles do not change the design concept as judged by the ENGINEER. The burden of proof of equality is on the proposer.

1.5 PROJECT CONDITIONS

A. Field Measurements: Take field measurements prior to preparation of Shop Drawings and fabrication to ensure proper fitting. Show recorded measurements on final Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delay.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Manufacturers of Panel Signs:

a. ABC Architectural Signing System.
b. Allenite.
c. ASI Sign Systems, Inc.
d. Best Manufacturing Company.
e. Mohawk Sign Systems.
f. Poblocki & Sons, Inc.
g. The Supersine Company.

2. Manufacturers of Dimensional Letters:
   a. Andco Industries Corp.
   b. A.R.K. Ramos Manufacturing Company, Inc.
   c. ASI Sign Systems, Inc.
   d. Gemini, Inc.
   e. Matthews International Corp.
   f. Metal Arts.
   g. Metallic Arts, Inc.
   h. The Southwell Company.
   i. Spanjer Brothers, Inc.
   j. Vomar Products, Inc.

2.2 MATERIALS

A. Photo etched faceplate with integral raised copy, Braille, and symbols, laminated to an opaque acrylic back plate.
   1. Use heat and pressure laminated photopolymer film system to form copy, Braille, symbols, and background color.
      a. Raised copy, Braille, and symbols thickness: Not less than 1/32-inch.
      b. Applied Braille plates are not acceptable.

B. Aluminum Sheet: Provide aluminum sheet of alloy and temper recommended by the sign manufacturer for the type of use and finish indicated, and with not less than the strength and durability properties specified in ASTM B 209 for 5005-H15.

C. Aluminum Castings: Provide aluminum castings of alloy and temper recommended by the sign manufacturer for the casting process used and for the use and finish indicated.

D. Fasteners: Use concealed fasteners fabricated from metals that are not corrosive to the sign material and mounting surface.

E. Anchors and Inserts: Use nonferrous metal or hot-dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.3 PANEL SIGNS

A. General: Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
   1. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of ±1/16-inch measured diagonally.

B. Unframed Panel Signs: Fabricate signs with edges mechanically and smoothly finished to conform with the following requirements:
   1. Edge Condition: Square cut.
   2. Edge Color: Edge color same as face color.
   3. Corner Condition: Corners rounded to radius indicated.

C. Graphic Content and Style: Provide sign copy, symbols, and Braille text that complies with the requirements indicated for size, proportions, style, spacing, content, position, material, finishes, and colors of letters, numbers, and other graphic devices.
   1. Signs featuring the International Symbol of Accessibility must comply with character height, proportion, symbols, finish, contrast, Braille, and other signage requirements of ANSI A117.1 - 1992 and the Americans with Disabilities Act. Where indicated, Grade 2 Braille translation to be provided by the sign manufacturer.

2.4 FINISHES

A. Colors and Surface Textures: For exposed sign material that requires selection of materials with integral or applied colors, surface textures or other characteristics related to appearance, provide color matches indicated, or if not indicated, as selected by the ENGINEER from the manufacturer's standards.

B. Metal Finishes: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations.

C. Aluminum Finishes: Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.
   1. Baked-Enamel Finish: AA-M4xC12C42R1x (Mechanical Finish: Manufacturer's standard, other non-directional textured; Chemical Finish: Chemical conversion coating, acid chromate-fluoride-phosphate pretreatment; Organic Coating: as specified below). Apply baked enamel in compliance with paint manufacturer's specifications for cleaning, conversion coating, and painting.
      a. Organic Coating: Thermosetting-modified acrylic enamel primer/topcoat system complying with AAMA 603.8 except with a minimum dry film thickness of 1.5 mils, medium gloss.

b. Color(s): As selected by the ENGINEER from the manufacturer's standard colors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.
   1. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.

B. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using the methods indicated below.
   1. Silicone-Adhesive Mounting: Use liquid silicone adhesive recommended by the sign manufacturer to attach sign units. Use double-sided vinyl tape where recommended by the sign manufacturer to hold the sign in place until the adhesive has fully cured.
   2. Shim Plate Mounting: Provide 1/8-inch thick concealed aluminum shim plates with predrilled and countersunk holes, at exterior locations. Attach the plate with fasteners and anchors suitable for secure attachment to the substrate. Attach panel sign units to the plate using the method specified above.

C. Dimensional Letters and Numbers: Mount letters and numbers using standard fastening methods recommended by the manufacturer for letter form, type of mounting, substrate or wall construction, and condition of exposure indicated. Provide heavy paper template to establish letter spacing and to locate holes for fasteners.

D. Flush Mounting: At smooth, uniform substrates and wall surfaces mount letters with backs in contact with the surface.

E. Projected Mounting: At irregular substrates and wall surfaces mount letters at the minimum projection distance from the surface, as recommended by the manufacturer.

3.2 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to the manufacturer's instruction. Protect units from damage until acceptance by the OWNER.

END OF SECTION

SECTION 11295

HYDRAULIC VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install all valves and valve accessories for water, non-potable water, wastewater, as indicated on the Plans, as listed at the end of this Section, and as specified herein, including all appurtenances required for a complete and operational installation.

1.2 SECTION INCLUDES

A. Plug valves.

B. Air/Vacuum relief valves.

C. Valve appurtenances.

1.3 RELATED SECTIONS

A. Section 01300, Submittals.

B. Section 01640, Materials and Equipment.

C. Section 01650, Starting of Systems.

D. Section 09900, Painting.

E. Section 15050, Piping Systems.

1.4 REFERENCES

A. ASME B16.1, Gray Iron Pipe Flanges and Flanged Fittings.

B. ASME B46.1, Surface Texture (Surface Roughness, Waviness, and Lay).

C. ASME A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

D. ASTM A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

E. ASTM A48, Standard Specification for Gray Iron Castings.

F. ASTM A536, Standard Specification for Ductile Iron Castings.

G. ASTM A582, Standard Specification for Free-Machining Stainless Steel Bars.

H. ASTM B271, Standard Specification for Copper-Base Alloy Centrifugal Castings.

I. ASTM D429, Standard Test Methods for Rubber Property—Adhesion to Rigid Substrates.

J. ASTM F439.

K. All other applicable ASTM and ANSI Standards.

1.5 SUBMITTALS

A. Descriptive submittals shall be made in accordance with the Data Reference Symbols defined in Section 01300, Submittals.
   1. All Valves: Shop Drawings and O&M Manuals:
      a. Final Certified Drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
      b. Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, lists of erection details, and list of spare parts supplied with equipment.
      c. Shop Detail Drawings showing individual sub- assemblies and fabricated pieces with material specifications and other applicable data.
      d. Installation instructions, operating and/or service manuals, and all other data pertinent to operating or servicing the complete apparatus. Preventative maintenance instructions and recommended frequency.
      e. General bulletins and catalog cuts describing complete apparatus, including operating principles and fundamentals.
      f. Service data sheets showing design performance, utility requirements, etc., as applicable to the specific duty for which the equipment is furnished.
      g. Materials of construction of all components.
      h. Renewal parts list with diagrammatic or cross-section drawings showing part identification. Material analysis or trades designation for each significant part is to be noted on parts lists or on a separate sheet.
      i. Stuffing box sizes; packing sizes; specifications and arrangement; and mechanical seal details, specifications, etc., if furnished in equipment.
      j. Bearing manufacturer's standard identification and/or interchangeable number for all anti-friction bearings in the equipment proper and its accessory items.

B. Each Shop Drawing Submittal shall include a hard copy of the relevant Specification Section and shall be clearly marked to indicate whether the requirements for

equipment and/or services in the Specification Section are met by writing "accept" or "deviate" next to each Paragraph. If clarifications are needed to any of the Paragraphs in the Specification Sections due to deviations, they shall be addressed next to the Paragraph as such and explained further with any additional information necessary. If any exceptions and/or deviations are proposed to any of the Specifications, they shall be clearly noted as such in the Submittal, and an explanation of any deviation and/or exception shall be provided. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

PART 2 - PRODUCTS

2.1 PLUG VALVES

A. Plug valves shall be of the tight-closing, resilient-faced plug type and shall be of bi-directional cylindrical eccentric seating such that the opening movement of the closing member (plug) results in the closing member rising off the body seat contact.

B. Valves shall be drop tight at rated pressure of 175 psi and shall be satisfactory for applications involving infrequent and frequent operation and for applications involving open/close valve operation. Operating air temperature range shall be 33° F to 180° F.

C. Valve bodies shall be constructed of cast iron ASTM A126, Class B. Flanges shall be faced and drilled in accordance with ANSI B16.1, Class 125. Mechanical joint end bodies shall be in full compliance with ANSI A21.11.

D. The valve plug shall be constructed of cast iron ASTM A126, Class B, or ductile iron ASTM A536. The plug shall have cylindrical seating surface which is eccentrically offset from the center of the plug shafts. The plug shafts shall be integral. The plug valve shall have neoprene or CIIR bonded to all surfaces except shaft and thrust bearing surfaces. The rubber compound shall be approximately 70 durometer hardness. The bond must withstand 75 lb pull under test procedure ASTM D429, Method B.

E. Valve body seats shall be corrosion resistant 90% pure nickel, 1/8-inch minimum thickness. Coated nonmetallic materials and stainless steel shall not be acceptable.

F. Valves shall be fitted with sleeve type bearings. Bearings shall be corrosion resistant and constructed of self-lubricating Type 316 stainless steel.

G. The valve bonnet or cover shall be fitted with a cavity to accommodate a packing set. The packing shall be field adjusted Chevron type replaceable without removing valve actuator. Buried and submerged service valves to have self adjusting packing; O-rings are not acceptable.

H. Grit seals shall be provided at the top and bottom faced surfaces of the plug.

I. All plug valves shall be subjected to a hydrostatic leak test at 150 psi and body hydro test at 300 psi prior to shipment. All electrically actuated valves shall be cycled at the factory per AWWA C540.

J. All above ground plug valves shall have handwheel/lever/t-handle geared operators or electric actuators as specified in the Valve Schedule and as shown on the Drawings. All buried valves shall be equipped with valve box and extension stem per City of Chandler standard details and either a handwheel and pedestal, actuator and pedestal, or with operating nut, as specified in the Valve Schedule and as shown on the Drawings. Valves specified with an operating nut shall be installed with a ground level valve position indicator. Valves with actuators shall have sealed geared actuators with extension stems and torque tubes.

K. Interior ferrous metal surfaces of the valve, except finished or bearing surfaces and the plug, shall be shop painted with two coats of an approved two component coal tar epoxy coating applied in accordance with the manufacturer's recommendations.

L. Valves will be provided with torque tube pedestal assemblies where pedestals are indicated on the plans. Assemblies shall consist of a torque tube and a pedestal. Torque tubes shall be designed for a maximum deflection of no more than 0.75 degrees when measured at the disc edge. The pedestal shall be made of high strength cast iron and shall support the full weight of the torque tube by use of corrosion resistant thrust bearings located in the pedestal. Design of a torque tube shall allow ±2-inches of free movement along the tube longitudinal axis. Pedestal shall have a height of 3 feet above the operating floor. Torque tube floorstand assemblies shall be factory assembled and shipped as integral units. For buried valves with actuators, the actuators shall be located on pedestals with overriding handwheel. See Section 11290, Actuators, for Actuator Specifications.

M. Eccentric plug valves shall be as manufactured by Henry Pratt Company, Val-Matic, or approved equal. The 100% minimum port area type plug valves shall be manufactured by Henry Pratt Company, Val-Matic, DeZurik, or approved equal.

N. Valve orientation shall be coordinated by supplier and CONTRACTOR for approval by ENGINEER. Orientation recommendation shall be submitted with Shop Drawings to the ENGINEER.

2.2 COMBINATION SEWAGE AIR RELEASE AND AIR/VACUUM RELIEF VALVES

A. Combination sewage air/vacuum relief and air release valves (SCAV) shall be designed to allow large volumes of air to escape through an orifice when filling the pipeline and shall shut off tight when water enters the valve. The SCAV large orifice shall also allow large amounts of air into the pipe when the pipe is drained, or at any point that a vacuum condition develops. During the large orifice closure, small air pockets accumulate at the high point of the piping system, thus increasing the air pressure inside the main valve and forcing the water level lower. As the water level lowers, the small air release orifice will open to allow small pockets of air to escape automatically. As small air releases from the valve, the water level in the valve rises again to shut off the small air release orifice.

B. Valve bodies shall be cast iron conforming to ASTM A126, Grade B. The floats shall be stainless steel and sealed to withstand 500 psi. Shafts shall be stainless steel and shall be double sealed to prevent leakage. The seat shall be Buna-N and shall be fastened with the valve cover for easy removal.

C. The sewage air release valves shall be fitted with a cast iron plug valve to isolate from force main, a blow off ball valve, and a 3/4-inch shut-off ball valve, all supplied by valve manufacturer.

D. The overall height of the valves shall not exceed 32-inches. Valve exterior shall be painted with a Phenolic Primer Red Oxide for high resistance to corrosion.

E. Sewage air release valves shall include backflushing attachments, which includes one 3/4-inch rubber hose, 5 feet minimum, with quick disconnect coupling one end and female NPT on the other.

F. Sewage air release valves shall be as indicated in the Valve Schedule.

G. Sewage air release valves shall be APCO Model 440 Series, Val-Matic, or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Workmanship shall be of the highest grade throughout and in accordance with the best standard practice for this type of equipment.

B. Valves of the various types and pattern shall be installed at the respective locations as shown on the Drawings, and specified herein. All appurtenances required for operation and control of the valves shall be included. Joints and connections shall be made in accordance with applicable requirements for pipe line or pipe joints. Valve stems shall be plumb and vertical unless otherwise specifically shown. Each valve shall be adjusted for smooth and easy operation and shall be watertight when placed in operation under maximum working pressure.

3.2 MANUFACTURER'S FIELD SERVICE

A. Equipment Start-up: A factory trained representative of the manufacturer shall visit the site and provide installation and start-up services as specified in Section 01650, Starting of Systems.

B. Training: A factory certified or authorized representative of the manufacturer shall visit the site and provide operator training services, in addition to equipment start-up services, as specified in Section 01650, Starting of Systems.

END OF SECTION

SECTION 11701

TEMPORARY ODOR CONTROL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. The material required under this specification shall be used to remove hydrogen sulfide, thereby preventing odor within wastewater collection and treatment systems. The material shall utilize and enhance naturally occurring biochemical processes to accomplish hydrogen sulfide removal.

B. The material shall be a liquid phase product. It shall be delivered, stored, and fed into the wastewater via standard liquid-phase chemical handling procedures.

C. The material shall be fully compatible with storage and feed equipment constructed of any of the following
   1. High Density Crosslinked Polyethylene
   2. PVC
   3. Polypropylene
   4. FRP
   5. Stainless Steel (316)

D. The temporary odor control system shall be installed at the Shawnee Well Facility, 1500 W Mesquite St, Chandler AZ 85224.

1.2 RELATED SECTIONS

A. Section 01300, Submittals.

B. Section 01640, Materials and Equipment.

C. Section 01650, Starting of Systems.

D. Section 02145, Summary of Work.

1.3 PROCESS DESCRIPTION

A. The material supplied shall utilize the inherent ability of the facultative bacteria normally present in wastewater to metabolize hydrogen sulfide and other odor causing, reduced sulfur containing compounds. The material shall provide nitrate-oxygen to the wastewater to support this biochemical mechanism. This nitrate-

oxygen shall be applied via nitrate salts. The material shall be chemically stable, allowing continuous removal of sulfide contributed by side streams downstream of the application point.

B. As a result of the biochemical process, the material shall provide the additional benefit of biochemical oxygen demand (BOD) reduction in the wastewater.

1.4 SUPPLIER

A. The supplier of this material shall be one recognized and established in the field of wastewater odor control. The supplier must provide a list of 10 references currently using the material for control of hydrogen sulfide and other compounds. The list shall contain telephone numbers and contact names. At least five of these references must have used the material for 3 or more years.

B. The supplier shall be capable of providing on-site technical assistance within 24 hours of notification.

C. The supplier shall provide delivery of the material within 72 hours of order placement.

D. The supplier shall have at least two distribution centers from which product can be shipped.

E. The supplier shall indemnify and hold harmless the OWNER and its officers, agents, employees, or any other interested party from any and all liability, including costs and expenses, associated with any product license or patent infringement resulting from the supply and application of the supplier's material.

1.5 SUBMITTALS

A. Descriptive submittals shall be made in accordance with the Data Reference Symbols defined in Section 01300, Submittals.

B. Material Safety Data Sheet for the material, showing the CAS number of the material.

C. Each Shop Drawing Submittal shall include a hard copy of the relevant Specification Section and shall be clearly marked to indicate whether the requirements for equipment and/or services in the Specification Section are met by writing "accept" or "deviate" next to each Paragraph. If clarifications are needed to any of the Paragraphs in the Specification Sections due to deviations, they shall be addressed next to the Paragraph as such and explained further with any additional information necessary. If any exceptions and/or deviations are proposed to any of the Specifications, they shall be clearly noted as such in the Submittal, and an explanation of any deviation and/or exception shall be provided. The

CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

PART 2 - PRODUCTS

2.1 DOSING/INJECTION EQUIPMENT

A. The dosing/injection equipment shall have the capability to minimize chemical use for the defined goals.

B. The dosing/injection system shall be complete with all components including the metering pumps.

2.2 BULK STORAGE TANK

A. The bulk storage tanks shall be double wall industrial grade and constructed of polyethylene with a minimum specific gravity rating of 1.65. There will be no penetrations in the inner tank on the side wall. The tank will have 2" fill line with a lockable cam-lock connection. The tank will have a 3" vent on the top.

2.3 METERING PUMPS

A. The metering pumps shall be designed for the ambient temperature conditions of the location. They shall have the following properties:
   1. The pumps shall be adjustable by a variable speed drive system.
   2. The pumps shall have a range of dose rates from 0.2 gph to the maximum output of the pump.
   3. The pumps shall have a suction lift of 30 feet of water column.
      The dose rates shall be within 0.5% from when the tank is full and when it is at low operating level.

2.4 TREATMENT SOLUTION

A. The treatment solution shall be calcium nitrate with the following properties:
   1. The solution shall contain 3.5 lbs./gallon of nitrate-oxygen.
   2. The solution shall be free of debris and any other contaminants.
   3. The solution shall not crystallize at the locations ambient temperatures.
   4. The pH shall be equal to or greater 7.5.
   5. The weight shall be 12.34 lbs./gallon.
   6. A certificate of analysis must be provided with each delivery.

PART 3 - EXECUTION

3.1 DELIVERY

A. The material shall be delivered by tanker trucks with a maximum volume of 2,000 gallons.

B. The supplier shall be responsible for the safe, clean delivery of the material into the storage tank. The supplier shall be responsible for any damage to the Owner's facility housing the storage tank and feed system. The supplier shall provide prompt clean-up of any spills made during delivery.

C. The supplier shall be responsible for the proper labeling of storage tanks in compliance with local, state and federal requirements. The supplier shall not deliver the material into any tank or vessel which is not properly labeled.

3.2 MANUFACTURER'S FIELD SERVICE

A. Equipment Start-up: A factory trained representative of the manufacturer shall visit the site and provide installation and start-up services as specified in Section 01650, Starting of Systems.

B. Training: A factory employed representative of the manufacturer shall visit the site and provide operator training services, in addition to equipment start-up services, as specified in Section 01650, Starting of Systems.

END OF SECTION

SECTION 15050

PIPING SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: This Section specifies systems of process piping and general requirements for piping systems. Detailed Specifications for the components listed on the Piping System Specification Sheets are found in other Sections of Division 15, Mechanical. This Section shall be used in conjunction with those Sections.

B. Related Sections:
   1. Section 02200, Earthwork.
   2. Section 09900, Painting.
   3. Section 11295, Hydraulic Valves.
   4. Section 15051, Buried Piping Installation.
   5. Section 15052, Exposed Piping Installation.

1.2 QUALITY ASSURANCE

A. This Section contains references to the following documents. They are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued, or replaced.
   1. ANSI A13.1, Scheme for the Identification of Piping Systems.
   2. ANSI B1.20.1, Pipe Threads, General Purpose (Inch).
   3. ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800.
   4. ANSI B16.3, Malleable Iron Threaded Fittings Class 150 and 300.
   5. ANSI B16.5, Pipe Flanges and Flanged Fittings.
   6. ANSI B16.12, Cast Iron Threaded Drainage Fittings.
   7. ANSI B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

8. ANSI B31.3, Chemical Plant and Petroleum Refinery Piping.
9. ASME Section IX, Boiler and Pressure Vessel Code; Welding and Brazing Qualifications.
10. ASTM A47, Malleable Iron Castings.
11. ASTM A74, Cast Iron Soil Pipe and Fittings.
12. ASTM A105/A105M, Forgings, Carbon Steel, for Piping Components.
13. ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
14. ASTM A197, Cupola Malleable Iron.
15. ASTM A234/A234M, Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
16. ASTM A536, Ductile Iron Castings.
17. ASTM C564, Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
18. ASTM D1248, Polyethylene Plastics Molding and Extrusion Materials.
19. ASTM D1784, Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
20. ASTM D1785, Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
21. ASTM D2241, Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).
22. ASTM D2513, Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
23. ASTM D2665, Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
24. ASTM D2996, Filament Wound Reinforced Thermosetting Resin Pipe.
25. ASTM D3034, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
26. ASTM D3261, Butt Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
27. ASTM D4174, Cleaning, Flushing, and Purification of Petroleum Fluid Hydraulic Systems.
28. ASTM D4101, Propylene Plastic Injection and Extrusion Materials.
29. ASTM F441, Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
30. AWWA C105, Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
31. AWWA C110, Ductile Iron and Gray Iron Fittings, 3" Through 48", for Water and Other Liquids.
32. AWWA C111, Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.
33. AWWA C115, Flanged Ductile Iron and Gray Iron Pipe with Threaded Flanges.
34. AWWA C151, Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
35. AWWA C205, Cement Mortar Protective Lining and Coating for Steel Water Pipe - 4" and Larger - Shop Applied.

36. AWWA C207, Steel Pipe Flanges for Waterworks Services - Sizes 4" Through 144".
37. AWWA C210, Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipe.
38. AWWA C214, Tape Coating Systems for the Exterior of Steel Water Pipelines.
39. AWWA C600, Installation of Ductile Iron Water Mains and Their Appurtenances.
40. AWWA C651, Disinfecting Water Mains.
41. AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe, 4" Through 12", for Water.
42. CISPI 301, Specification Data for Hubless Cast Iron Sanitary System with No-Hub Pipe and Fittings.
43. FEDSPEC L-C-530B(1), Coating, Pipe, Thermoplastic Resin, or Thermosetting Epoxy.
44. MIL-H-13528B, Hydrochloric Acid, Inhibited, Rust Removing.
45. MIL-STD-810C, Environmental Test Methods.
46. SAE J1227, Assessing Cleanliness of Hydraulic Fluid Power Components and Systems.
47. UPC, Uniform Plumbing Code.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Unless otherwise specified, piping materials, including pipe, gaskets, fittings, connection and joint assemblies, linings, and coatings, shall be selected from those listed on the Piping System Specification Sheets.

B. Piping materials shall conform to detailed specifications for each type of pipe and piping appurtenance specified in other Sections of Division 15, Mechanical.

C. All piping shall be compatible with the fluid to which it is exposed.

2.2 PIPING IDENTIFICATION

A. Pipe Coding:
   1. Refer to Section 09900, Painting, for pipe identification in above ground installations.

B. Plastic Tracer Tape:
   1. Tracer tape shall be per MAG Section 616, colored the same as the background colors, as specified in Table A, Paragraph 3.5 of this Section.

2. Tape shall be capable of stretching to twice its original length and shall be as manufactured by Allen Systems, W. H. Brady Co., Seton Name Plate Corporation, Marking Services, Inc., or equal.
3. The message shall read "**CAUTION CAUTION CAUTION _____ PIPE BURIED BELOW**", with bold letters approximately 2-inches high. The blank shall be filled with the particular system fluid, such as chlorine, potable water line, or storm sewer line. All lines shall have tracer tape.

C. Locator Tape:
1. Detectable locator tape shall be per MAG Section 616. Locator tape shall be used for non-potable lines.

2.3 VALVES

A. Valves of the same size and service shall be provided by a single valve manufacturer. Packing shall be non-asbestos material. Actual length of valves shall be within ±1/16-inch of the manufacturer's specified length. Flanges shall meet the requirement of ANSI B16.5 and conform to the requirements of Section 15052, Exposed Piping Installation. Push-on and mechanical joints shall meet the requirements of AWWA C111 and conform to the requirements of Section 15051, Buried Piping Installation. Refer to Section 11295, Hydraulic Valves, for additional requirements.

2.4 FLEXIBLE COUPLINGS

A. Not all required flexible couplings are shown on Drawings. CONTRACTOR is responsible to provide and install flexible couplings as required in addition to those shown on Drawings.

2.5 AIR – REEASE VALVES (ARV)

A. The alignments of piping systems as shown in the Drawings may necessitate the use of air-release valves. It will be the responsibility of the CONTRACTOR to provide and install required ARVs and other appurtenances including manholes, at all high points encountered in the routing of potable and non-potable water lines as well as other pressurized process piping.

2.6 SUBMITTALS

A. The following shall be included in all piping submittals:
1. Shop Drawings:
   a. Letters of Certification of Compliance on materials, equipment, etc.
   b. Final certified drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
   c. Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, and lists of erection details.

d. Shop detail drawings showing individual sub- assemblies and fabricated pieces with material specifications and other applicable data.
e. Drawings and/or diagrams depicting proposed pipe and fittings layout, locations and quantities.

2. O&M Manuals:
   a. Letters of Certification of Compliance on materials, equipment, etc.
   b. Final certified drawings showing outline dimensions, foundation layout or mounting information, and other pertinent dimensions.
   c. Field erection instructions, assembly drawings and/or diagrams, detailed reference drawing lists, and lists of erection details.
   d. Shop detail drawings showing individual sub- assemblies and fabricated pieces with material specifications and other applicable data.

B. Shop Drawings shall also include the following information for all piping systems:
   1. Fabrication and/or Layout Drawings:
      a. Exterior Yard Piping Drawings (minimum 1-inch = 10 feet) with information, including:
         1) Dimensions of piping lengths.
         2) Invert or centerline elevations of piping crossings. CONTRACTOR shall provide a proposed solution if conflicts do exist.
         3) Acknowledgement of bury depth requirements.
         4) Details of fittings, tapping locations, thrust blocks, restrained joint segments, harnessed joint segments, hydrants, and related appurtenances.
         5) Acknowledge designated valve or gate tag numbers, manhole numbers, instrument tag numbers, pipe, and line numbers.
         6) Line slopes and vents.
         7) Electrical duct bank locations shall be provided in the Drawings. CONTRACTOR shall provide a proposed solution if conflicts do exist.
      b. Interior Piping Drawings (minimum scale 1/8-inch = 1 foot), with information, including:
         1) Dimensions of piping from column lines or wall surfaces.
         2) Centerline dimensions of piping.
         3) Centerline elevation and size of intersecting ductwork, conduit/conduit racks, or other potential interferences requiring coordination.
         4) Location and type of pipe supports and anchors.
         5) Locations of valves and valve actuator type.
         6) Details of fittings, tapping locations, equipment connections, flexible expansion joints, connections to equipment, and related appurtenances.
         7) Acknowledgement of valve, equipment, and instrument tag numbers.
         8) Provisions for expansion and contraction.

9) Line slopes and air release vents.
10) Rough-in data for plumbing fixtures.

c. Product Technical Data, including:
1) Acknowledgement that products submitted meet requirements of standards referenced.
2) Copies of manufacturer's written directions regarding material handling, delivery, storage, and installation.
3) Separate schedule sheet for each piping system scheduled in this Section showing compliance of all system components. Attached technical product data on gaskets, pipe, fittings, and other components.

d. Qualifications:
1) Qualifications of lab performing disinfection analysis on water systems.

e. Test Reports:
1) Copies of pressure test results on all piping systems.
2) Reports defining results of dielectric testing and corrective action taken.
3) Disinfection test report.
4) 24 hour notification of time and date prior to conducting piping pressure tests.

C. All additional Submittal information shall be included with this Submittal information as noted in the Division 15, Mechanical, Pipe Material Specifications.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Location:
1. Piping shall be provided as specified, except for adjustments to avoid architectural and structural features, and shall be coordinated with electrical construction.

B. Piping Sizes:
1. Where the size of piping is not specified, the CONTRACTOR shall provide piping of the sizes required by UPC. Unless specified otherwise, small piping (less than 1-inch in diameter) required for services not described by UPC shall be 1/2-inch.

C. Pipe Support, Anchorage, and Seismic Bracing:
1. Piping shall be supported by anchor brackets, guides, saddles, or hangers.
2. Acceptable types of supports, guides, saddles, hangers, and structure attachments for general pipe support, expansion/contraction, and for seismic bracing, as well as anchorage details, are shown on the Drawings.

3. Minimum spacing shall be as specified for supports and for seismic bracing.
4. Where a specific type of support or anchorage is indicated on the Drawings, only that type shall be used there.
5. Piping shall be vertically supported by anchor brackets, guides, saddles, or hangers and shall be seismically braced where indicated to resist lateral load.
6. Supports shall be provided on each run at each change of direction.
7. Pipe supports shall be hot-dip or mechanically galvanized.
8. Unless otherwise specified, existing pipes and supports shall not be used to support new piping.

D. Anchorage for Buried Piping:
1. All plugs, caps, tees, and bends in buried pressure piping systems shall be anchored by means of restrained joints.

E. Bedding and Backfill:
1. Bedding and backfill for all pipes shall conform to Section 02200, Earthwork, and Section 15051, Buried Piping Installation.
2. All piping, at a minimum, shall be backfilled with a 4-inch thick bedding layer below the pipe, extending to a height equal to 1 foot above the top of the pipe.
3. The bedding and backfill operations shall, at minimum, follow the Maricopa Association of Government (MAG) guidelines.

3.2 PIPING IDENTIFICATION

A. Pipe Coding:
1. After application of the specified coating and insulation systems, exposed piping, interior and exterior, and piping in ceiling spaces, pipe trenches, pipe chases, and valve boxes shall be identified with plastic markers, as specified in Paragraph 2.2.A of this Section.
2. Legend markers and directional arrows shall be located at each side of walls, floors, and ceilings, at one side of each piece of equipment, at piping intersections, and at approximately 50 foot centers.

B. Plastic Tracer Tape:
1. A single line of tape, as specified in Paragraph 2.2.B of this Section, shall be provided 2-1/2 feet above the centerline of buried pipe.
2. For pipelines buried 8 feet or greater below finished grade, CONTRACTOR shall provide a second line of tape 12-inches below finished grade, above and parallel to each buried pipe.
3. Tape shall be spread flat with message side up before backfilling.

C. Locator Tape:
1. Detectable pipe locating tape, as specified in Paragraph 2.2.C of this Section, shall be installed per MAG Section 616.5.

3.3 TESTING

A. General:
   1. Upon completion of piping, but prior to application of insulation on exposed piping, the CONTRACTOR shall test the piping systems in accordance with the appropriate MAG Specifications. Pressures, media, and test durations shall be as specified in the PIPESPEC. Equipment which may be damaged by the specified test conditions shall be isolated. Testing shall be performed using calibrated test gauges and calibrated volumetric measuring equipment to determine leakage rates. Each test gauge shall be selected so that the specified test pressure falls within the upper half of the gauge's range. Unless otherwise specified, the CONTRACTOR shall notify the Construction Manager 24 hours prior to each test.
   2. Unless otherwise specified, testing, as specified herein, shall include existing piping systems which connect with new pipe systems. Existing pipe shall be tested to the nearest existing valve.
   3. All piping shall be tested at the pressure values listed in the Section 15051, Buried Piping Installation, and 15052, Exposed Piping Installation.
   4. Pressure and leakage testing for water systems shall be in accordance with MAG Section 610. Unless otherwise specified, leakage from other buried liquid piping systems shall be less than 0.02 gallons per hour per inch diameter per 100 feet of buried piping.
   5. Building Drains:
      a. Drain systems, other than pumped drain systems, shall be tested in accordance with UPC.

3.4 CLEANING AND FLUSHING

A. General:
   1. Piping systems shall be cleaned following completion of testing and prior to connection to operating, control, regulating, or instrumentation equipment.
   2. The CONTRACTOR may, at his option, clean and test sections of buried or exposed piping systems. Use of this procedure, however, will not waive the requirement for a full pressure test of the completed system.
   3. Unless specified otherwise, piping 24-inches in diameter and smaller shall first be cleaned by pulling a tightly fitting cleaning ball or swab through the system.
   4. Piping larger than 24-inches in diameter may be cleaned manually or with a cleaning ball or swab.

B. Liquid Systems:
   1. After completion of cleaning, liquid systems, unless otherwise specified, shall be flushed with clean water.

C. Water Systems:
   1. Potable water piping systems shall be flushed and disinfected in accordance with AWWA C651 and MAG Section 611.
   2. For non-potable water systems, final flushing and microbiological testing, as specified in MAG Section 611.15, is not required.

3.5 PIPING SPECIFICATION SHEETS (PIPESPEC)

A. Piping and valves for groupings of similar plant processes or types of service lines are specified on individual Piping Specification Sheets (PIPESPECS). Piping services are grouped according to the chemical and physical properties of the fluid conveyed and/or by the temperature or pressure requirements. Piping services specified in the PIPESPECS and on the Drawings are alphabetically arranged by designated service symbols, as shown in Table A. Table A also indicates the system symbol, fluid category, and pipe marker background color of each service.

TABLE A - PIPING SERVICES

Symbol	Service	Fluid Category
POT	POTABLE WATER	LIQUID
SS	SANITARY SEWER	LIQUID

1. Gasket:

Service	Pipe Material	Gasket	
		Flange	Push-on
WW	DIP	Red Rubber Gasket Material (SBR) conforming to ASTM D1330	Nitrile or Neoprene

2. Buried Pipe and Fitting:

Service	Diameter	Pipe	Connections	Fittings	Spec
POT	3 inches and smaller	Copper Tube, ASTM B88, Type K, annealed or drawn	Solder type with threaded or flanged adapters for valves	Wrought copper or bronze, ANSI b16.22	15064
SS	16	Ductile Iron, AWWA C151, Protecto 401 lining	Restrained push-on rubber gasket joint. Flanged adapters for valves and ends.	Coating, lining and ends to match pipe	15061

3. Exposed Pipe and Fitting:

Service	Diameter	Pipe	Connections	Fittings	Spec
POT	3 inches and smaller	Copper Tube, ASTM B88, Type L	Solder type with threaded or flanged adapters for valves	Wrought copper or bronze, ANSI b16.22	15064
SS	16	Ductile Iron, AWWA C151, Protecto 401 lining	Flanged	Ductile Iron, AWWA C151, Protecto 401 lining	15061

END OF SECTION

SECTION 15051

BURIED PIPING INSTALLATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to install and test all buried piping, fittings, and specials. The Work includes, but is not limited to, the following:
      a. All types and sizes of buried piping, except those specified under other Sections.
      b. Piping beneath structures.
      c. Supports, restraints, and thrust blocks.
      d. Pipe encasements.
      e. Work on or affecting existing piping.
      f. Testing.
      g. Cleaning and disinfecting.
      h. Installation of all jointing and gasketing materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie-rods, and all other Work required for completing the buried piping installation.
      i. Incorporation of valves, meters, and special items shown or specified into the piping systems as required and as specified in the appropriate Division 15, Mechanical, Sections.
      j. Unless otherwise specifically shown, specified, or included under other Sections, all buried piping work required begins at the outside face of structures or structure foundations and extending away from structure.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate with the Work that is related to this Section.
   2. Section 15051, Buried Pipe Installation, specifies the installation of all buried piping materials specified in Sections of Division 15, Mechanical. Coordinate with these Sections.

C. Related Work Specified Elsewhere:
   1. Section 02150. Shoring and 02200, Earthwork.
   2. Section 11295, Hydraulic Valves.
   3. Section 15050, Piping Systems.
   4. Section 15061, Ductile Iron Pipe.

5. Section 15064, Copper Pipe.
6. Section 15065, Thermoplastic Pipe and Accessories.
7. Section 15120, Piping Specialties and Accessories.
8. Section 15104, RGRCP.

1.2 QUALITY ASSURANCE

A. CONTRACTOR shall conform to all applicable requirements of Parts 600 and 700 of the Uniform Standard Specifications for Public Work Construction by the Maricopa Association of Governments (MAG). If there is a conflict between MAG Standard Specifications and these Specifications, the provisions of these Specifications shall govern.

B. Requirements of Regulatory Agencies:
   1. Comply with requirements of NFPA Standard No. 24 for "Outside Protection" where applicable to water pipe systems used for fire protection.
   2. Comply with requirements of UL, FM, and other jurisdictional authorities, where applicable.
   3. Refer to the General and Supplementary Conditions regarding permit requirements for this Work.
   4. Applicable building codes.

C. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. ASTM D2321, Practice for Underground Installation of Flexible Thermoplastic Pipe.
   2. ASTM D2774, Practice for Underground Installation of Thermoplastic Pressure Piping.
   3. AWWA C105, Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
   4. AWWA C111, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
   5. AWWA C200, Steel Water Pipe.
   6. AWWA C205, Cement Mortar Protective Lining and Coating for Steel Water Pipe.
   7. AWWA C206, Field Welding of Steel Water Pipe.
   8. AWWA C207, Steel Pipe Flanges for Waterworks Service.
   9. AWWA C208, Dimensions for Fabricated Steel Water Pipe Fittings.
   10. AWWA C600, Installation of Ductile Iron Water Mains and Their Appurtenances.
   11. AWWA C606, Grooved and Shouldered Joints.
   12. AWWA C651, Disinfecting Water Mains.
   13. AWWA M11, Steel Pipe - A Guide for Design and Installation.
   14. AWWA M23, PVC - Design and Installation.
   15. AWWA M41, Ductile Iron Pipe and Fittings.

16. ASCE MOP No. 37, Design and Construction of Sanitary and Storm Sewers.
17. Concrete Pipe Handbook, American Concrete Pipe Association.

1.3 SUBMITTALS

A. Shall be in accordance with Section 15050, Piping Systems, Submittal information.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the site to ensure uninterrupted progress of the Work.

B. Handle all pipe, fittings, specials, and accessories carefully with approved handling devices. Do not drop or roll material off trucks. Do not otherwise drop, roll, or skid piping.

C. Store pipes and fittings on heavy wood blocking or platforms so they are not in contact with the ground.

D. Unload pipe, fittings, and specials opposite to or as close to the place where they are to be installed as is practical to avoid unnecessary handling. Keep pipe interiors completely free from dirt and foreign matter.

E. Inspect delivered pipe for cracked, gouged, chipped, dented, or other damaged material and immediately remove defective pipe from site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Required pipe materials are listed in the Piping Schedule. Refer to applicable Sections for Material Specifications.

B. General:
   1. Marking Piping:
      a. Clearly mark each piece of pipe or fitting with a designation conforming to those shown on the laying schedule and/or Shop Drawings.
      b. Cast or paint material, type, and pressure designation on each piece of pipe or fitting 4-inches in diameter and larger. Each piece of steel pipe shall be clearly marked with the thickness of the steel in the pipe wall.
      c. Pipe and fittings smaller than 4-inches in diameter shall be clearly marked by manufacturer as to material, type, and rating.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Installation of all pipe, fittings, valves, specials, and appurtenances shall be subject to the review and/or approval of the ENGINEER.
2. Install piping as shown, specified, and as recommended by the manufacturer and in conformance with referenced standards and approved Shop Drawings.
3. Request instructions from ENGINEER before proceeding if there is a conflict between the manufacturer's recommendations and the Contract Documents.
4. All piping shall be inspected by the ENGINEER prior to installation. ENGINEER'S inspection will not relieve CONTRACTOR or manufacturer from responsibility for damaged products.
5. All piping shall be carefully examined for cracks, damage, or other defects before installation. Any piping that is defective, including, but not limited to, cracked, damaged, in poor condition, or with damaged linings or improper markings shall be rejected, unless the product can be repaired in a manner acceptable to the manufacturer and ENGINEER. Any piping found to be broken or defective after it has been installed shall be removed, replaced, or repaired at the CONTRACTOR'S expense.
6. Minimum earth cover over the piping shall be as shown on the Drawings, specified, or directed by the ENGINEER, but in no case shall the earth cover be less than 4 feet for all piping, except drains.
7. Required earthwork shall be as specified in applicable Sections of Division 2, Sitework.
8. Present all conflicts between piping systems and equipment, structures, or facilities to ENGINEER for determination of corrective measures before proceeding.
9. Take field measurements, where required, prior to installation to ensure proper fitting of Work. The CONTRACTOR shall uncover the existing pipelines sufficiently in advance of the proposed Work in order that the type and location of the existing pipes and joints and other information required to fabricate the proposed piping can be determined. It shall be the responsibility of the CONTRACTOR to obtain whatever information is required to complete the connections of the proposed pipelines to the existing pipelines. Refer to Paragraph 3.3 of this Section, as applicable.
10. Interior of all piping and mating surfaces shall be inspected and all dirt, gravel, sand, debris, or other foreign material shall be completely removed from the interior and mating surfaces before installation. Measures shall be taken to maintain the interior of all piping clean until acceptance of the completed Work. Care shall be taken to prevent foreign matter from entering joint space. Bell and spigot mating surfaces shall be wiped clean immediately before piping is laid. For ductile iron pipe, the bell and spigot mating surfaces shall be thoroughly cleaned with a wire brush.

11. Install piping accurately to line and grade shown, specified, or directed, unless otherwise approved by the ENGINEER. Accurate means of determining and checking the alignment and grade shall be used, which shall be subject to the approval of the ENGINEER. Any modifications to the Contract Documents to suit the pipe manufacturer's standard shall be approved by the ENGINEER. Remove and relay piping that is incorrectly installed, at CONTRACTOR'S expense.
12. Do not lay piping in water unless otherwise specified in these Specifications or approved by the ENGINEER. Ensure that the water level in the trench is at least 6-inches below the bottom of piping. Maintain a dry trench until jointing and backfilling are complete unless otherwise specified in these Specifications or approved by the ENGINEER.
13. Where unforeseen conditions will not permit the installation of piping as shown or specified, no piping shall be installed without approval of the ENGINEER. Do not modify structures or facilities without approval of the ENGINEER.
14. Start laying piping at lowest point and proceed toward the higher elevations, unless otherwise approved by the ENGINEER. Slope piping uniformly between elevations shown on the Drawings or as otherwise directed by the ENGINEER.
15. Place bell and spigot piping so that the bells face the direction of laying, unless otherwise approved by the ENGINEER.
16. Piping shall be installed so that the barrel of the piping, and not the joints, receives the bearing pressure from the trench bottom or other bedding condition.
17. No piping shall be brought into position until the preceding length, valve, fitting, or special has been bedded and secured in place.
18. Whenever pipe laying is not actively in progress, the open ends of the piping shall be closed by a temporary plug or cap to prevent soil, water, and other foreign matter from entering the piping.
19. Field cutting of metallic piping, where required for inserting valves, fitting, specials, and closures, shall be made with a machine specially designed for cutting piping and in accordance with the manufacturer's instructions. Cuts shall be carefully done, without damage to piping, so as to leave a smooth end at right angles to the axis of the piping. Cut end shall be tapered and sharp edges filed off smooth. Flame cutting shall not be permitted. Piping damaged by the CONTRACTOR by improper or careless methods of cutting shall be replaced or repaired at his expense.
20. Blocking under piping shall not be permitted, unless specifically approved by ENGINEER for special conditions.
21. Protective linings and coatings shall be touched up prior to installation, where required.

22. Except where bends, wyes, or similar fittings are used, changes in alignment and grade of the piping shall be made by deflecting joints or with beveled pipe. Permissible joint deflection shall not exceed 75% of the amount allowed by the manufacturer.
23. All joints shall be made in the presence of the ENGINEER, or his duly authorized representative, except as otherwise approved.
24. Special care shall be taken to ensure that each section of piping abuts against the next in such a manner that there will be not shoulder or unevenness of any kind along the piping invert.
25. Piping shall be rotated as required to place outlets in proper position.
26. Blind flanges and cleanouts shall be provided at locations shown on the Drawings, specified, or required. Cleanouts on buried piping shall include all pipe, fittings, and appurtenances required to bring cleanout to finished grade and terminate in a flange and blind flange or suitably capped piping as shown. Cleanout piping shall be same as that specified for the main run.
27. All gravity lines shall pitch uniformly at the grade shown or as specified or approved.
28. Short pipe stubs, maximum 4 feet in length, shall be used at all manholes and other wall faces, except as otherwise specified.
29. Field painting shall be accomplished after joints are made.
30. All piping shall be plugged watertight with a suitable cap or plug securely fastened to the end of the piping at all contact interfaces.
31. CONTRACTOR shall notify ENGINEER in advance of backfilling operations.
32. On steep slopes, take measures acceptable to ENGINEER to prevent movement of the pipe during installation.
33. Thrust Restraint: During the installation of the pipe, thrust blocks, tied joints, or proprietary restrained joint systems shall be provided wherever required for thrust restraint. Thrust restraint shall conform to the applicable requirements of Paragraph 3.2 of this Section.
34. Exercise care to avoid flotation when installing pipe in cast-in-place concrete.

B. Manufacturer's Installation Specialist:
   1. Provide the services of a competent installation specialist of the pipe manufacturer when pipe laying begins if the CONTRACTOR is not experienced in laying and jointing a particular type of pipe.
   2. Retain installation specialist at the site for a minimum of two days or until competency of the pipe laying crew has been satisfactorily demonstrated.

C. Separation of Sewers and Potable Water Pipe Lines:
   1. Conform to the requirements of all applicable requirements of the Uniform Standard Specifications for Public Work Construction by the Maricopa Association of Governments (MAG).

D. Plugs:
   1. Temporarily plug installed pipe at the end of each day's Work or other

interruption to the installation of any pipe line. Plugging shall prevent the entry of animals, liquids, or persons into the pipe or the entrance or insertion of deleterious materials.

2. Install standard plugs into all bells at dead ends, tees, or crosses. Cap all spigot ends.
3. Fully secure and block all plugs and caps installed for pressure testing to withstand the specified test pressure.
4. Where plugging is required for phasing of the Work or for subsequent connection of piping, install watertight, permanent type plugs.

E. Bedding Pipe: Bed pipe as specified below and in accordance with the details shown.
   1. Trench excavation and backfill and bedding materials shall conform to the requirements of Section 02150, Shoring and 02200, Earthwork, as applicable.
   2. Excavate trenches below the pipe bottom by an amount specified. Remove all loose and unsuitable material from the trench bottom.
   3. Carefully and thoroughly compact all pipe bedding with hand held pneumatic compactors.
   4. Do not lay pipe until the ENGINEER approves the bedding condition. If a conflict exists, obtain clarification from ENGINEER before proceeding.
   5. No pipe shall be brought into position until the preceding length has been bedded and secured in its final position.

F. Laying Pipe:
   1. Conform to manufacturer's instructions and requirements of the standards listed below, where applicable:
      a. Ductile Iron Pipe: AWWA C600, AWWA C105.
      b. Thermoplastic Pipe: ASTM D2774.
      c. ASCE Manual of Practice No. 37.

G. Polyethylene Encasement:
   1. Provide polyethylene encasement for ductile iron piping to prevent contact between the pipe and surrounding bedding material and backfill.
   2. Polyethylene may be supplied in tubes or in sheet material.
   3. Polyethylene encasement materials and installation shall be in accordance with the requirements of MAG Section 610.5.

H. Jointing Pipe:
   1. Ductile Iron Mechanical Joint Pipe:
      a. Wipe clean the socket, plain end, and adjacent areas immediately before making joint. Make certain that cut ends are tapered and sharp edges are filed off smooth.
      b. Lubricate the plain ends and gasket with soapy water or an approved pipe lubricant, in accordance with AWWA C111, just prior to slipping the gasket onto the plain end of the joint assembly.

c. Place the gland on the plain end with the lip extension toward the plain end, followed by the gasket with the narrow edge of the gasket toward the plain end.
d. Insert the pipe into the socket and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during assembly.
e. Push gland toward socket and center it around the pipe with the gland lip against the gasket.
f. Insert bolts and hand tighten nuts.
g. Make deflection after joint assembly, if required, but prior to tightening bolts. Alternately tighten bolts 180 degrees apart to seat the gasket evenly. The bolt torque shall be as follows:

Pipe Size (inches)	Bolt Size (inches)	Range of Torque
3	5/8	45-60
4-24	3/4	75-90
30-36	1	100-120
42-48	1-1/4	120-150

h. All bolts and nuts shall be heavily coated with two 10 mil, minimum, coats of coal-tar epoxy coating as manufactured by Koppers, Tnemec, or equal.
i. Restrained mechanical joints shall be in accordance with Section 15061, Ductile Iron Pipe.

2. Ductile Iron Push-On Joint Pipe:
   a. Prior to assembling the joints, the last 8-inches of the exterior surface of the spigot and the interior surface of the bell shall be thoroughly cleaned with a wire brush, except where joints are lined or coated with a special protective lining or coating.
   b. Rubber gaskets shall be wiped clean and flexed until resilient. Refer to manufacturer's instructions for procedures to ensure gasket resiliency when assembling joints in cold weather.
   c. Insert gasket into joint recess and smooth out the entire circumference of the gasket to remove bulges and to prevent interference with the proper entry of the spigot of the entering pipe.
   d. Immediately prior to joint assembly, apply a thin film of approved lubricant to the surface of the gasket which will come in contact with the entering spigot end of pipe. CONTRACTOR may, at his option, apply a thin film of lubricant to the outside of the spigot of the entering pipe.
   e. For assembly, center spigot in the pipe bell and push pipe forward until it just makes contact with the rubber gasket. After gasket is compressed and before pipe is pushed or pulled all the way home, carefully check the gasket for proper position around the full circumference of the joint. Final assembly shall be made by forcing the spigot end of the entering pipe past the rubber gasket until it makes contact with the base of the

bell. When more than a reasonable amount of force is required to assemble the joint, the spigot end of the pipe shall be removed to verify the proper positioning of the rubber gasket. Gaskets which have been scoured or otherwise damaged shall not be used.

f. Maintain an adequate supply of gaskets and joint lubricant at the site at all times when pipe jointing operations are in progress.

3. Proprietary Joints:
   a. Pipe which utilizes proprietary joints such as Fastite, by American Cast Iron Pipe Company, Tyton by U.S. Pipe Incorporated, restrained joints described under Paragraph 3.2 of this Section, or other such joints shall be installed in strict accordance with the manufacturer's instructions.
4. Thermoplastic Pipe Joints:
   a. Solvent Cement Joints:
      1) Bevel pipe ends and remove all burrs before making joints. Clean both pipe and fittings thoroughly. Do not attempt to make solvent cement joints if temperature is below 40° F or above 90° F when exposed to direct sunlight or in wet conditions.
      2) Use solvent cement supplied or recommended by the pipe manufacturer.
      3) Apply joint primer and solvent cement and assemble joints in strict accordance with the recommendations and instructions of the manufacturer of the joint materials and the pipe manufacturer.
      4) Observe safety precautions with the use of joint primers and solvent cements. Allow air to circulate freely through pipelines to permit solvent vapors to escape. Slowly admit water when flushing or filling pipelines to prevent compression of gases within pipes.
   b. Push-On Joints:
      1) Bevel all field-cut pipe, remove all burrs, and provide a reference mark the correct distance from the pipe end.
      2) Clean the pipe end and the bell thoroughly before making the joint. Insert the O-ring gasket, making certain it is properly oriented. Lubricate the spigot well with an approved lubricant; do not lubricate the bell or O-ring. Insert the spigot end of the pipe carefully into the bell until the reference mark on the spigot is flush with the bell.
5. Copper Tubing Joints:
   a. Assemble copper tubing with soldered joints. Solder shall be 95-5 tin-antimony solder conforming to ASTM B32.
   b. Ream or file pipe to remove burrs.
   c. Clean and polish contact surfaces of joints.
   d. Apply flux to both male and female ends.
   e. Insert end of tube into full depth of fitting socket.
   f. Heat joint evenly.
   g. Form continuous solder bead around entire circumference of joint.

h. Runs shall contain unions at connection to equipment and at reasonable distances along the lengths of runs to permit convenient disassembly of piping and removal of equipment.

6. Mechanical Coupling Joints:
   a. Prior to the installation and assembly of mechanical couplings, the joint ends shall be cleaned thoroughly with a wire brush to remove foreign matter. Following this cleaning, lubricant shall be applied to the rubber gasket or inside of the coupling housing and to the joint ends. After lubrication, the gasket shall be installed around the joint end of the previously installed piece and the joint end of the subsequent piece shall be mated to the installed piece. The gasket shall be positioned and the coupling housing placed around the gasket and over the grooved or shouldered joint ends. The bolts shall be inserted and the nuts screwed up tightly by hand. The bolts shall then be tightened uniformly in order to produce an equal pressure on all parts of the housing. When the housing clamps meet metal to metal, the joint is complete and further tightening is not required.
7. Stainless steel Pipe Joints:
   a. All joints in stainless steel pipe shall be welded, except that flanged connections shall be provided at connections to valves, meters and similar equipment.
   b. Welding shall conform to the requirements of AWWA C206. All field welded joints shall be full circumferential welds designed to take the thrust at the joint location. A minimum 3/16-inch weld is required.
   c. After assembly and welding the interior and exterior of the joint and the surrounding damaged or uncoated area shall be lined and coated with the same material and to the same thickness as the shop applied lining and coating.
   d. Where flanged connections or couplings are provided, the flanges, couplings, bolts and nuts shall be coated with two 8 mil coats of high-build epoxy coating as manufactured by Tnermec, or approved equal.

I. Backfilling:
   1. Conform to the applicable requirements of Section 02150, Shoring and 02200 Earthwork.
   2. Place backfill as construction progresses. Backfill by hand and use power tampers until pipe is covered by at least 1 foot of fill.

J. Connections to Valves and Hydrants:
   1. Install valves and hydrants as shown on Drawings.
   2. Provide suitable adapters when valves or hydrants and piping have different joint types.
   3. Provide thrust restraint at all hydrants and at valves at pipeline terminations.

K. Transitions from One Type of Pipe to Another:

1. Provide all necessary adapters, specials, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

L. Unions:
   1. Install dielectric unions wherever dissimilar metals are connected, except for bronze or brass valves, in ferrous piping.
   2. Provide a union downstream of each valve with screwed connections.
   3. Provide screwed or flanged unions at each piece of equipment, where shown, and where necessary to install or dismantle piping.

M. Closures:
   1. Provide all closure pieces shown or required to complete the Work.

3.2 THRUST RESTRAINT

A. Provide thrust restraint on all piping systems. Pipe joints shall be restrained as specified in Paragraph 3.2.C of this Section.

B. Thrust restraint shall be accomplished by means of restrained pipe joints. Concrete thrust blocks shall be used only when specifically shown on the Drawings or as directed by the ENGINEER. Thrust restraints shall be designed for the axial thrust exerted by the test pressure given in the Buried Piping Schedule.

C. Restrained Pipe Joints:
   1. Pipe joints shall be restrained by means suitable to the type of pipe being installed.
      a. Ductile iron push-on joints and mechanical joints shall be restrained utilizing a proprietary restrained joint system such as American Lok-Ring, Lok-Fast, Lok-Set, U.S. Pipe Field Lok Gasket, U.S. Pipe TR Flex System, lugs and tie-rods, or other system approved by ENGINEER.
      b. Steel pipe shall be restrained with welded joints or flanged joints. Steel pipe requiring restraint shall have sufficient longitudinal steel reinforcement provided to handle the thrust forces at a maximum design stress of 15,000 psi. The thrust forces in the longitudinals must be transmitted directly to the steel joint bands using welded connections sufficient to carry the stresses involved. No allowance for the mortar coating to handle any tensile forces is permitted.
      c. Thermoplastic and copper piping shall generally be installed with soldered, solvent weld, threaded, flanged, or similar type joints. Where push-on type or other non-restrained joints are provided, the CONTRACTOR shall provide tie-rods or other suitable joint restraint system for these joints, subject to the approval of ENGINEER.
      d. All pipe lengths shall be restrained.

D. Concrete Thrust Blocks:
   1. Thrust blocks shall be constructed of Class "B" concrete, conforming to the requirements of MAG.
   2. Blocks shall be placed against undisturbed soil as shown on Drawings or as directed by the ENGINEER. Concrete shall be placed so that pipe joints and fitting joints will be accessible for repair.
   3. Size of concrete thrust blocks shall be as shown on the Drawings, or as directed and approved by ENGINEER.
   4. Concrete thrust blocks shall not be used for pipe restraint except where specifically shown on the Drawings or as approved by the ENGINEER.

3.3 WORK AFFECTING EXISTING PIPING

A. Location of Existing Piping:
   1. Locations of existing piping shown should be considered approximate.
   2. CONTRACTOR shall determine the true locations of existing piping to which Work is to be performed and locations of other facilities which could be disturbed during earthwork operations or which may be affected by CONTRACTOR'S Work already installed.

B. Taking Existing Pipelines Out of Service:
   1. Do not take pipelines out of services, unless specifically provided for under this Project or approved by ENGINEER.
   2. Notify ENGINEER at least 48 hours prior to taking pipeline out of service.

C. Work on Existing Pipelines:
   1. Cut or tap pipes as shown or required with machines specifically designed for this Work.
   2. Install temporary plugs to prevent entry of mud, dirt, water, and debris.
   3. Provide all necessary adapters, fittings, pipe, and appurtenances required to complete the Work.
   4. Existing pipelines which are cut and abandoned shall be adequately capped or filled with grout.

3.4 TESTING OF PIPING

A. General:
   1. Test all piping, except as otherwise authorized by ENGINEER.
   2. Notify ENGINEER 48 hours in advance of testing.
   3. Provide all testing apparatus, including pumps, hoses, gauges, and fittings.
   4. Unless otherwise noted, pipelines shall hold specified test pressure for two hours.
   5. Repair and retest pipelines that fail to hold specified test pressure or which exceed the allowable leakage rate.
   6. Unless otherwise specified, test pressures required are at the lowest elevation of the pipeline section being tested.

7. Conduct all tests in the presence of ENGINEER.
8. Advise local authorities having jurisdiction if their presence is required during testing.
9. All testing shall conform to the MAG Standard Specifications. In case of contradiction with these Specifications, the CONTRACTOR shall notify the ENGINEER before proceeding with the testing.

B. Schedule of Pipeline Tests:
1. All pressure lines shall be hydrostatically tested at 150 or 200 psi, depending on size, per MAG 610.15 and MAG 610.14-A.
2. Sewer lines shall be air or hydrostatically tested per MAG Section 615.
3. All ductile iron gravity pipe shall be hydrostatically tested to a pressure of 50 psi at the upper end. No measurable water loss shall occur during the 120 minute duration of the test.
4. RCP testing shall be done per Section 15104, Reinforced Concrete Pipe.
5. All potable water lines shall be disinfected and tested per MAG Section 611
6. All piping shall be water tested after installation, except as otherwise specified or directed by ENGINEER.
7. For piping not included in the Schedule, the ENGINEER will notify CONTRACTOR in writing of the test pressure to be used.

C. Pressure Test Procedure:
1. Complete backfill and compaction at least to the pipe centerline before testing, unless otherwise required or approved by ENGINEER.
2. Allow concrete for thrust blocks to reach design strength before testing.
3. Fill section to be tested slowly with water and expel all air. Install corporation cocks, if necessary, to remove all air.
4. Test only one section of pipe at a time.
5. Apply specified test pressure for two hours and observe pressure gage. Check carefully for leaks while test pressure is being maintained.

D. Leakage Testing:
1. Conduct leakage test for all liquid piping after satisfactory completion of pressure test.
2. Allow concrete pipe to stand full of water at least 12 hours prior to starting leakage test.
3. Maintain test pressure constantly for the minimum test period and accurately measure the amount of water, which must be added to maintain the test pressure.
4. Allowable Leakage Rates (in gallons per hour per 1,000 feet per inch diameter):
   a. DIP Push-On or Mechanical Joints: 0.075.
   b. Copper, Steel, and Thermoplastic: None.
5. Leakage Test Procedure:

a. Examine exposed pipe, joints, fittings, and valves. Repair visible leakage or replace the defective pipe, fitting, or valve.
b. Refill the line under test to reach the required test pressure.
c. Provide a test container filled with a known quantity of water at the start of the test. Attach the test pump suction to the test container.
d. Pump water from the test container into the line with the test pump to hold the specified test pressure for the test period. Water remaining in the container shall be measured and the amount used during the test shall be recorded on the test report.
e. Perform all repairs, replacement, and retesting required because of failure to meet testing requirements.
f. Leakage shall be less than the rate specified above.

E. Required Tests for Storm Drains and Sanitary Sewer Connections:
1. CONTRACTOR shall use water test procedures only.
   a. Tests shall be performed after backfilling is completed, but shall be performed before final cleanup and acceptance of Work.
   b. Tests shall be performed prior to final acceptance.
      1) Test all piping and manholes for leakage by means of the tests described below.
      2) Test to be performed between adjacent manholes or as approved by the ENGINEER.
   c. Prior to making tests, the CONTRACTOR shall submit details of his testing procedures, with a description of methods and equipment he proposes to use, to the ENGINEER for approval. The CONTRACTOR shall furnish all necessary labor, equipment, water, watertight bulkheads, rodding machine, generator, pumps, and all else necessary to carry out the required tests.
2. Water Test:
   a. When a water test is performed for reinforced concrete pipe, the test section shall be filled with water and allowed to stand for 24 hours. The water shall then be replenished and the test performed.
   b. Insert test plugs and securely brace.
   c. Fill the pipe and manhole with water to provide a positive differential head on the top of the pipe at the highest point of the pipeline under test of at least the test pressure specified in the Buried Piping Schedule.
   d. The amount of water added to maintain this head shall be the leakage.
   e. Test for a period of at least four hours.
   f. Total leakage of any section tested shall not exceed the following rates:
      1) Gravity Sewer: 0.5 gallons per hour per 100 feet of pipe per inch diameter of pipe.
      2) Storm Drains: 2.0 gallons per hour per 100 feet of pipe per inch diameter of pipe.
   g. If the leakage in the section tested exceeds the specified amount, the CONTRACTOR shall make the necessary repairs or replacements

required to reduce the leakage to within the specified limits and the test shall be repeated until the leakage requirements is met.

h. On steep grades it may be necessary to place plugs in the pipe between manholes to avoid excessive pressures in the pipe.

3. Visual Inspection:
   a. Prior to final acceptance, a visual inspection by ENGINEER of all appurtenant structures, e.g., manholes, chambers, etc., shall be required. Any visual leaks, regardless of their magnitude, shall be repaired by the CONTRACTOR.
4. Watertight Sewers:
   a. It is imperative that all sewers and appurtenant structures be constructed as watertight as practicable. The CONTRACTOR shall adhere rigidly to all requirements of the Contract Documents and follow all directions of the ENGINEER to secure a watertight sewer. If, during the Work or after its completion, any leaks are discovered, they shall be repaired in a satisfactory manner at the expense of the CONTRACTOR, even though the pipe and appurtenant structures may have already successfully passed the leakage tests.

3.5 DISPOSAL OF WATER

A. CONTRACTOR shall provide suitable means for disposal of test and, flushing water so that no damage results to facilities or waterways.

B. Means of disposal of test and flushing water shall be subject to the approval of ENGINEER, local governing authorities, and regulatory agencies.

C. CONTRACTOR shall be responsible for any damage caused by his water disposal operations.

3.6 CLEANING

A. Cleaning:
   1. Thoroughly clean all piping and flush prior to placing in service in a manner approved by ENGINEER.
   2. Piping 24-inches in diameter and larger shall be inspected from inside and all debris, dirt, and foreign matter removed.
   3. If piping that requires disinfection has not been kept clean during storage or installation, CONTRACTOR shall swab each section individually before installation with a 5% hypochlorite solution to ensure clean piping.

B. Disinfection:
   1. Disinfect all potable water piping.
   2. Disinfection shall conform to the requirements of MAG Section 611.

3.7 PIPING SCHEDULE

A. The following abbreviations are used in the Buried Piping Schedule included at the end of the Section.
   1. Service Abbreviations:
      a. Potable Water: POT
      b. Sanitary Sewer: SS
   2. Material Abbreviations:
      a. Ductile Iron Pipe: DIP
      b. Copper Pipe: COP
   3. Lining/Coating Abbreviations:
      a. Polyethylene Wrap: PE
      b. Ceramic Epoxy: CE
      c. Bituminous Coating: BC
      d. Painted per Section 09900, Painting: P
   4. Joint Abbreviations:
      a. Flanged: Flg
      b. Mechanical Joint: MJ
      c. Soldered: SD

Pipe	Pipe Size (in)	Material	Class	Lining	Coating	Joints	Service
Potable water	3/4	COP	PER SPEC	N/A	N/A	SD	PRESSURE
16" Discharge	16	DIP	350	CE	BC, PE	MJ	PRESSURE

END OF SECTION

SECTION 15052

EXPOSED PIPING INSTALLATION

PART 1 - PART 1- GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to install and test all exposed piping, fittings, and specials. The Work includes, but is not limited to, the following:
      a. All types and sizes of exposed piping except those specified under other Sections.
      b. Piping embedded in concrete within a structure or foundation will be considered as exposed and included herein.
      c. Supports, restraints, and other anchors.
      d. Work on or affecting existing piping.
      e. Testing.
      f. Cleaning and disinfecting.
      g. Installation of all jointing and gasketing materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie-rods, and all other Work required for completing the exposed piping installation.
      h. Incorporation of valves, meters, and special items shown or specified into the piping systems as required and as specified in the appropriate Division 15, Mechanical, Sections.
      i. Unless otherwise specifically shown, specified, or included under other Sections, all exposed piping Work required, beginning at the outside face of structures or structure foundation, and extending into the structure.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate with the Work that is related to this Section.
   2. Section 15052, Exposed Piping Installation, specifies the installation of all exposed piping materials specified in Division 15, Mechanical. Coordinate with these Sections.

C. Related Work Specified Elsewhere:
   1. Section 02200, Earthwork.
   2. Section 09900, Painting.

3. Section 11295, Hydraulic Valves.
4. Section 15050, Piping Systems.
5. Section 15061, Ductile Iron Pipe.
6. Section 15064, Copper Pipe.
7. Section 15120, Piping Specialties and Accessories.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:
   1. Comply with applicable requirements of NFPA Standard No. 13 for "Installation of Sprinkler Systems" and NFPA Standard No. 14 for "Standpipe and Hose Systems" used for fire protection.
   2. Comply with requirements of UL, FM, and other jurisdictional authorities, where applicable.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. ANSI B16.3, Malleable Iron Threaded Fittings, Classes 150 and 300.
   2. ANSI B16.4, Cast Iron Threaded Fittings, Classes 125 and 250.
   3. ANSI B16.5, Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys.
   4. ANSI B16.9, Factory Made Wrought Steal Butt Welding Fittings.
   5. ANSI B16.11, Forged Steel Fittings, Socket Welding and Threaded.
   6. AWWA C111, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
   7. AWWA C206, Field Welding of Steel Water Pipe Joints.
   8. AWWA C600, Installation of Ductile Iron Water Mains and Their Appurtenances.
   9. AWWA C606, Grooved and Shouldered Type Joints.
   10. AWWA C651, Disinfecting Water Mains.
   11. AWWA M11, Steel Water Pipe Design and Installation.
   12. AWWA M23, PVC Piping.
   13. AWS D1.1, Structural Welding Code.
   14. AWS D10.7, Recommended Practices for Gas Shielded-Arc Welding of Aluminum and Aluminum Alloy Pipe.
   15. AWS D10.9, Standard for Qualification of Welding Procedures and Welders for Piping and Tubing.
   16. ASME Boiler and Pressure Vessel Code.
   17. MAG, Maricopa County Association of Government Standard Specifications and Details.

1.3 SUBMITTALS

A. Shall be in accordance with Section 15050, Piping Systems submittal information.

B. Each Shop Drawing Submittal shall include a hard copy of the relevant Specification Section and shall be clearly marked to indicate whether the requirements for equipment and/or services in the Specification Section are met by writing "accept" or "deviate" next to each Paragraph. If clarifications are needed to any of the Paragraphs in the Specification Sections due to deviations, they shall be addressed next to the Paragraph as such and explained further with any additional information necessary. If any exceptions and/or deviations are proposed to any of the Specifications, they shall be clearly noted as such in the Submittal, and an explanation of any deviation and/or exception shall be provided. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the site to insure uninterrupted progress of the Work.

B. Handle all pipe, fittings, and accessories carefully with approved handling devices. Do not drop or roll pipe off trucks. Do not otherwise drop, roll, or skid piping.

C. Store pipes and fittings on heavy wood blocking or platforms so they are not in contact with the ground.

D. Unload pipe, fittings, and specials opposite to or as close to the place where they are to be installed as is practical to avoid unnecessary handling. Keep pipe interiors completely free from dirt and foreign matter.

E. Inspect delivered pipe for cracked, gouged, chipped, dented, or other damaged material and immediately remove from site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Required pipe materials are listed in the Piping Schedule. Refer to applicable Sections for Material Specifications.

B. General:
   1. Marking Piping:

a. Clearly mark each piece of pipe or fitting with a designation conforming to that shown on the Shop Drawings.
b. Cast or paint material, type, and pressure designation on each piece of pipe or fitting 4-inches in diameter and larger.
c. Pipe and fittings smaller than 4-inches in diameter shall be clearly marked by manufacturer as to material, type, and rating.

C. Pipe Identification Markers and Arrows: Refer to Section 09900, Painting.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Install piping as shown, specified, and as recommended by the manufacturer.
2. If there is a conflict between manufacturer's recommendations and the Contract Documents, request instructions from ENGINEER before proceeding.

B. Manufacturer's Installation Specialist:
1. Provide the services of a competent installation specialist of the pipe manufacturer when pipe installation begins for the following:
   a. Stainless steel pipe.
   b. Steel pipe.
   c. Ductile iron pipe.
   d. Fiberglass reinforced plastic pipe.
2. Retain installation specialist at the site for a minimum of two days or until competency of the pipe installation crew has been satisfactorily demonstrated.

C. Piping Installation:
1. Install straight runs true to line and elevation, unless otherwise noted on Plans.
2. Install vertical pipe truly plumb in all directions.
3. Install piping parallel or perpendicular to building walls. Piping at angles and 45 degree runs across corners will not be accepted unless specifically shown or approved.
4. Install small diameter piping generally as shown when specific locations and elevations are not indicated. Locate such piping as required to avoid ducts, equipment, beams, and other obstructions.
5. Install piping so as to leave all corridors, walkways, work areas, and like spaces unobstructed. Unless otherwise approved, provide a minimum headroom clearance under all piping of 7 feet 6-inches.

6. Protect and keep clean water pipe interiors, fittings, and valves.
7. Provide temporary caps or plugs over all pipe openings at the end of each day's Work and when otherwise required or directed by ENGINEER.
8. Cutting: Cut pipe from measurements taken at site, not from Drawings.
9. Install dielectric unions wherever dissimilar metals are connected, except for bronze or brass valves in ferrous piping.
10. Provide a union downstream of each valve with screwed connections.
11. Provide screwed or flanged unions at each piece of equipment where shown and where necessary to install or dismantle piping.
12. Additional Requirements for Thermoplastic Piping:
    a. Support all valves independently of the piping system.
    b. Utilize wide band supports as recommended by manufacturer and approved by ENGINEER to minimize localized stresses.
    c. Provide piping passing through walls with a sleeve of wearing material to prevent abrasion damage to piping.
    d. When anchors are required at locations other than equipment or tanks they shall be placed at elbows, valve locations, and at bends in pipeline.
    e. Spacing of supports shall be in accordance with the manufacturer's published recommendations at the maximum design operating temperature of the pipe.
    f. Use "U" clamps with wide band circumferential contact.
    g. Use guides on long runs of piping to maintain alignment and reduce chance of elastic failure of pipe. Space guides as recommended by manufacturer.
    h. Use bellows with low axial force to take up pipe expansion. Provide anchors to restrain the expansion joint. Use of bellows joints shall be kept to a minimum. Flexible connectors may be used to absorb thermal movement when approved by ENGINEER.
    i. Do not install pipe when ambient temperature is less than 60° F.

D. Joints:
1. General:
    a. Make joints in accordance with the pipe manufacturer's recommendations and the following requirements:
        1) Cut piping accurately and squarely and install without forcing or springing.
        2) Ream out all pipes and tubing to full inside diameter after cutting. Remove all sharp edges on end cuts.
        3) Remove all cuttings and foreign matter from the inside of pipe and tubing before installation. Thoroughly clean all pipe, fittings, valves, specials, and accessories before installing.
2. Mechanical Joints:

a. Wipe clean the socket, plain end and adjacent areas immediately before making joint. Make certain that cut ends are tapered and sharp edges are filed off smooth.
b. Lubricate the plain end and gasket with soapy water or manufacturer's recommended pipe lubricant, in accordance with AWWA C111, just prior to slipping the gasket onto the plain end of the joint assembly.
c. Place the gland on the plain end with the lip extension toward the plain end, followed by the gasket with the narrow edge of the gasket toward the plain end.
d. Insert the pipe into the socket and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during assembly.
e. Push gland toward socket and center it around pipe with the gland lip against the gasket.
f. Insert bolts and hand tighten nuts.
g. Make deflection after joint assembly, if required, but prior to tightening bolts. Alternately tighten bolts 180 degrees apart to seat the gasket evenly. The bolt torque shall be as follows:

Pipe Size (inches)	Bolt Size (inches)	Range of Torque (ft-lbs)
3	5/8	45 to 60
4 to 24	3/4	75 to 90
30 to 36	1	100 to 120
42 to 48	1-1/4	120 to 150

3. Flanged Joints:
   a. Assemble flanged joints using 1/8-inch ring-type gaskets for raised face flanges. Use full face gaskets for flat face flanges, unless otherwise approved by ENGINEER. Gaskets shall be suitable for the service intended in accordance with the manufacturer's ratings and instructions. Gaskets shall be properly centered.
   b. Bolts shall be tightened in a sequence which will insure equal distribution of bolt loads.
   c. The length of bolts shall be uniform, and they shall not project beyond the nut more than 1/4-inch or fall short of the nut when fully taken up. The ends of bolts shall be machine cut so as to be neatly rounded. No washers shall be used.
   d. Bolt threads and gasket faces for flanged joints shall be lubricated prior to assembly.
   e. Alternately tighten bolts 180 degrees apart to compress the gasket evenly.
4. Stainless Steel Pipe Joints:

a. For threaded joints, use standard, right hand tapered full depth threads on steel piping and apply an approved joint compound, to the male threads only, before installation. Remove all cuttings and foreign matter from the inside of the pipe. Thoroughly clean all pipe, fittings, valves, specials, and accessories before installing.

5. Steel Pipe:
   a. Joints in steel pipe shall be butt welded, flanged, or threaded joints, except that flexible couplings, mechanical couplings, or flanged connections shall be provided where shown on the Drawings.
   b. Welding shall conform to the requirements of AWWA C206. Pipe 36-inches in diameter and larger shall be welded both inside and outside of the pipe.
      1) Submit documentation that all welders have been qualified in accordance with ASME Boiler and Pressure Vessel Code Section IX or American Welding Society Structural Welding Code D1.1, Section 5, whichever is required. Submit current certificates for the ENGINEER'S review.
   c. After welding, the joint and the surrounding damaged or uncoated area shall be coated with the same material and to the same thickness as the shop applied coating.
   d. Additional Welding Requirements:
      1) On pipe lines specified to be welded, all joints between sections of pipe and between pipe and fittings 2-inches and larger shall be electric arc welded, and all joints on pipe 1-1/2-inches and smaller shall be gas welded. Entire responsibility for the quality of the welding belongs to CONTRACTOR.
         a) Conduct tests not only of the welding procedure used by his organization to ensure welds that will meet the required tests, but also of the welding operators to determine the ability of the operators to make sound welds under standard conditions.
         b) Be thoroughly familiar with ANSI B 31.1, and American Welding Society Standard B3.0.
         c) Be capable of performing all welding operations required for construction and installation of the piping systems.
      2) Qualification of Welders: Rules of procedure for qualification of all welders and general requirements for fusion welding shall conform with the applicable portions of ANSI B31.1 and American Welding Society Standard B3.0, and also as outlined below.
      3) Examining Welder: Each welder shall be examined at the job site by CONTRACTOR in the presence of the ENGINEER to determine the ability of the welder to meet the qualifications required. Welders for piping shall be tested for all positions, including welds with the axis horizontal (not rolled) and with the axis vertical. Each welder shall be:

a) Allowed to weld only in the position in which the welder is qualified.
b) Required to identify the weld with the specific code marking signifying the name and number assigned.

4) Examination Results: ENGINEER shall be provided with a listing of names and corresponding code markings. Where a welder fails to meet the prescribed welding qualifications, that welder shall be retested and, if the welder fails the second test, the welder shall be disqualified for work on the Project.

e. For threaded joints, use standard, right hand tapered full depth threads on steel piping and apply an approved joint compound to the male threads only, before installation. Remove all cuttings and foreign matter from the inside of the pipe. Thoroughly clean all pipe, fittings, valves, specials, and accessories before installing.

6. Thermoplastic Pipe Joints:
   a. Solvent Cement Joints:
      1) Bevel pipe ends and remove all burrs before making joints. Clean both pipe and fittings thoroughly. Do not attempt to make solvent cement joints if temperature is below 40° F or above 90° F when exposed to direct sunlight, nor in wet conditions.
      2) Use solvent cement supplied or recommended by the pipe manufacturer.
      3) Apply joint primer and solvent cement and assemble joints in strict accordance with the recommendations and instructions of the manufacturer of the joint materials and the pipe manufacturer.
      4) Observe safety precautions with the use of joint primers and solvent cements. Allow air to circulate freely through pipelines to permit solvent vapors to escape. Slowly admit water when flushing or filling pipelines to prevent compression of gases within pipes.
   b. Threaded Joints:
      1) Clean both pipe and fittings thoroughly.
      2) Use Teflon tape to ensure a watertight seal with threads.
      3) Observe safety precautions with the use of joint primers and solvent cements. Allow air to circulate freely through pipelines to permit solvent vapors to escape. Slowly admit water when flushing or filling pipelines to prevent compression of gases within pipes.
7. Copper Tubing Joints:
   a. Assemble copper tubing with soldered joints. Solder shall be 95-5 tin-antimony conforming to ASTM B32.
   b. Ream or file pipe to remove burrs.
   c. Clean and polish contact surfaces of joints.
   d. Apply flux to both male and female ends.
   e. Insert end of tube into full depth of fitting socket.
   f. Heat joint evenly.

g. Form continuous solder bead around entire circumference of joint.
h. Runs shall contain unions at connections to equipment and at reasonable distances along the lengths of runs to permit convenient disassembly of piping and removal of equipment.

E. Installing Valves and Accessories:
1. Provide supports for large valves, flow meters, and other heavy items as shown or required.
2. Position valve operators as shown. When the position is not shown, CONTRACTOR shall notify ENGINEER prior to installation for position approval by ENGINEER. The valve shall be installed so that it can be conveniently operated and as approved by ENGINEER. Avoid placing operators at angles to the floors or walls. If valve operator is installed without notification to ENGINEER, CONTRACTOR shall move valve, as required, without additional expense.
3. Position flow measuring devices in pipe lines so that they have the amount of straight upstream and downstream runs recommended by the manufacturer, unless specific location dimensions are shown.

F. Unions:
1. Install dielectric unions wherever dissimilar metals are connected, except for bronze or brass valves, in ferrous piping.
2. Provide a union downstream of each valve with screwed connections.
3. Provide screwed or flanged unions at each piece of equipment, where shown, and where necessary to install or dismantle piping.

G. Eccentric Reducers: Use eccentric reducers where shown and where air or water pockets would otherwise occur in mains because of a reduction in pipe size.

H. Transitions From One Type of Pipe to Another:
1. Do not take pipelines out of service unless specifically named below or approved by ENGINEER.
2. Provide all necessary adapters, specials, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

I. Work on Existing Pipelines:
1. Cut or tap pipes as shown or required with machines specifically designed for this Work.
2. Install temporary plugs to keep out all dirt, water, and debris.
3. Provide all necessary adapters, fittings, pipe, and appurtenances required.

3.2 THRUST RESTRAINT

A. Provide thrust restraint on all piping systems

B. Restrained Pipe Joints:
   1. Pipe joints shall be restrained by flanges for all exposed ductile iron as specified herein.

3.3 PAINTING

A. All pipe field painting shall conform to the requirements of Section 09900, Painting.

3.4 TESTING OF PIPING

A. General:
   1. Test all piping as specified below, unless otherwise authorized by ENGINEER.
   2. Notify ENGINEER 48 hours in advance of testing.
   3. Provide all testing apparatus including pumps, hoses, gauges, and fittings.
   4. Pipelines shall hold the specified test pressure for two hours.
   5. Repair and retest pipelines which fail to hold specified test pressures or which exceed the allowable leakage rate.
   6. Test pressures required are at the lowest elevation of the pipeline section being tested, unless otherwise specified.
   7. Follow special test procedures below for gaseous chemical and liquid chlorine lines.
   8. Conduct all tests in the presence of the ENGINEER. Repeat tests in the presence of local authorities having jurisdiction, if required.

B. Pressure Test Procedure:
   1. Insure that all supports and restraint protection are securely in place.
   2. Fill section to be tested slowly with water and expel all air. Install cocks, if necessary, to ensure removal of air.
   3. Test only one section of pipe at a time.
   4. Apply 150 psi for two hours and observe pressure gauge. Check carefully for leaks while test pressure is being maintained.

C. Leakage Testing:
   1. Conduct leakage test after satisfactory completion of pressure test.
   2. Allowable Leakage Rates (gallons per hour per 1,000 feet per inch diameter:
      a. Copper, Steel, Ductile Iron, Thermo Plastic, and all Other Piping: 0.0 gallons/hour.
   3. Leakage Test Procedure:

a. Examine exposed pipe, joints, fittings, and valves. Repair visible leakage or replace the defective pipe, fitting, or valve.
b. Refill the line under test to reach the required test pressure.
c. Provide a test container filled with a known quantity of water at the start of the test. Attach the test pump suction to the test container.
d. Pump water from the test container into the line with the test pump to hold the specified test pressure for the test period. Water remaining in the container shall be measured and the amount used during the test shall be recorded on the test report.
e. Perform all repairs, replacement, and retesting required because of failure to meet testing requirements.
f. Leakage shall be less than rate specified above.

3.5 CLEANING AND DISINFECTION

A. Cleaning:
1. Thoroughly clean all piping and flush prior to placing in service in a manner approved by ENGINEER.
2. Piping 24-inches in diameter and larger shall be inspected from inside and all debris, dirt, and foreign matter removed.
3. If piping which requires disinfection has not been kept clean during storage or installation, CONTRACTOR shall swab each section individually with a 5% hypochlorite solution to ensure clean piping.

B. Disinfection:
1. Disinfect all potable water piping. Disinfection shall conform to MAG Section 611.

3.6 IDENTIFICATION OF PIPING

A. Piping markers shall conform to the requirements of Section 09900, Painting.

3.7 PIPING SCHEDULE

A. The following abbreviations are used in the Exposed Piping Schedule at the end of this Section.
1. Service Abbreviations:
   a. Potable Water: POT
   b. Wastewater: WW
   c. Foul Air: FA
   d. Drain: D
2. Material Abbreviations:
   a. Ductile Iron Pipe: DIP
   b. Stainless Steel Pipe: SST

c. Chlorinated Polyvinyl Chloride: CPVC
d. Copper Pipe: COP

3. Lining/Coating Abbreviations:
   a. Cement Mortar Lined: CM
   b. Polyethylene Wrap: PE
   c. Glass Lined: GL
   d. Protecto 401 Ceramic Epoxy: CE
   e. Bituminous Coated: BC
   f. Galvanized: Galv
   g. T-Lock: TL
   h. Painted per Section 09900, Painting: P
4. Joint Abbreviations:
   a. Flanged: Flg
   b. Push-On: PO
   c. Mechanical Joint: MJ
   d. Welded: W
   e. Solvent Welded: SW
   f. Threaded: THR

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Pipe	Service	Pipe Size[1]	Material	Class	Lining	Joints	Testing (media, test pressure, test duration)
Pump Discharge	WW	10	DIP	350	CE	FLG	Water, 100PSI, 120 min
Pump Discharge	WW	16	DIP	350	CE	FLG	Water, 100PSI, 120 min
Potable Water	POT	3/4	COP	NA	NA	PER SPEC	PER SPEC
Drain	DR	¾	SST	NA	NA	PER SPEC	PER SPEC

NOTE:
1. ALL EXPOSED PIPING SHALL BE PAINTED PER SECTION 09900. PAINTING.

END OF SECTION

SECTION 15061

DUCTILE IRON PIPE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install ductile iron pipe and fittings.
   2. The extent of ductile iron pipe is shown on the Drawings and in the Schedules included in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.

B. Related Sections:
   1. Section 02200, Earthwork.
   2. Section 15051, Buried Piping Installation.
   3. Section 15120, Piping Specialties and Accessories.

1.2 QUALITY ASSURANCE

A. Manufacturers' Qualifications:
   1. Manufacturer shall have a minimum of five years of experience producing ductile iron pipe and fittings and shall show evidence of at least five installations in satisfactory operation.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. AWWA C104, Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water.
   2. AWWA C105, Polyethylene Encasement for Ductile Iron Pipe Systems.
   3. AWWA C110, Ductile Iron and Gray Iron Fittings, 3-inches through 48-inches, for Water and Other Liquids.
   4. AWWA C111, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
   5. AWWA C115, Flanged Ductile Iron Pipe with Threaded Flanges.
   6. AWWA C115, Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings for Water Supply Service.
   7. AWWA C150, Thickness Design of Ductile Iron Pipe.
   8. AWWA C151, Ductile Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
   9. ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings.

10. ANSI B18.2.1, Square and Hex Bolts and Screws Inch Series, including Hex Cap Screws and Lag Screws.
11. ANSI B18.2.2, Square and Hex Nuts.
12. ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
13. ASTM A 354, Specification for Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners.
14. AWWA C600, Installation of Ductile Iron Water Mains and Their Appurtenances.
15. AWWA C153, American National Standard for Ductile Iron Compact Fittings for Water Service.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Letter of Certification of Compliance on materials, equipment, etc.
   2. Final Certified Drawing showing outline dimensions, mounting information, and other pertinent dimensions.
   3. Detailed drawings and data on pipe, fittings, gaskets, and appurtenances. Submit these with Shop Drawings required under Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
   4. Installation instructions, operating and/or service manuals, and all other operating data. Preventive maintenance instructions and recommended frequency.
   5. Service data sheets showing design performance, utility requirements, etc., as applicable.
   6. Renewal parts list diagrammatic or cross-section drawings showing part identification. Material analysis or traders designation for each significant part is to be noted on parts lists or on a separate sheet.
   7. Submit test certificates.

B. Certificates: Submit Certificates of Compliance with referenced standards.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 15051, Buried Piping Installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Joints shall be as specified in piping schedules in Section 15051, Buried Piping Installation. If not specified, provide flanged joints for exposed piping and push-on or mechanical joints for buried piping. Couplings shall be provided on pipe with plain ends, where shown or where approved by ENGINEER.

B. Ductile Iron Pipe and Fittings:
   1. Flanged Pipe: Fabricate in accordance with requirements of AWWA C115.
      a. Thickness: As shown on Piping Schedules. If not shown, use Special Thickness Class 53.
      b. All exposed DIP shall be flanged.
      c. Mechanical groove and shouldered type fittings are not acceptable.
   2. Non-Flanged Pipe: Conform to AWWA C151 for material, pressure, dimensions, tolerances, tests, markings, and other requirements.
      a. Pressure: As shown on Piping Schedules. If not shown, use Pressure Class 350 (Buried Piping).
      b. Special Thickness Class 53 (Exposed Piping).
   3. Joints:
      a. Flanged Joints: Conform to AWWA C110 and C115 capable of meeting, working, and test pressure specified in Section 15051, Buried Piping Installation.
         1) Gaskets: High temperature resistant sealing compounds (Loctite PST 592) or equivalent with Dimethacrylate ester base and Teflon can be used.
            a) Gaskets: Unless otherwise specified, gasket stock shall be a synthetic rubber, 1/8-inch thick, full face compound in which the elastomer is nitrile or neoprene. The compound shall contain not less than 50% by volume nitrile or neoprene and shall be free from factice, reclaimed rubber, and other deleterious substances. Gaskets shall comply with AWWA C111 for push-on and mechanical joints.
         2) Bolts and Nuts: Conform to ANSI B18.2.1 and ANSI B18.2.2, respectively. Exposed bolts and nuts shall be ASTM A307, Grade B. Buried or submerged bolts and nuts shall be Type 316 stainless steel.
      b. Mechanical Joints: Conform to AWWA C153 or AWWA C110 and AWWA C111.
         1) Glands: Ductile iron.
         2) Gaskets: Plain tip.
         3) Bolts and Nuts: High strength, low alloy steel.
      c. Push-On Joints: Conform to AWWA C111.
         1) Gaskets: Molded rubber.
         2) Stripes: Each plain end shall be painted with a circular stripe to provide a guide for visual check that joint is properly assembled.
      d. Restrained Push-On Joints: Restrained push-on joints shall be capable of being deflected after full assembly. Joint assembly shall be in strict conformance with AWWA C600 and manufacturer's recommendations. No field cuts of restrained pipe are permitted without prior approval of the ENGINEER.
      e. Restrained Mechanical Joints:
         1) Restrained joints for mechanical joint piping shall be one of the following:

a) Push-On-Restrained Joint, as manufactured by Clow Cast Iron Pipe and Foundry Division of the Clow Corporation.
b) Megalug, as manufactured by EBBA Iron Sales, Inc.
c) Or equal.

2) Restrained joints for push-on joint piping shall be one of the following:
a) Clow Super-lock Joint Pipe Style F-128, as manufactured by Clow Cast Iron Pipe and Foundry Division of Clow Corporation.
b) Lok-Ring Joint, as manufactured by American Cast Iron Pipe Company.
c) Push-On Restrained piping shall be provided by a single manufacturer.
d) Or equal.

4. Flanged Fittings: Conform to AWWA C110 or C115.
   a. Pressure Rating: 150 psig.
   b. Material: Ductile iron.
   c. Gaskets: As specified above for joints.
   d. Bolts and Nuts: As specified above for joints.
5. Mechanical Joint Fittings: Conform to AWWA C110 or AWWA C153.
   a. Pressure Rating: 150 psig.
   b. Material: Ductile iron.
   c. Glands: Use ductile iron glands only. Cast iron glands are not allowed.
   d. Gaskets: As specified above for joints.
   e. Bolts and Nuts: As specified above for joints.
6. Coatings:
   a. Bituminous Coatings: Buried pipe and fittings shall be coated on the outside with a bituminous coating, approximately 1 mil thick. Buried pipe shall be provided with polyethylene encasement in accordance with Section 15051, Buried Piping Installation.
   b. Polywrap: All buried ductile iron pipe, valves, and fittings shall be wrapped in a polyethylene sleeve or sheet for protection against corrosive soils. The polyethylene sleeve for protective wrap shall conform to the requirements of ANSI/AWWA C105/A21.5-05 and be as manufactured by the American Cast Iron Pipe Company or equal. Installation of polyethylene wrap shall be per MAG 610.
7. Linings:
   a. Provide linings as specified in the Pipe Schedules. Pipe and fittings shall be lined with the same materials.
   b. Cement mortar lining shall be performed in accordance with AWWA C104.
   c. Bituminous seal coating shall be performed in accordance with AWWA C104.
   d. Epoxy Lining:
      1) Condition of Ductile Iron Prior to Surface Preparation:

a) No asphalt, cement, or other lining shall be applied to interior of pipe and fittings prior to epoxy lining.
b) No asphalt, cement, or other coating shall be applied to the first 6-inches of the exterior of the pipe ends.

2) Epoxy Lining Material: The material shall be an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. Epoxy lining material manufacturer shall demonstrate a successful history of lining pipe and fittings for sewer service and submit a test report verifying the following properties and a certification of the test results.
   a) A permeability rating of 0.00 when tested according to Method A of ASTM E96-66, Procedure A, with a test duration of 30 days.
   b) The following tests shall be run on coupons from factory lined ductile iron pipe:
      i. ASTM B1117 Salt Spray (scribed panel): Results to equal 0.0 undercutting after two years.
      ii. ASTM G95 Cathodic Disbondment 1.5 volts @ 77° F: Results to equal no more than 0.5 mm undercutting after 30 days.
      iii. Immersion Testing rated using ASTM D714-87:
         i) 20% Sulfuric Acid: No effect after two years.
         ii) 25% Sodium Hydroxide: No effect after two years.
         iii) 160° F Distilled Water: No effect after two years.
         iv) 120° F Tap Water (scribed panel): 0.0 undercutting after two years with no effect.
   c) An abrasion resistance of no more than 4 mils loss after one million cycles - European Standard EN 598: 1994 Section 7.8 Abrasion Resistance.
3) Interior of the pipe shall receive 40 mils dry film thickness.
4) Applicator: The lining shall be applied by a competent firm with a successful history of applying linings to the interior of ductile iron pipe and fittings.
5) Surface Preparation: Pipe surfaces shall be cleaned and sandblasted prior to lining application in accordance with manufacturer's recommended procedures.
6) Inspection and Certification:
   a) All ductile iron pipe and fitting linings shall be checked for thickness using a magnetic film thickness gauge. The thickness testing shall be done using the method outlined in SSPC-PA-2 Film Thickness Rating.
   b) The interior lining of all pipe barrels and fittings shall be tested for pinholes with a non-destructive 2,500 volt test. Any defects found shall be repaired prior to shipment.

c) The pipe or fitting manufacturer shall supply a certificate attesting to the fact that the applicator met the requirements of this Specification.

7) Produce and Manufacturer: Provide one of the following
   a) Protecto 401.
   b) No other product or manufacturer will be accepted.

8) Mortar lining with an epoxy top coat is not acceptable.

C. Couplings:
   1. Refer to Section 15120, Piping Specialties and Accessories.

D. Specials:
   1. Transition Pieces:
      a. Furnish suitable transition pieces (adapters) for connections to process piping.
   2. Taps:
      a. Provide taps where shown or required for small diameter pipe connections.
      b. Provide corporation stops where shown or required.
      c. Where pipe wall thickness or tap diameter will not permit the engagement of two full threads, provide a tapping saddle as manufactured by Ford, Model No. FC 202.
   3. Tangential Outlets:
      a. Provide tangential outlet fittings, as shown on the Drawings.

E. Pipe and fittings shall be the product of the product of a single manufacturer.

2.2 MARKING FOR IDENTIFICATION

A. All pipeline materials shall be stamped, marked, or identified with the following:
   1. Name or trade mark of the manufacturer.
   2. Pipe class.
   3. Size and length dimensions.
   4. Date and place of manufacture.

2.3 SURFACE PREPARATION AND SHOP PAINTING

A. Buried Pipe and Fittings:
   1. Refer to Paragraph 2.1.B.6.b, above.

PART 3 - EXECUTION

3.1 INSTALLATION

A. For buried piping installation, refer to Section 15051, Buried Piping Installation.

3.2 INSPECTION

A. CONTRACTOR shall inspect all piping to assure that piping is free from defects in material and workmanship. The compatibility of all pipe, fittings, and coatings shall be verified by CONTRACTOR.

END OF SECTION

SECTION 15064

COPPER PIPE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown on the Drawings, specified and required to furnish and install copper pipe and fittings.
   2. The extent of the piping is shown on the Drawings and Section 15050, Piping Systems, Section 15051, Buried Piping Installation, and Section 15052 Exposed Piping Installation.
   3. All jointing materials, end caps and other appurtenances and accessories shall be provided.
   4. It is the intent of the Contract Documents to provide complete and workable piping systems. Any supplementary fittings and appurtenances required for proper completion of the Work shall be considered as having been included under this Section.

B Related Sections:
   1. Section 02200, Earthwork.
   2. Section 15050, Piping Systems.
   3. Section 15051, Buried Piping Installation.
   4. Section 15052, Exposed Piping Installation.
   5. Section 15120, Piping Specialties and Accessories.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years experience in the production of copper pipe and fittings, and shall be able to show evidence of satisfactory service in at least five installations.
   2. Each type of pipe and fitting shall be obtained from no more than one manufacturer.

B. Requirements of Regulatory Agencies: Comply with the applicable provisions of the following regulatory agencies, where applicable:
   1. ASME, Boiler and Pressure Vessel Code.
   2. National Fire Protection Association.
   3. Underwriters' Laboratories, Incorporated.
   4. Uniform Plumbing Code.
   5. State and Local Building Codes and Ordinances.

C. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. ANSI B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
   2. ANSI B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
   3. ASTM B32, Specification for Solder Metal.
   4. ASTM B42, Specification for Seamless Copper Pipe, Standard Size.
   5. ASTM B68, Specification for Seamless Copper Tube, Bright Annealed.
   6. ASTM B75, Specification for Seamless Copper Tube.
   7. ASTM B88, Specification for Seamless Copper Water Tube.
   8. ASTM B280, Specification for Seamless Copper Tube for Air-Conditioning and Refrigeration Field Service.
   9. ASTM B302, Specification for Threadless Copper Pipe, Standard Sizes.
   10. ASTM B306, Specification for Copper Drainage Tube (DWV).

D. Inspection: The quality of all materials provided and adequacy of installation shall be subject to the review and approval of the ENGINEER.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Detailed drawings and data on pipe fittings and appurtenances. Submit these with Shop Drawings required under Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.

B. Certificates: Where specified or otherwise required by the ENGINEER submit test certificates. Submit certificates of compliance with referenced standards.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Potable Piping: Potable piping shall conform to the requirements of ASTM B88. Underground, buried piping, unless otherwise specified, shall be Type K. All fittings shall be soldered, except at valves which may be flared, compression types or threaded type supplied with solder socket by threaded adaptors. Exposed piping shall be Type L, unless otherwise specified.

B. Threadless Copper Pipe: Pipe shall be assembled with brazing-joint pipe fittings. Material shall conform to ASTM B302.

C. Copper Drainage Pipe: Pipe for sanitary drainage or soil, waste and vent pipe, shall conform to ASTM B306.

D. Couplings and fittings for copper tubing:
   1. Unless otherwise specified, couplings for copper tubing 1/2-inch and smaller nominal diameter shall be compression type, bronze or brass, capable of holding the full bursting strength of the tubing and shall meet the requirements of ANSI B16.26.
   2. Product and Manufacturer: Provide fittings and couplings for copper tubing by one of the following:
      a. Swagelok.
      b. Gyrolok.
      c. Or equal.

2.2 JOINTS

A. Potable water piping shall be assembled with soldered type joints. Fittings shall conform to ANSI B 16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
   1. Soldered joints shall be 95-5 tin- antimony solder, conforming to ASTM B32

B. All joints shall conform to manufacturer's recommendations and shall be made by skilled workmen.

C. Joints shall develop full strength and shall be greater than the pipe joined.

2.3 MARKING

A. All items shall be marked or labeled with the following information:
   1. Metal or alloy designation.
   2. Temper.
   3. Size and schedule.
   4. ASTM specification number.
   5. Name and location of supplier.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Section 15050, Piping Systems, Section 15051, Buried Piping Installation, for installation, testing and cleaning.

B. Refer to Section 15050, Piping Systems, and Section 15052, Exposed Piping Installation, for installation, testing and cleaning.

C. Dielectric Protection: Copper tubing or fittings shall not be permitted to come in contact with steel piping, reinforcing steel, or other steel at any location. Electrical checks shall be made to ensure no contact is made between copper tubing and steel elements. Wherever electrical contact is demonstrated by such tests, CONTRACTOR shall provide dielectric protection as specified in Section 15120, Piping Specialties and Accessories.

END OF SECTION

SECTION 15070

HDPE PRESSURE PIPE

PART 1 - GENERAL

1.1 SUMMARY

A. The CONTRACTOR shall provide buried solid wall high density polyethylene (HDPE) pressure pipe with thermal butt fusion joints complete in place, in accordance with ASTM F714 and AWWA as modified by the Contract Documents.

B. A single pipe supplier shall be responsible for furnishing all HDPE pipe. This does not prevent multiple pipe and fitting manufacturers; however, supplier of the HDPE pipe shall direct all Work. The responsibility of the pipe supplier, at a minimum, shall include:
   1. Certify all pipe and fittings are being manufactured in full accordance with the Contract Documents.
   2. Manage the design and fabrication of the pipe and fittings.
   3. Prepare and submit all submittal information and shop drawings.
   4. Make any corrections that may be required to the submittal information and shop drawings.

1.2 RELATED SECTIONS

A. Section 01300, Submittals.

B. Section 02200, Earthwork.

C. Section 15050, Piping Systems.

D. Section 15051, Buried Piping Installation.

1.3 REFERENCES

A. Except as modified or supplemented herein, all HDPE pressure pipe shall conform to the applicable requirements of AWWA and ASTM F714 for PE4710 pipe material.

B. ASTM D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

C. ASTM F704. Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

D. ASTM D3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing .

E. ASTM F2620, Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings .

F. ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings: NPS 1/2 through 24 - Metric/Inch Standard.

G. ASME B 18.2.1, Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series).

H. ASTM A193, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.

I. ASTM A194, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

J. AWWA C906, Polyethylene (Pe) Pressure Pipe & Fittings 4 In (100 Mm) Thru 63 In (1,575 Mm) For Water Distribution And Transmission.

K. ASTM F2164, Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure

L. City of Chandler, Detail C408.

1.4 SUBMITTALS

A. Drawings and data shall be submitted in accordance with the data reference symbols defined in Section 01300, Submittals.

B. Each Shop Drawing Submittal shall include a hard copy of the relevant Specification Section and shall be clearly marked to indicate whether the requirements for equipment and/or services in the Specification Section are met by writing "accept" or "deviate" next to each Paragraph. If clarifications are needed to any of the Paragraphs in the Specification Sections due to deviations, they shall be addressed next to the Paragraph as such and explained further with any additional information necessary. If any exceptions and/or deviations are proposed to any of the Specifications, they shall be clearly noted as such in the Submittal, and an explanation of any deviation and/or exception shall be provided. The CONTRACTOR shall furnish equipment and/or services as

specified if an exception and/or deviation is rejected. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

C. Certified dimensional drawings of all pipe, fittings and appurtenances.

D. Pipe Laying Schedule Information.
   1. Pipe laying schedule, marking diagrams that indicate the unique identification number of each pipe and fitting and the location of each pipe and the direction of each fitting in the completed line. In addition, the line layouts shall include the station and centerline or invert elevation to which the pipe will be laid; all elements of curves and bends, both in horizontal and vertical alignment and the limits of concrete encasement.
   2. The pipe laying schedule shall have a sequence of laying and an explanation of all abbreviations used in the schedule. For long, straight pipe runs, the pipe laying schedule shall list the pipeline station and either the pipe centerline or invert elevation coordinated with the Drawings at least every 100 feet.
   3. Drawings showing proposed location and details for hydrostatic testing of the pipeline.
   4. Details and locations of closures for length adjustment.
   5. The method that the CONTRACTOR proposes to use for measuring deflection of pipe joints.

E. Fusion Information. Submit the following prior to performing any Work:
   1. Written fusion procedures.
   2. Documentation that the fusion operators have received training per the manufacturer's recommended procedure. The CONTRACTOR shall maintain records of trained personnel and shall certify that training was received not more than 12 months before commencing construction.
   3. Data Logger specification and sample report. At a minimum, reports shall include fusion operator, time, date, heater temperature, pressure, and station number of joint.
   4. Log listing for all fusion operators to be used for the Work.
   5. Fusion map showing the sequence of fusions.
   6. Fusion machine(s) specification and maintenance log.
   7. Shop drawings and fusion information together as a complete package.

F. Detail drawings indicating the type, number and other pertinent details of the slings and other methods proposed for pipe support and handling during manufacturing, transport, and installation. Documentation confirming that the handling and support system has been designed and sealed by a registered professional engineer, licensed in the State of Arizona. The recommended methods of handling and placement of the pipe shall be submitted to the City as a

record copy prior to transporting of any pipe to the Site. All pipe handling equipment and methods shall be acceptable to the City.

G. For record copy, detailed drawings indicating loading and shipping procedures that are designed to minimize damage to pipe

H. Pipe manufacturer's Written Quality Assurance/Control Program.

I. Sample of pipeline conductive tracer.

1.5 MANUFACTURER QUALIFICATIONS

A. The CONTRACTOR shall submit the qualifications for the pipe manufacturers. Qualifications shall include the following:
   1. Pipe Supplier Information. Submit company name, contact name, and contact number.
   2. Years of Experience. Submit written verification that the pipe manufacturer has been manufacturing ASTM F714 pipe with similar design pressure and size as this Project for a minimum of five years.
   3. Project Experience. Submit written verification that the pipe manufacturer has produced a minimum of 45,000 linear feet of 30-inch or larger pipe. Submit reference names, telephone numbers, and descriptions of projects for pipe conforming to ASTM F714 and this requirement. Descriptions for applicable projects shall include, but not be limited to, length, diameter, SDR, location of facility where pipe was manufactured and names and titles of key plant personnel involved with the Work.
   4. Personnel Qualifications. Submit names, titles and qualifications of current plant personnel to be used to manufacture/fabricate pipe for the Work and the experienced pipe manufacturer's representative proposed for onsite observation. Pipe manufacturer's representative shall be as specified in the Submittals Procedures section and as specified in this Section. Experience shall be applicable to the fabrication plant facilities and personnel and is not required to be specifically related to the company or corporation that currently owns the fabrication facility or employs the personnel.
   5. Production and Delivery Capability. Submit written verification from the pipe manufacturer/fabricator demonstrating compliance with the production and delivery schedule of the pipe as indicated in the CONTRACTOR's preliminary construction schedule.

1.6 QUALITY ASSURANCE

A. The pipe manufacturer shall provide the services of an experienced, competent, and authorized representative to visit the site of the work to advise and consult with CONTRACTOR during joining and installation of the pipe. The

manufacturer's representative shall not directly supervise CONTRACTOR's personnel, and CONTRACTOR shall remain responsible for the pipeline work.

B. Fusion joints shall be made by qualified fusion technicians who shall demonstrate fusion experience on projects completed within a year of the CONTRACTOR's NTP date which included similar or larger installation lengths, similar pipe sizes (+/- 2 pipe sizes) and similar DRs (+/- 2 DRs).

C. Storage and handling shall meet the requirements of Product Storage and Handling Requirements section, and shall be in accordance with Chapter 7, Transportation, Handling and Storage of Pipe and Fittings of AWWA Manual M55, to ensure installation in sound, undamaged conditions. Pipe shall not be stored uncovered in direct sunlight.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN REQUIREMENTS

A. The dimension ratios (DRs) of HDPE pressure pipe shall be as indicated in the following table:

Location	Nominal Size inches	DR
Per Plans	42	19

2.2 MATERIALS

Pipe	PE4710 (ASTM F714) high density polyethylene, minimum cell classification 445574C as determined by ASTM D3350, IPS (Iron Pipe Size). Pressure class and wall thickness as specified herein. Thermal butt fusion joints, ASTM D3261. Green striped.
Heat Fusion Joints	Butt fusion joints, ASTM D3261; manufactured by injection molding; pressure class of the pipe or greater. Transitions between unlike wall thickness equal to one Standard DR shall be butt fusion joints, ASTM F2620. Shall have the same pressure rating as the adjoining pipe unless

	otherwise specified.
Flanged Joints	
HDPE Flange Adapters	PE4710 (ASTM F714) high density polyethylene, minimum cell classification 445574C. Shall have a manufacturing standard of ASTM D3261. Shall have the same pressure rating as the adjoining pipe unless otherwise specified. Stub Ends are not allowed.
Backup Rings	Convoluted Type per ANSI/ASME B16.5, Class 150, AISI 316, or 316L. Rings shall be equally or greater pressure rated than the pipe, unless otherwise specified. Plate rings are not allowed.
Flange Bolts	ASTM A193 Class 2, AISI Type 316, ANSI B18.2.1, heavy hex head, length such that, after installation, the bolts will project 1/8 to 3/8 inch beyond outer face of the nut.
Flange Nuts	ASTM A194, AISI Type 316, ANSI/ASME B18.2.2, heavy hex pattern. Washers shall be installed under the nuts.
	Smith Blair, Model 975, AISI Type 316
Dismantling Joints	All dismantling joints shall be restrained
Fittings	PE4710 (ASTM F714) high density polyethylene, minimum cell classification 445574C.
Electrofusion Type	ASTM F1055 having pressure class equivalent to the pipe or greater as required.
Fabricated Type	Meet applicable AWWA C906 requirements; pressure class and cell class equivalent to the pipe or greater as required.
Molded Types	Shall be manufactured and tested in accordance with ASTM D3261. Shall have the same pressure rating as the adjoining pipe unless otherwise specified.
Other Types	Subject to review by the Engineer.
Coal Tar Epoxy	High-build coal tar epoxy; Ameron "Amercoat 78HB Coal Tar Epoxy", Carboline "Bitumastic 300 M", Tnemec "46H-413

	Hi-Build Tneme-Tar", or Sherwin-Williams "Hi-Mil Sher-Tar Epoxy".
Conductive Tracer	Detection tape, 3 inches wide; aluminum foil core, 0.5 mil thick, encased in a protective inert plastic jacket; 5,000 psi min tensile strength; 2.5 lb/inch per 1,000 feet min weight; color coded in accordance with APWA Uniform Color Code; Allen Systems "Detectatape", Lineguard "Type III", or Reff Industries "Terra Tape D".
Identification Tape	Per City of Chandler Detail C-408

PART 3 - EXECUTION

3.1 INSPECTION

A. Pipe and fittings shall be carefully examined for cracks and other defects immediately before installation, with special attention to pipe ends. All defective pipe and fittings shall be removed from the site of the work.

3.2 INSTALLATION

A. Laying Pipe. Pipe shall be protected from lateral displacement by pipe embedment material installed as specified in the Trenching and Backfilling section. Pipe shall not be laid in water or under unsuitable weather or trench conditions, and shall be protected against entry of foreign matter.
   1. During freezing weather, particular care shall be taken in handling and laying pipe to prevent damage by impact.
   2. Whenever pipe laying is stopped, the open end of the line shall be closed with a tight-fitting end board to keep out sand and earth. The end board shall have several perforations near its center to admit water into the pipe, to prevent flotation in the event the trench is flooded. Any standing water shall be removed from the trench before the end board is removed.
   3. Pipe shall be protected from extended exposure to sunlight, shall be kept as cool as possible during installation, and shall be covered with backfill immediately after installation.
   4. Conductive tracer shall be installed per City of Chandler Detail C-408.

B. Cleaning. The interior of all pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean until the work has been accepted.

C. Alignment. Piping shall be laid to the lines and grades indicated on the drawings. Pipelines or runs intended to be straight shall be laid straight. Deflections from a

straight line or grade shall not exceed the maximum deflection specified by the manufacturer.

1. Unless otherwise specified or indicated on the drawings, and subject to acceptance of the Engineer, either shorter pipe sections or fittings shall be installed as required to maintain the indicated pipeline alignment or grade.

D. Cutting Pipe. Cutting shall be in accordance with the pipe manufacturer's recommendations. Cuts shall be smooth, straight, and at right angle to the pipe axis. After cutting, the end of the pipe shall be dressed to remove all roughness and sharp corners and shall be beveled in accordance with the manufacturer's instructions.

E. Jointing. Jointing of pipe and fittings shall be performed in accordance with the instructions and recommendations of the pipe manufacturer and in accordance with ASTM F2620. Sections of HDPE pipe shall be joined above ground into continuous lengths by the thermal butt fusion method. All fusions shall be made with fusion equipment equipped with a Data Logger.

1. Where required, electrofusion shall be performed in accordance with ASTM F1055 and the manufacturer recommended procedure.
2. Socket fusion and extrusion welding or hot gas welding will not be acceptable.
3. All joining procedures shall be acceptable to Engineer.

F. Connections with Existing Piping. Connections between new work and existing piping shall be made using suitable fittings. Each connection with an existing pipe shall be made at a time and under conditions which will least interfere with service to customers, and as authorized by the City. Facilities shall be provided for proper dewatering and for disposal of all water removed from the dewatered lines and excavations without damage to adjacent property.

G. Flange Installation. Flange connections shall be installed in accordance with the manufacturer's recommended procedure. Flanges shall be centered and aligned to the mating component before assembling and tightening bolts. In no case shall flange bolts be used to draw the connection into alignment. Bolt threads shall be lubricated, and flat washers should be used under the nuts. Bolts shall be evenly tightened according to the tightening pattern and torque step recommendations of the manufacturer. At least 1 hour after initial assembly, flange connections shall be re-tightened following the tightening pattern and torque step recommendations of the manufacturer. Connections shall be retightened a second time after at least 4 hours in accordance with manufacturer's recommendations. The final tightening torque shall be as recommended by the gasket manufacturer

H. Concrete Encasement. Concrete encasement shall be installed as indicated on the drawings. Concrete and reinforcing steel shall be as specified in the Cast-in-Place

Concrete section. All pipes to be encased shall be suitably supported and blocked in proper position and shall be anchored against flotation.

I. Reaction Anchorage and Blocking. All tees and plugs installed in piping subject to internal hydrostatic head in excess of 30 feet shall be provided with suitable reaction blocking, anchors, joint harnesses, or other acceptable means of preventing movement of the pipe caused by internal pressure.
   1. Concrete blocking shall extend from the fitting to solid undisturbed earth and shall be installed so that all joints are accessible for repair. The dimensions of concrete reaction blocking shall be as indicated on the drawings or as directed by Engineer.
   2. Reaction blocking, anchorages, or other supports for fittings installed in fill or in other unstable ground shall be provided as indicated on the drawings or as directed by Engineer.

J. Protective Coating. All steel clamps, rods, bolts, and other metal components of tapping saddles or reaction anchorages subject to submergence or in contact with earth or other fill material, and not encased in concrete, shall be protected from corrosion by two coats of coal tar paint applied to clean, dry surfaces. The first coat shall be dry and hard before the second coat is applied.

3.3 FIELD QUALITY CONTROL

A. Hydrostatic Tests. After installation, HDPE piping shall be hydrostatically tested for defective workmanship and materials as specified below:

   1. Pressure Testing. After the piping to be tested has been filled with water, the test pressure shall be applied and maintained without interruption within plus or minus 5 psi of test pressure for 2 hours plus any additional time required for the Engineer to examine all piping being tested and for the CONTRACTOR to locate any defective joints and pipe materials. The test pressure shall be in accordance with the requirements specified for the pipeline or plant piping.

      a. Pipeline Test Pressure. Piping shall be subjected to a hydrostatic test pressure indicated as:

         42" HDPE Pipe Test Pressure Plane Elevation: 1,300 ft (NAVD88)

         The test pressure, expressed in feet of water, to be applied at any point in the piping shall be equivalent to the arithmetic difference between the specified test pressure plane elevation and the elevation of the horizontal center line of the piping at the selected location. The valve obtained shall be multiplied by .433 to obtain psi.

B. Leakage. All HDPE piping shall be watertight and free from leaks. Each leak that is discovered within the correction period stipulated in the General Conditions shall be repaired by and at the expense of CONTRACTOR.

C. Fusion Joint Tests. Bent Strap Test in accordance to ASTM F2620 shall be performed on the first fusion of the project. In addition, the CONTRACTOR shall perform Bent Strap Test in accordance to ASTM F2620 whenever a fusion operator whose work has not yet been Bent Strap Tested performs a fusion for the first time and randomly as requested by the City at the expense of the CONTRACTOR.

D. Pipe Deflection Tests. Pipe shall be measured for deflection at 50 foot intervals unless otherwise required by the City.

E. Fusion Bead Visual Inspection. Each fusion joint shall be inspected to check for fusion uniformity and alignment. A double-bead will be formed in the fusion process. Each side of the double bead shall be equally rolled over the surface of the pipe, uniformly rounded, and consistent in size around the perimeter of the joint. The width of the double bead should be 2 to 2 ½ times the bead height above the pipe surface. The v-groove depth between the beads should not be more than ½ the bead height. A fusion bead troubleshooting guide from the pipe supplier shall be available on site at all times.

END OF SECTION

SECTION 15114

FLEXIBLE CHECK VALVES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals required to furnish and install all check valves and appurtenances complete and operational as shown on the Drawings and as specified.
   2. The Work includes, but is not necessarily limited to, all types of valves required for buried, exposed, submerged and other types of piping, except where otherwise specifically included in other Sections.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate with the Work which is related to this Section including buried piping installation, exposed piping installation and site utilities.

C. Related Sections: CONTRACTOR shall coordinate the requirements of this Section along with the requirements of the Sections listed below which includes, but not necessarily limited to, Work that is directly related to this Section.
   1. Section 01640, Materials and Equipment.
   2. Section 15050, Piping Systems.
   3. Section 15052, Exposed Piping Installation.
   4. Section 15061, Ductile Iron Pipe for Wastewater Service.
   5. Section 15064, Copper Pipe.
   6. Section 15070, HDPE Pressure Pipe.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years experience of producing substantially similar equipment, and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.
   2. Each type of check valve shall be the product of one manufacturer.
   3. Manufacturer shall have compatibility with ISO 9000 standards.
   4. Manufacturer shall perform hydraulic tests on valves through 48-inches for flow capacity, head loss, and jet velocity at a qualified flow test laboratory. Manufacturer shall provide test data upon request.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. AGMA Standards.

2. ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
3. ANSI B16.4, Cast Iron Fittings.
4. ASTM A48, Specification for Gray Iron Castings.
5. ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
6. ASTM A216, Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
7. ASTM A240, Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
8. ASTM A285, Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength.
9. ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
10. ASTM A354, Specification for Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners.
11. ASTM A436, Specification for Austenitic Gray Iron Castings.
12. ASTM A536, Specification for Ductile Iron Castings.
13. ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
14. ASTM D1784, Specification for Rigid Poly (Vinyl Chloride) PVC Compounds and Chlorinated Poly (Vinyl Chloride) CPVC compounds.
15. AWWA C111, Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.
16. AWWA C506, Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.
18. NEMA, National Electrical Manufacturer's Association.
19. NSF 61, Drinking Water System Components-Health Effects.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Manufacturer's literature that includes information on the performance and operation of the valve, materials of construction, flow data, dimensions and weights, elastomer characteristics, head loss data, and pressure ratings.
   2. Deviations from Contract Documents.

B. Operation and Maintenance Manuals:
   1. Submit complete installation, operation and maintenance manuals including test reports, maintenance data and schedules, description of operation, and spare parts information.
   2. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01781, Operation and Maintenance Data.

C. Certificates: Where specified or otherwise required by ENGINEER, submit test certificates.

D. Each Shop Drawing Submittal shall include a hard copy of the relevant Specification Section and shall be clearly marked to indicate whether the

requirements for equipment and/or services in the Specification Section are met by writing "accept" or "deviate" next to each Paragraph. If clarifications are needed to any of the Paragraphs in the Specification Sections due to deviations, they shall be addressed next to the Paragraph as such and explained further with any additional information necessary. If any exceptions and/or deviations are proposed to any of the Specifications, they shall be clearly noted as such in the Submittal, and an explanation of any deviation and/or exception shall be provided. The CONTRACTOR shall furnish equipment and/or services as specified if an exception and/or deviation is rejected. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to not delay the Work.

B. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the site. Notify ENGINEER if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition, in accordance with manufacturer's instructions.

C. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms or other supports. Protect steel members and packaged materials from corrosion and deterioration.

D. Store all mechanical equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long term storage.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:
   1. Check Valves are to be of an all rubber design operated check type with a slip-on or flanged connection. The Check Valve shall be flanged and drilled to comply with CONTRACTOR supplied specifications. The inlet area shall taper to a duckbill, which shall allow flow in one direction only. The valve shall be a one piece rubber construction with appropriate reinforcement.
   2. Unless otherwise specified, all flanged valves shall have ends conforming to ANSI B16.1. The pressure class of the flanges shall be equal to or greater than the specified pressure rating of the valves.

3. All bolts, nuts and studs on or required to connect buried or submerged valves shall be Type 316 stainless steel.
4. All bolts and studs embedded in concrete and studs required for wall pipe shall be of Type 316 stainless steel.
5. For stainless steel bolting, except where Nitronic-60 nuts are required, use anti-seize compound, graphite free, to prevent galling. Strength of the joint shall not be affected by the use of anti-seize compound.
6. All other bolts, nuts and studs shall, unless otherwise approved, conform to ASTM A307, Grade B; or ASTM A354.
7. Bolts and nuts shall have hexagon heads and nuts.
8. Gasket material and installation shall conform to manufacturer's recommendations.
9. Identification: Identify each valve 4-inches and larger with a stainless steel nameplate stamped with the approved designation. Nameplate shall be permanently fastened to valve body at the factory. Stenciled designations are acceptable for buried valves.
10. All materials of construction of the valves shall be suitable for the applications as shown on the Drawings.
11. Company name and location, valve size and serial number shall be bonded to the check valve.
12. Standard materials of construction will be NSF61 certified Nitrile tube with a NSF61 certified Nitrile cover.

B. Flexible Check Valves - Liquid Service:
   1. General:
      a. When internal pressure inside the valve exceeds the backpressure being exerted on outside of the valve by a definite amount; the internal pressure opens the valves bill and allows media to flow out. When backpressure surpasses the internal line pressure by at least the same amount, the bills of the valve will close and remain that way until the internal pressure is again greater.
   2. Product and Manufacturer: Provide one of the following:
      a. Proco Series 710.
      b. Series 35 as manufactured by Tideflex Technologies Inc.
      c. Or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all valves and appurtenances in accordance with manufacturer's instructions and recommendations.

B. Unless otherwise approved by the ENGINEER, install all valves plumb and level. Install valves free from distortion and strain caused by misaligned piping, equipment or other causes.

3.2 FIELD TESTS AND ADJUSTMENTS

A. Adjust all parts and components as required to provide correct operation.

B. Conduct functional field test of each valve in presence of ENGINEER to demonstrate that each part and all components together function correctly.

3.3 MANUFACTURER'S SERVICE

A. A factory trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of three visits, four hours per visit, to the site. The first visit shall be for assistance in the installation of equipment. The second visit shall be for checking the completed installation and start-up of the system. The third visit shall be as described under Section 01821, Instruction of Operations and Maintenance Personnel. Manufacturer's representative shall test operate the system in the presence of the ENGINEER and verify that valves conform to the requirements. Manufacturer's representative shall revisit the job site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

B. All costs, including travel, lodging, meals and incidentals, shall be considered as included in CONTRACTOR'S bid price.

++ END OF SECTION ++

SECTION 15120

PIPING SPECIALTIES AND ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install all piping specialties and accessories. Included, but not limited to, are flexible couplings, mechanical couplings, flanged and harnessed adapters, and expansion joints.

B. Related Sections:
   1. Section 09900, Painting.
   2. Section 11295, Hydraulic Valves.
   3. Division 15, Mechanical.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have a minimum of five years of experience in the production of substantially similar types of piping specialties specified and shall show evidence of satisfactory service in at least five installations.
   2. Each type of piping specialty and accessory shall be the product of one manufacturer.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
   1. Detailed drawings and data on each type of coupling, adaptor, expansion joint, and sight glass to be furnished. Submit and coordinate these with Shop Drawings required for piping systems.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 15051, Buried Piping Installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Couplings: Unless otherwise specified, piping 2-inches in diameter and larger passing from concrete to earth shall be provided with two pipe couplings or flexible joints as specified within 2 feet or one pipe diameter of the structure, whichever is greater.

1. Sleeve Type, Flexible Couplings:
   a. Pressure and Service: Same as connected piping.
   b. Material: Carbon steel for carbon steel and exposed ductile iron piping systems, or stainless steel for stainless steel and buried or submerged ductile iron piping systems.
   c. Gasket: Suitable for wastewater service or high temperature air service.
   d. Bolts and Nuts: Alloy steel, corrosion-resistant, prime coated. Buried couplings shall have Type 316 stainless steel bolts and nuts.
   e. Harnessing:
      1) Harness couplings to restrain pressure piping. Test pressures for pressure pipe lines are included in the Piping Schedules in Section 15051, Buried Piping Installation.
      2) Adjacent flanges shall be tied with bolts of corrosion resistant alloy steel. Provide flange mounted stretcher bolt plates as shown and to be designed by manufacturer, unless otherwise approved.
      3) Conform to dimensions, size, spacing, and materials for lugs, bolts, washers, and nuts as recommended by manufacturer and approved by ENGINEER for the pipe size, wall thickness, and test pressure required. However, the following minimum bolting shall be provided, unless otherwise approved by the ENGINEER.

Pipe Diameter (inches)	Number of Bolts	Bolt Diameter (inches)	At (degrees)
4	2	5/8	180
6-8	2	3/4	180
10-12	2	7/8	180 or 250
14-20	4	1	190
24-48	4	1	90

   f. Remove pipe stop, unless otherwise shown or specified.
   g. Product and Manufacturer: Provide one of the following:
      1) Style 38, as manufactured by Dresser Industries.
      2) Type 411, as manufactured by Rockwell International.
      3) Or equal.
2. Flanged Adapters:
   a. Description: One end of adapter shall be flanged and the other end shall have a sleeve type flexible coupling.
   b. Pressure and Service: Same as connected piping.

c. Material: Cast iron or steel.
d. Gasket: Suitable for wastewater service and can withstand the specified temperature. EPDM gaskets for 250° F air service.
e. Bolts and Nuts: Type 316 stainless steel.
f. Harnessing:
    1) Harness adapters to restrain pressure piping. Test pressures for pressurized pipe lines are included in the piping schedules in Section 15051, Buried Piping Installation.
    2) For adapters 12-inch diameter and less, provide 1/2-inch minimum stainless steel anchor studs installed in a pressure tight anchor boss. Provide number of studs required to restrain test pressure and service conditions. Harness shall be as designed and recommended by manufacturer; however, the following minimum anchor studs shall be provided, unless otherwise approved by ENGINEER.
        a) 6-inch diameter and less: Two.
        b) 8-inch diameter and less: Four.
        c) 10-inch diameter and less: Six.
        d) 12-inch diameter and less: Eight.
    3) For adapters larger than 12-inch diameter, provide split-ring harness clamps with a minimum of four Type 316 stainless steel bolts. Harness assembly shall be as designed and recommended by manufacturer. Dimensions, sizes, spacings, and materials shall be suitable for service and conditions encountered and shall be approved by ENGINEER.
    4) Harness couplings to restrain pressure piping.
    5) Test pressures for pressure pipe lines are included in the piping schedules in Section 15051, Buried Piping Installation.
    6) Harnessing shall conform to the details shown on the Drawings.
g. Product and Manufacturer: Provide one of the following:
    1) Style 120, as manufactured by Dresser Industries.
    2) Type 913, as manufactured by Rockwell International.
    3) Or equal.

B. Rubber Type Expansion Joints:
1. General:
    a. Use rubber type expansion joints at all expansion joint locations, as noted on the Drawings.
2. Construction:
    a. Tube and Cover: Synthetic or natural rubber.
    b. Body:
        1) Fabric Reinforcement: High quality cotton or synthetic fabric impregnated with rubber or other synthetic compounds to permit flexibility.
        2) Metal Reinforcement: Wire or solid steel rings embedded in and bonded to the body rubber.

c. Retaining Rings:
   1) Steel with hot-dipped galvanized coating in accordance with ASTM A123.
   2) Drilled to match flanged drilling.
d. Flanges: Flat faced, ANSI Class 125 drilling.
e. Temperature:
   1) Expansion couplings for ambient service shall be suitable for service temperature up to 300° F at 25 psi pressure.

3. Restraints:
   a. General:
      1) Provide control units on all expansion joints to permit movement and prevent excessive compression or elongation.
      2) Furnish and install control units complete with all tie bolts, drilled plates, spacers, rubber and steel washers, stretcher bolt plates, retaining rings, stretcher bolts, sleeves, and appurtenances, as required.
      3) Design and install all control units to limit expansion and compression to within the manufacturer's standard limits.
      4) Design the stretcher bolts and sleeves to withstand the maximum thrusts developed within the piping system.
      5) Anchor, guide, and install all expansion joints according to the manufacturer's recommendations.
      6) Harness all rubber expansion joints by tying between adjacent flanges.
   b. Materials:
      1) Stretcher Bolts and Nuts:
         a) Material: Type 304 stainless steel.
         b) Number:
            i. Twice the number of stretcher bolts as recommended by manufacturer.
            ii. Minimum four required for each rubber expansion joint.
   c. Washers: Rubber or neoprene.
4. Product and Manufacturer: Provide one of the following:
   a. Standard spool type, single arch by Mercer Rubber Company
   b. Standard spool type, single arch by U.S. Rubber
   c. Or equal.

C. Special Restrainers for PVC Pipe:
   1. All transitions from PVC pipe to DIP shall be provided with a restraining device. The device must not impart point loads or distort PVC pipe. Device shall be a two-piece uni-flange design with machined serrations on the inside diameter of the flange. Device must be rated for all rated pressures of PVC pipe class and range in sizes of 2-inch diameter to 36-inch diameter for PVC pipe. Restrained device shall be Uni-Flange Block Buster 1300, as manufactured by Ford Meter Box.

D. Dielectric Connections:
   1. Where a copper pipe is connected to steel or cast iron pipe, an insulating section of rubber or plastic pipe shall be provided. The insulating section shall have a minimum length of 12 pipe diameters. Dielectric unions may be used instead of the specified insulating sections.
   2. Product and Manufacturer: Provide one of the following:
      a. EPCO.
      b. Capitol Manufacturing.
      c. Or equal.

E. DIP to PVC Adapters:
   1. All transitions from CPVC/PVC pipe to DIP pipe shall be provided with a restraining device. The device must not impart point loads or distort CPVC/PVC pipe. Device shall be two-piece uni-flange design with machine serrations on the inside diameter of the flange. Device must be rated for all rated pressures of CPVC/PVC pipe class and range in sizes of 2-inch diameter to 36-inch diameter for CPVC/PVC pipe. Restrained device shall be Uni-Flange Block Buster 1300 as manufactured by Ford Meter Box.

2.2 PAINTING

A. Clean and prime coat ferrous metal surfaces of equipment in the shop in accordance with the requirements of Section 09900, Painting.

B. Coat machined, polished and non-ferrous surfaces and similar unpainted surfaces with corrosion prevention compound which shall be maintained during storage and until equipment begins operation.

C. Field painting shall conform to the requirements of Section 09900, Painting.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install piping specialties and accessories in accordance with manufacturer's instructions.

B. Make adjustments to expansion joints as required to ensure that they will be fully extended when the ambient temperature is at minimum operating temperature and fully compressed at maximum operating temperature for the system in which they are installed.

END OF SECTION

SECTION 16000

GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Work and materials necessary for erecting a complete electrical and instrumentation system, tested and ready for continuous use.

B. Related Sections:
   1. Division 0, Bid Requirements, Contract Forms, and Contract Conditions.
   2. Division 1, General Requirements.
   3. Division 2, Site Construction.
   4. Division 3, Concrete.
   5. Division 9, Finishes.
   6. Division 11, Equipment.
   7. Division 13, Special Construction.
   8. Division 15, Mechanical.
   9. Division 17, Instrumentation and Controls.

1.2 DEFINITIONS

A. The term "Provide" means "Furnish and Install".

1.3 SYSTEM DESCRIPTION

A. Design Requirements:
   1. If any contradictions, contrasts, or inconsistency appears, the most strict criteria noted and the collective requirements in any and all of the Project documents shall apply.

1.4 SUBMITTALS

A. Intent:
   1. Organize Work so that a complete electrical, instrumentation, and control system for the facility will be provided and will be supported by accurate Shop Drawings, Record Drawings, and O&M Manuals.
   2. Submit detailed Shop Drawings and data prepared and organized by the suppliers. Provide quantity of submittal sets in accordance with the requirements of Division 1, General Requirements.

3. Submittals shall be neatly grouped and organized by Specification Section number, and sub-section. Related information shall be highlighted and the specific product shall be marked. All Submittals shall be complete and presented in one package. Incomplete Submittals will be returned without review. If a portion of the Project requires a fast track schedule, that portion only may be submitted earlier under a separate cover letter.
4. Work performed or equipment provided without ENGINEER approved Submittals is done at CONTRACTOR'S risk. Cost to re-work or re-supply will be born solely by the CONTRACTOR.

B. Product Data:
1. A complete list of the equipment and materials, including the manufacturer's name, product Specification, descriptive data, technical literature, performance charts, catalog cuts, installation instructions, and spare part recommendations for each different item of the equipment specified. The above shall clearly show all the specified requirements as described in the Specifications including but not limited to specific UL and NEMA rating, technical capabilities, test result verifications, and acceptance letters.
2. Submittals not in compliance with the Specifications must include the following information:
   a. Reason for non-compliance or variance.
   b. Calculations and Drawings for redesign of related components, including detail drawings showing internal and assembly details, with installation instructions.
   c. Proposed layout showing any modifications or exceptions to related Work made necessary by this Work, with calculations and drawings showing such modifications or exceptions.

C. Shop Drawings:
1. Drawings containing complete wiring and schematic diagrams, control diagrams, and any other details required to demonstrate that the system has been coordinated and will operate as intended. Drawings shall show proposed layout, anchoring, support, and appurtenances of equipment, and equipment relationship to other parts of the Work, including clearances for maintenance and operations.

D. Utility Coordination:
1. Submit copies of service entrance Shop Drawings to the utility, per utility submittal requirements, prior to submittal to the ENGINEER. Obtain written approval from the power utility company that the service entrance equipment is acceptable prior to release the order to the supplier for fabrication. Provide a copy of the approval letter from the utility with the Submittal.

E. Closeout Submittals:

1. Provide "Record Drawings" of the electrical, control, and instrumentation work to include:
   a. Step-by-step procedure manuals for the installation, operation start-up, and maintenance of the equipment.
   b. Installation, operating, troubleshooting, and maintenance and overhaul instructions in complete detail.
   c. Possible breakdowns and repairs, and troubleshooting guides, as well as simplified wiring and control diagrams of the system installed. This shall provide the OWNER with comprehensive information on all systems and components to enable operation, service, maintenance and repair.
   d. Exploded or other detailed views of all equipment, devices, assemblies, and accessory components shall be included, together with complete parts lists and ordering instructions.
2. Provide an "As Built" set of Plans to OWNER. Maintain at all times a marked up set of Plans showing the following information:
   a. Actual installed circuit numbers, conduit sizes, cable tray routing, number of conductors, conductor sizes (larger than #12 AWG), and all other deviations from the Design Plans.
   b. Underground conduit, duct banks, and concealed items dimensioned on the Plans from permanent, visible, building features.
   c. Actual motor size, starter size, and overload heater size, along with all other protective equipment for all 480 V and 4160 V motor circuits.
   d. Conductor identification and panel schedules.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Electrical work, including connection to electrical equipment integral with mechanical equipment, shall be performed in accordance with the latest published regulations, codes, and standards, of the following:
      a. National Electrical Code (NEC).
      b. State and local codes.
      c. Institute of Electrical and Electronic Engineers (IEEE).
      d. American National Standards Institute (ANSI).
      e. American Society for Testing and Materials (ASTM).
      f. Insulated Cable Engineers Association (ICEA).
      g. National Electrical Manufacturers Association (NEMA) Standards.
      h. Federal Occupational Safety and Health Act (OSHA).
      i. National Fire Protection Association (NFPA).
      j. National Electrical Testing Association (NETA).

1.6 DELIVERY, STORAGE, AND HANDLING

A. Electrical panels, switchgear, motor control centers, and other electrical equipment, shall be shipped in sealed dust and moisture proof plastic sheet enclosures, and the seal maintained until units are installed. Said units shall be new and free of any dirt, dust, water, grease, rust, damaged parts, or components.

1.7 PROJECT/SITE CONDITIONS

A. Verify site conditions before bidding or performing Work.

1.8 SCHEDULING

A. Maintain a Work schedule showing Work to be performed, sequence of Work, major milestones, and manpower loading. Coordinate schedule requirements with other trades. Provide adequate staff to perform the Work in the time required by the schedule.

1.9 SYSTEM START-UP

A. After installation and testing of all electrical and instrumentation equipment and systems, energize all equipment and leave ready for continuous operation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers and model numbers shown on Plans or listed in the Specifications are intended to establish a minimum standard of quality and acceptability.

2.2 MATERIALS

A. Materials, equipment, and parts comprising any unit, or part thereof, specified or indicated on the Plans, shall be new and unused, of current manufacture, and of highest grade consistent with the state of the art. Damaged materials, equipment, and parts are not considered to be new and unused and will not be accepted.

2.3 MANUFACTURED UNITS

A. The fabricator of major components and manufactured units, such as distribution panel boards, switchgear, and motor control centers, shall also be the manufacturer of the major devices therein.

B. Electrical equipment provided with mechanical equipment assemblies shall be in compliance with this Specification.

2.4 EQUIPMENT

A. Minimum sizes of equipment and electrical devices are indicated, but it is not intended to show every offset and fitting, nor every structural or mechanical difficulty that will be encountered during the installation of the Work.

B. Electrical equipment shall be capable of operating successfully at full-rated load, without failure, at an ambient air temperature of 60° C, and specifically rated for the altitude indicated on the Plans. Provide air conditioning to meet the manufacturers' operating temperature for electrical equipment not rated for operation at that temperature.

C. When applicable, the material used in the performance of the electrical work shall be listed by the Underwriters' Laboratories, Inc. (UL), for the class of service for which they are intended.

D. Provide nameplates where indicated elsewhere in these Specifications or on the Plans. Nameplates shall be black laminate with white letters and fastened to the various devices with round head stainless steel screws. Provide nameplates for each disconnecting means for service, feeder, branch, or equipment conductors indicating its purpose.

2.5 FABRICATION

A. Shop Assembly:
   1. Equipment assemblies, such as Service Entrance Sections, Switchgear, Switchboards, Control and Distribution Panels, and other custom fabricated electrical enclosures, shall bear a UL label as a complete assembly. The UL label on the individual components making up the assembly will not be considered sufficient to meet the present requirement. Whenever a generic UL label does not apply for the assembly, a serialized UL label shall be affixed to the assembly, and the serial number shall be submitted with the assembly record Shop Drawings.
   2. Custom fabricated electrical control panels, and enclosures, shall bear a UL label affixed by a local UL inspector.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions:
   1. Verify site conditions before bidding or performing Work.

3.2 INSTALLATION

A. Coordinate Work with other trades and with certified vendor shop drawing submittals.

B. Provide equipment in accordance with the manufacturers' requirements.

C. Identify each conductor as required by the Contract Documents.

D. Equipment Access:
   1. Install equipment so it is readily accessible for operation and maintenance.
   2. Equipment shall not be blocked or concealed.
   3. Do not install electrical equipment such that it interferes with normal maintenance requirements of other equipment.

E. Equipment shall be installed plumb, square and true with the building construction, and shall be securely fastened.

F. Outdoor wall-mounted equipment and indoor equipment mounted on earth or water bearing walls, shall be provided with corrosion-resistant spacers to maintain 1/4-inch separation between the equipment and the wall.

G. Arrange for the building in of equipment during structure construction. Where equipment cannot be built-in during construction, arrange for sleeves, box-outs, and other openings, as required to allow installation of equipment after structure construction is complete.

H. Verify that equipment will fit support layouts indicated.

I. Screen or seal all openings into outdoor equipment to prevent the entrance of rodents and insects.

J. Equipment fabricated from aluminum shall not be imbedded in earth or concrete.

K. Provide all necessary anchoring devices and supports.
   1. Use supports as detailed on the Plans and as specified.
   2. Supports and anchoring devices shall be rated and sized based on dimensions and weights verified from approved equipment Submittals.
   3. Hardware shall be stainless steel.
   4. Do not cut, or weld to, building structural members.

5. Do not mount safety switches and external equipment to other equipment enclosures, unless enclosure mounting surface is properly braced to accept mounting of external equipment.

L. Verify exact rough-in location and dimensions for connection to electrical items furnished by others.
   1. Obtain Shop Drawings from those furnishing the equipment.
   2. Proceeding without proper information may require the CONTRACTOR to remove and replace Work that does not meet the conditions imposed by the equipment supplied.
   3. Provide sleeves wherever openings are required through new concrete or masonry members. Place sleeves accurately and coordinate locations with the ENGINEER.
   4. Do not endanger the stability of any structural member by cutting, digging, chasing, or drilling and shall not, at any time, cut or alter the Work without the ENGINEER'S written consent.
      a. Provide additional reinforcing if required.
      b. Use proper tools and methods to cut, core drill, or make other penetrations.
      c. Restore walls, ceilings, or floors to their original condition.

M. Provide concrete foundations or pads required for electrical equipment as indicated or specified.
   1. Provide a 4-inch concrete housekeeping pad for floor mounted electrical equipment. Pour on top of the finished floor or slab. Drill existing slab and epoxy rebar to anchor housekeeping pad in place.

N. Do not use equipment that exceeds the indicated dimensions except as approved in writing by the ENGINEER.

O. Do not use equipment or arrangements of equipment that reduce required clearances or exceed the space allocation.

P. Work indicated on the Plans is approximately to scale, but actual dimensions and detailed Plans should be followed as closely as field conditions permit. Field verification of scale dimensions on Plans is governed by field conditions. Installation of systems and equipment is subject to clarification as indicated in reviewed Shop Drawings and field coordination.

Q. Discrepancies indicated on different Plans, between Plans and actual field conditions, or between Plans and Contract Documents shall be promptly brought to the attention of the ENGINEER for clarification, prior to purchasing and installing equipment.

R. Adjust the alignment of equipment and conduit to accommodate architectural changes or to avoid work of other trades.

S. Provide parts and pieces necessary to the installation of equipment, in accordance with the best practice of the trade, and in conformance with the requirements of these Contract Documents.

T. Items not specifically mentioned in these Contract Documents, or noted on the Plans, or indicated on reviewed Shop Drawings, but which are obviously necessary to make a complete working installation, shall be deemed to be included herein.

U. Layout and install electrical work prior to placing floors and walls. Provide sleeves and openings through floors and walls, required for installation of conduits. Sleeves shall be rigidly supported and suitably packed, or sealed, to prevent ingress of wet concrete. Spacers shall be installed in order to prevent conduit movement. Dimensions indicated for electrical equipment and their installation are restrictive dimensions.

V. Provide inserts and hangers required to support conduits and other electrical equipment. Coordinate inserts and hangers with other trades. Replace inserts, hangers, sleeves, or other mounting hardware which are improperly placed.

W. Perform necessary saw cutting, core drilling, excavating, removal, shoring, backfilling, and other work required for the proper installation of conduits, whether inside, or outside of the buildings and structures. Use core drills to make circular holes.

X. Electrical Utility:
   1. Coordinate the electrical utility work with the electrical utility company. Note the additional submittal requirements under Paragraph 1.4.D of this Specification. Provide equipment and material required to bring electrical service to the service location in conformance with the electrical utility requirements. Provide the following for the electrical utility company's primary (from utility power line to the utility transformer) and secondary (from utility transformer to the service) electrical lines in accordance with the electrical utility company's specifications and requirements:
      a. Conduits (verify quantity and sizes).
      b. Trenching, backfill, and compacting (verify trench size(s), backfill material, and compaction percentage requirements).
      c. Concrete pad(s) (for pad mounted transformer(s)).
      d. Cable protection along the vertical drop at the utility company's pole (if pole mounted transformer(s)).
      e. Other items required by the power utility company's specifications.

Y. Telephone Service:
   1. Coordinate with the telephone company to provide telephone service as shown on the Plans. Provide trenching, conduit, and backfill for the telephone company's communication lines from the telephone company's main distribution panel to the telephone company's connection box at this Project site, as required by the telephone company.

Z. Temporary Power:
   1. Provide and maintain temporary power and lighting systems needed for construction. Work shall include:
      a. Weatherproof panel(s) for the CONTRACTOR'S main breakers and distribution system.
      b. Conduit and cable.
   2. Use ground fault interrupting equipment.
   3. Connections shall be watertight, with wiring done with Type SO portable cable.
   4. Route and support cables to avoid mechanical damage.
   5. Remove temporary power equipment and devices upon completion of construction.

AA. Corrosion Protection:
   1. Wherever dissimilar metals, except conduit and conduit fittings, come in contact, the CONTRACTOR shall isolate these metals, as required, with neoprene washers, 9 mil polyethylene tape, or gaskets. Where fastening conduit, electro plated, or equivalent fasteners and stainless steel bolts shall be used.

3.3 REPAIR/RESTORATION

A. Repair damage caused by construction or demolition work to restore damaged areas to original condition.

B. Factory finishes damaged during shipping, or construction, shall be restored to original new condition. Rust shall be removed, and bare metal surfaces shall be primed and painted to match the original surrounding finish.

3.4 FIELD QUALITY CONTROL

A. Site Tests:
   1. The electrical work shall be free from improper grounds and from short circuits. Visually compare the conductor connections with connection diagrams. Perform individual circuit continuity checks using electrical circuit testers. Demonstrate proper operation of the energized electrical and mechanical devices. Correct any wiring deficiencies.

3.5 ADJUSTING

A. Calibrate and set all adjustable electrical equipment, including circuit breakers, motor circuit protectors, overload relays. Align photo cells and lights to achieve desired effects.

3.6 CLEANING

A. Relays, starters, circuit breakers, switches, contacts, insulators, mechanisms, and buses shall be free of dust, dirt, oil, moisture, metal shavings, and other debris before testing and energizing equipment. Vacuum and wipe down inside and outside of electrical enclosures and control panels.

3.7 PROTECTION

A. Once equipment is installed, it shall be protected at all times with plastic sheet covers until the area is free of dirt, dust, paint spray, water, and other trades. Provide heat to eliminate condensation.

END OF SECTION

SECTION 16010

ELECTRICAL: BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes basic requirements for electrical work.

B. Install and wire all equipment, including pre-purchased equipment, and perform all tests necessary to assure conformance to the Drawings and Specifications and ensure that equipment is ready and safe before energizing.

C. Related Sections include but are not necessarily limited to:
   1. Division 0, Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1, General Requirements.

D. Drawings Use and Interpretation:
   1. Drawings indicate the location and arrangement of electrical equipment and the approximate location of other equipment requiring electrical work.
      a. For exact locations of building elements, refer to dimensioned architectural/structural drawings.
      b. Field measurements take precedence over dimensioned drawings.

E. Installation of all systems and equipment is subject to clarification as indicated in reviewed Shop Drawings and field coordination drawings.

1.2 AREA CLASSIFICATIONS

A. Outdoor locations may contain corrosive and hazardous areas:
   1. Corrosive and hazardous areas are identified on the Drawings.
      a. Areas not identified as such shall be considered wet.

B. Indoor locations may contain damp, wet corrosive, and hazardous areas:
   1. Damp, wet, corrosive and hazardous areas are identified on the Drawings.
      a. Areas not identified as such shall be considered unclassified.

1.3 DEFINITIONS

A. Outdoor Areas:

1. Those locations on the Project site where the equipment is normally exposed to wind, dust, rain, snow, etc.

B. Indoor Areas:
   1. Those locations on the Project site where the equipment is normally protected from wind, dust, rain, snow, etc.

C. Shop Fabricated:
   1. Manufactured or assembled equipment for which a UL test procedure has not been established.

1.4 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Iron and Steel Institute (AISI):
      a. Steel Products Manual - Stainless and Heat Resisting Steel.
   2. American National Standards Institute (ANSI):
      a. C2, National Electrical Safety Code.
   3. American Society for Testing and Materials (ASTM):
      a. A36, Specification for Structural Steel.
      b. A153, Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   4. Factory Mutual System (FM):
      a. A Guide to Equipment, Materials and Services.
   5. Institute of Electrical and Electronics Engineers (IEEE):
      a. 141, Recommended Practice for Electrical Power Distribution for Industrial Plants.
      b. 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
   6. National Electrical Manufacturers Association (NEMA):
      a. ICS 6, Enclosures for Industrial Controls and Systems.
   7. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   8. Underwriters Laboratories, Inc (UL):
      a. 508, Safety Industrial Control Equipment.
      b. 698, Industrial Control Equipment for Use in Hazardous Locations.

B. When a specific code or standard has not been cited, the applicable codes and standards of the following code-making authorities and standards organizations shall apply:
   1. American Association of State Highway and Transportation Officials (AASHTO).
   2. American Iron and Steel Institute (AISI).
   3. American National Standard Institute (ANSI).
   4. American Society for Testing and Materials (ASTM).

5. ETL Testing Laboratories, Inc (ETL).
6. Insulated Cable Engineers Association (ICEA).
7. Institute of Electrical and Electronic Engineers (IEEE).
8. Illuminating Engineering Society of North America (IES).
9. Instrument Society of America (ISA).
10. Lightning Protection Institute (LPI).
11. National Electrical Manufacturers Association (NEMA).
12. National Fire Protection Association (NFPA).
13. Occupational, Health and Safety Administration (OSHA).
14. Underwriters Laboratories Inc (UL).

C. In case of conflict or disagreement between codes, standards, laws, ordinances, rules, regulations, Drawings, and Specifications, or within either document itself, the more stringent condition shall govern.

1.5 SYSTEM DESCRIPTION

A. Provide functional systems in compliance with manufacturer's instructions, performance requirements specified or shown on the Drawings, and modifications resulting from reviewed Shop Drawings and field coordinated drawings.

1.6 SUBMITTALS

A. Shop Drawings:
   1. See Contract Documents for other requirements.
   2. Submit shop drawings prior to purchase or fabrication of equipment. See individual Division 16, Electrical, Sections for specific requirements.
   3. Prior to submittals of Shop Drawings, coordinate electrical equipment, particularly motor control equipment, control panels, and instrumentation, with all applicable equipment and systems interfacing with that equipment.
   4. For each product, clearly identify manufacturer by name.
   5. Provide manufacturer's technical information on products to be used, including:
      a. Product descriptive bulletin.
      b. Electrical data pertinent to the Project and necessary to assure compliance with Specifications and Drawings.
      c. Equipment dimensions, where applicable.
      d. Evidence that the products submitted meet the requirements of the standards referenced.
   6. When general data sheets are provided as part of the submittal, specifically identify the products to be used on this Project.
   7. Ensure that all submittals clearly indicate the equipment is UL or ETL listed or is constructed utilizing UL or ETL listed or UL recognized components.

Where an UL standard has not been established, clearly identify that no UL standard exists for that equipment.

8. For all equipment, provide manufacturer's installation instructions.

B. Operation and Maintenance Manuals:
   1. See Contract Documents for requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. See Section 01640.

B. Ensure that equipment is not used as steps, ladders, scaffolds, platforms, or for storage, either inside or on top of enclosures.

C. Protect nameplates on electrical equipment to prevent defacing.

D. Repair, restore, or replace damaged, corroded, and rejected items at no additional cost to the OWNER.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Refer to related Division 16, Electrical, Sections.
   1. All equipment of a similar type shall be by one manufacturer, unless otherwise noted in the Specifications.

2.2 MATERIALS

A. Trade names and catalog numbers may be used in the Drawings or Specifications to establish quality standards and basics of design.
   1. Other listed manufacturers in the applicable Specification Sections with equal equipment may be acceptable.
   2. If no other manufacturer is listed, then manufacturers of equal equipment may be acceptable.

B. Listed:
   1. Where UL test procedures have been established for the product type, electrical equipment shall be approved by UL or ETL and shall be provided with the UL or ETL label.

C. Structural Steel Supports:
   1. Galvanized Steel: ASTM A36.

a. PVC coated in Class I and in corrosive areas.

2. Stainless Steel: AISI Type 316.

2.3 FABRICATION

A. When equipment is shop fabricated for the Project, the electrical devices and enclosures utilized shall be UL or ETL listed and labeled or shall be UL recognized.

B. Shop or Factory Finishes:
   1. Interiors of other painted equipment shall be either white or light gray.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment shall be installed in accordance with the requirements of the NEC.

B. Enclosures for Use with Electrical Equipment:
   1. NEMA 12: Use in unclassified indoor locations.
   2. NEMA 3R: Use with HVAC equipment in wet outdoor locations.
   3. NEMA 4X:
      a. Use in wet indoor locations.
      b. Use in wet outdoor locations except with HVAC equipment.
      c. Use in all corrosive locations.
   4. Exceptions:
      a. As modified in other Division 16, Electrical, Sections.
      b. As otherwise indicated on the Drawings.
   5. Standards:
      a. NEMA ICS-6, Enclosures for Industrial Controls and Systems.
      b. UL 508, Safety Industrial Control Equipment.
      c. UL 698, Industrial Control Equipment for Use in Hazardous Locations.

C. Coordinate the installation of electrical equipment with other trades.
   1. Arrange for the building in of equipment during structure construction.
   2. Where equipment cannot be built-in during construction, arrange for sleeves, box-outs, openings, etc., as required to allow installation of equipment after structure construction is complete.

D. Verify that equipment will fit support layouts indicated.

E. Equipment Dimensions and Clearances:
   1. Do not use equipment that exceeds the indicated dimensions.

a. Except as approved in writing by the ENGINEER.

2. Do not use equipment or arrangements of equipment that reduce required clearances or exceed the space allocation.

F. Install equipment in accordance with the manufacturer's instructions.

G. Equipment Access:
   1. Install equipment so it is readily accessible for operation and maintenance.
   2. Equipment shall not be blocked or concealed.
   3. Do not install electrical equipment such that it interferes with normal maintenance requirements of other equipment.

H. Equipment shall be installed plumbed, square, and true with the building construction and shall be securely fastened.

I. Outdoor wall-mounted equipment and indoor equipment mounted on earth or water bearing walls shall be provided with corrosion-resistant spacers to maintain 1/4-inch separation between the equipment and the wall.

J. Screen or seal all openings into outdoor equipment to prevent the entrance of rodents and insects.

K. Equipment fabricated from aluminum shall not be placed in direct contact with earth or concrete.

L. Provide all necessary anchoring devices and supports.
   1. Use supports as detailed on the Drawings and as specified.
      a. Where not detailed on the Drawings or specified, use supports and anchoring devices rated for the equipment load and as recommended by the manufacturer.
   2. Supports and anchoring devices shall be rated and sized based on dimensions and weights verified from approved equipment submittals.
   3. Hardware shall be malleable type, corrosion resistant, and shall be supported by heavily plated machine screws or brass, bronze or stainless steel bolts.
   4. Do not cut, or weld to, building structural members.
   5. Do not mount safety switches and external equipment to other equipment enclosures, unless enclosure mounting surface is properly braced to accept mounting of external equipment.

M. Provide concrete foundations or pads required for electrical equipment as indicated or specified.
   1. Floor-mounted equipment shall be mounted on a 4-inch high concrete housekeeping pad. Pad shall be poured on top of the finished floor or slab.

N. Material that may cause rusting or streaking on a building surface shall not be used.

O. To avoid interference with structural members and equipment of other trades, it may be necessary to adjust the intended location of electrical equipment. Unless specifically dimensioned or detailed, the CONTRACTOR may, at his discretion, make minor adjustments in equipment location without obtaining the ENGINEER'S approval.

P. Provide tagging of electrical equipment, conduits, and conductors in accordance with the Contract Documents.
   1. Each equipment item shall be provided with a nameplate identifying the equipment by the tag number shown on the Drawings.
   2. Each branch circuit and feeder shall be provided with a nameplate identifying, by name and tag number as shown on the Drawings, the load served.
      a. Do not abbreviate.
   3. Each control device shall be provided with an escutcheon defining the device function and a nameplate identifying the controlled equipment.

Q. Provide electrical danger, caution, warning or safety instruction signs in accordance with applicable safety standards.

R. Conduit and wire between temperature control thermostats and the associated HVAC equipment shall be furnished and installed with the equipment (see Division 15, Mechanical, of the Specifications).
   1. Conduit and wire between alarm or shutdown thermostats and air flow switches and the associated alarm devices or panels shall be furnished and installed as part of Division 16, Electrical.
   2. Thermostats included as part of a heat trace system shall be installed as part of Division 16, Electrical.

3.2 FIELD QUALITY CONTROL

A. Do not remove or damage fireproofing materials.
   1. Install hangers, inserts, supports, and anchors prior to installation of fireproofing.
   2. Repair or replace fireproofing removed or damaged.

B. Make all penetrations through roofs prior to installation of roofing.
   1. For penetrations required after installation of roofing:
      a. In built-up roofing (BUR), provide all curbs, cants and base flashings.
      b. In elastic sheet roofing (ESR), arrange and pay for base flashing work by authorized roofer.

C. Make all penetrations of electrical work through walls and roofs water and weather-tight.

D. Equipment furnished under this Contract for use on future work and all concealed equipment, including conduits, shall be dimensioned, on the Record Drawings, from visible and permanent building features.

E. After installation, test all electrical equipment and systems as recommended by the manufacturer and in accordance with Specification 16920, Electrical Acceptance Testing.

F. Test Equipment Interface:
   1. Verify systems coordination and operation.

3.3 CLEANING

A. Clean dirt and debris from all surfaces.

B. Apply touch-up paint as required to repair scratches, etc.

C. Replace nameplates damaged during installation.

D. Thoroughly vacuum the interior of all enclosures to remove dirt and debris.

3.4 DEMONSTRATION

A. Demonstrate equipment in accordance with the Contract Documents.

END OF SECTION

SECTION 16050

BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section consists of general electrical materials and methods. Electrical materials that are a part of equipment specified under other Sections shall meet the requirements of this Section, unless part of larger factory-assembled equipment.

1.2 SUBMITTALS

A. Submit manufacturer's literature for raceways and fittings, boxes, wires and cables, wiring devices, nameplates, legend plates, labels, panel boards, and safety switches, service entrance equipment, control panels, and any other electrical component utilized in this Project.

1.3 QUALITY ASSURANCE

A. Refer to Section 16000, General Electrical Requirements.

1.4 SPARE PARTS

A. Provide spare components as indicated on Drawings and elsewhere herein.

PART 2 - PRODUCTS

2.1 BASIC MATERIALS

A. Electrical safety switches, distribution and control equipment shall be rated for heavy-duty service.

B. Wiring devices shall be Specifications Grade.

2.2 MISCELLANEOUS METAL AND MOUNTING CHANNELS

A. Metal Framing:

1. Unless otherwise shown, mounting channels shall be cold rolled from mild strip steel, 12 gage, 1-5/8-inches by 1-5/8-inches, with 316 stainless steel by Unistrut, Unistrut P-1000, as manufactured by Unistrut, or equal.
2. Screws, bolts, washers, and nuts shall be 316 stainless steel. Parts and brackets for assembly of channels shall be 316 stainless steel.

B. Miscellaneous Metal: 316 stainless steel, unless otherwise shown.

2.3 NAMEPLATES, LEGEND PLATES, AND LABELS

A. Nameplates: Laminated sheet plastic, approximately 1/16-inch-thick, with engraved black letters on a white background, with adhesive backing and mounting screw holes. Stainless steel or brass screws; minimum height of letters shall be 5/16-inch. Card holders are not acceptable.

B. Legend Plates: Type KN-3 standard legend plates; Square D, or equal.

C. Control Wire Markers: Heat-shrink sleeve types, manufactured by W.H. Brady Company or equal.

PART 3 - EXECUTION

3.1 BASIC MATERIALS

A. The completed installation shall conform to all applicable Federal, State, and local codes, ordinances, and regulations. CONTRACTOR shall obtain necessary permits and inspections required by the governing authorities. Work shall be done in a neat, workmanlike, finished and safe manner, according to the latest published NECA Standards of installation, under competent supervision. Install grounding as required by the National Electrical Code.

3.2 MISCELLANEOUS METAL AND MOUNTING CHANNELS

A. Install where electrical equipment is to be surface-mounted to walls and where indicated on Drawings. Where two or more devices are to be installed side by side, support on metal framing, bolt together, and brace as required to form a rigid structure.

B. Clean cuts and welds. Coat unpainted surfaces with cold application zinc galvanizing. Coat cuts and welds on painted surfaces with zinc chromate primer and finish to match existing paint.

3.3 NAMEPLATES, LEGEND PLATES, AND LABELS

A. Nameplates: Identify panels, switchgear, regulators, load-break junction boxes, disconnect switches, and component enclosures. Fasten nameplates with stainless steel self-tapping screws or rivets.
   1. Panels: Identify panel number, voltage, and amperage of panel bus.
   2. Switchgear: Identify equipment, voltage, amperage, and phase and number of wires.
   3. Safety Switches and Relays: Identify equipment controlled and circuits from which they are fed.

B. Legend Plates: Install on selector switches, pushbuttons, pilot lights, starters, and other components.

C. Control Wire Markers: Install at both ends of each control wire interconnecting between such items as control panels, sensors, and control devices at each end of control wires within control panels, and other such enclosures. Wiring markers shall correspond to control wire numbers on approved wiring diagrams.

END OF SECTION

SECTION 16060

ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Demolition of existing electrical shall be as indicated on the Drawings or as indicated elsewhere herein.

B. Demolition information shown on the Drawings is based on visual field examination and existing Record Drawings. The CONTRACTOR is responsible for verification of all items indicated or not. All items affected that are not indicated on the Drawings shall be brought to the ENGINEER'S attention before demolition for direction.

C. The CONTRACTOR shall confine demolition work to the item specifically identified on the drawings. The CONTRACTOR shall be liable for any other damage he may inflict to the existing installations.

D. Locations and Description of work to be performed:
   1. Plant Wide:
      a. Remove copper MODBUS plus network cables.
      b. Cut and Cap all abandoned conduit to grade.
   2. Old Lift Station:
      a. Disconnect Lift Station PLC from the network and abandon in place.
   3. Headworks:
      a. Remove and salvage Quantum CPU and Redundant Quantum CPU at the Influent Pump Station PLC panel.
      b. Remove and salvage Quantum CPU at RTU-POCS.
   4. Aeration Basins:
      a. Remove and salvage existing DO probes and analyzers
      b. Remove and salvage existing air control valves.
   5. Blower Building:
      a. Remove and salvage Quantum CPU and Redundant Quantum CPU at the Return/Waste Sludge Pump PLC panel.
   6. Intel Pump Station:
      a. Remove and salvage Momentum CPU at the Intel Pump Station.
   7. GRIC/ASR Building:
      a. Remove and salvage Quantum CPU at RTU-GRIC.
      b. Remove and salvage Momentum CPU at PLC-100.

8. Final Effluent Electrical Building:
   a. Remove and salvage the Low/High Pressure PLC panel in its entirety.
   b. Relocate existing Chlorine Residual Analyzers.
9. South Solids Building:
   a. Remove and salvage the Sludge Holding Tank PLC Panel in its entirety.
10. North Solids Tank Building:
   a. Remove and salvage Quantum CPU at RTU-SOCS.
11. Administration Building:
   a. Remove and salvage the Belt Filter Press PLC Panel in its entirety.
   b. Remove and salvage Quantum CPU and Redundant Quantum CPU at the Conference Room PLC panel.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Care shall be taken in demolition or removal of items as indicated on drawings as being returned to the OWNER. The CONTRACTOR shall notify the OWNER prior to removing existing equipment.

B. Whether indicated on the Drawings or not, the CONTRACTOR shall provide patching material to fill voids where demolition has taken place. Patching materials shall match, as nearly as practical, the existing original structure material for each surface being patched.

PART 3 - EXECUTION

3.1 COORDINATION

A. The CONTRACTOR shall verify existing field conditions, measurement, circuitry etc., as indicated on Drawings prior to performing any demolition.

B. The CONTRACTOR shall verify that abandoned or demolished wiring and electrical equipment serve only abandoned facilities. If demolished or abandoned electrical is necessary for proper operation of facilities to remain in service, the CONTRACTOR shall immediately notify the ENGINEER for direction.

C. Demolition shall not be performed without coordinating with new construction to limit down time and ease of switchover. The CONTRACTOR must coordinate with the ENGINEER and the OWNER prior to any demolition.

D. Prior to performing any demolition work, the CONTRACTOR shall provide temporary wiring and connections to maintain existing systems in service during construction. Temporary wiring shall conform to the National Electrical Code.

3.2 PERFORMANCE

A. General: The means and methods of performing electrical demolition and removal operations are the sole responsibility of the CONTRACTOR. However, equipment used, and methods of demolition and removal will be subject to approval of the ENGINEER.
   1. Remove exposed abandoned conduit systems, including abandoned conduit systems in false ceilings.
   2. Remove wiring in abandoned conduit systems to source of power supply, where indicated.
   3. In exposed through-structure conduit or foundation locations, cut conduits and foundation below the finished structure surfaces in order to perform adequate surface patching.
   4. Maintain electrical continuity of existing electrical installations which remain active. Modify installations as necessary to maintain continuity and provide adequate access as required by the National Electrical Code.
   5. Extend existing installations using materials and methods compatible with existing electrical installations, and as specified elsewhere herein.
   6. Disconnect and leave in place electrical devices and equipment serving utilization equipment that has been removed or demolished.

B. Cutting: Perform cutting work of existing structure materials by such methods as will prevent extensive damage beyond the immediate area of cutting.

C. Unless otherwise indicated existing, electrical equipment, conduit, wire, etc., indicated for demolition shall be removed and disposed of in a lawful manner, off-site.

D. The CONTRACTOR shall move existing electrical equipment required to be returned to the OWNER, to locations as directed by the OWNER. Care shall be taken to ensure existing electrical equipment being returned to the OWNER does not become damaged. The CONTRACTOR shall provide a means for storing and or stacking of the returned equipment prior to moving to final location, if necessary.

E. Items Abandoned in Place:
   1. All items to be abandoned in place shall be de-energized.
   2. Connections shown or otherwise indicated as disconnected shall be removed with lugs left in place and with all conduit and cable openings properly plugged and sealed as required by the NEC.

3. Any abandoned in-place equipment damaged by CONTRACTOR shall be repaired and restored to its original condition.

END OF SECTION

SECTION 16111

CONDUITS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Furnish and install conduits as required and as shown on the Drawings. Materials employed shall be as shown on the Drawings.

1.2 SUBMITTALS

A. Submit product literature including manufacturer part number, model number, material, size, and specifications. Material shall not be installed until the ENGINEER has reviewed the submittal data.

B. Shop Drawings shall be submitted for review and acceptance showing routing, conduit size, and number and size of wires in each conduit before installation of conduit and any related work.

C. Proposed routing of conduits buried under floor slabs-on-grade.

D. Identify conduit by tag number of equipment served or by circuit schedule number.

E. Proposed routing and details of construction including conduit and rebar embedded in floor slabs, columns, etc. Identify conduit by tag number of equipment served or by circuit schedule number.

F. Proposed location and details of construction for openings in slabs and walls for raceway runs.

G. Refer to Section 16000, General Electrical Requirements, for further submittal requirements.

1.3 REFERENCES

A. American National Standards Institute (ANSI): C80.1, Rigid Steel Conduit - Zinc-Coated.

B. National Electric Manufacturers Association (NEMA), RN-1, Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit.

C. Underwriters Laboratories Inc. (UL):
   1. 1, Flexible Metal Conduit.
   2. 6, Rigid Metal Conduit.
   3. 360, Liquid-Tight Flexible Steel Conduit.
   4. 467, Grounding and Bonding Equipment.
   5. 514, Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers.
   6. 651, Schedule 40 and 80 Rigid PVC Conduit.
   7. 870, Wireways, Auxiliary Gutters, and Associated Fittings.
   8. 884, Underfloor Raceways and Fittings.
   9. 886, Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.

PART 2 - PRODUCTS

2.1 RACEWAYS

A. Exposed conduit in an unclassified or hazardous area shall be galvanized rigid steel (GRS) unless specifically indicated otherwise on the Drawings. Conduits in wet and corrosive areas shall be PVC coated GRS, unless otherwise indicated. Underground and/or concrete encased conduits shall be PVC, unless otherwise indicated. All wiring, except as otherwise noted, shall be in conduit. Conduit size shall not be less than the National Electrical Code (NEC) size required for the conductors therein and shall not be smaller than 3/4-inch. No underground conduit shall be less than 1-inch.

B. Condulet type fittings shall be Crouse-Hinds, Appleton, or equal with wedge nut covers. All condulets located outdoors or in wet locations shall be weathertight.

C. In unclassified areas, flexible conduit shall be grounding type, weatherproof, corrosion resistant, and watertight.

D. Couplings, connectors, and fittings shall be standard types specifically designed and manufactured for the purpose. They shall be installed to provide a firm mechanical assembly and electrical conductivity throughout.

E. Expansion fittings shall be OZ type AX with jumper for exposed locations and Type DX at structural expansion joints, Spring City, or equal. Conduits shall have expansion fittings in accordance with NEC.

F. The conduits and fittings shall be supported per NEC requirements as a minimum.

2.2 GALVANIZED RIGID STEEL (GRS)

A. Conduit and couplings shall be hot-dipped galvanized with zinc coated threads and outer coating of zinc bichromate, in accordance with ANSI C80.1 Standards, as manufactured by Jones & Laughlin Steel Corporation, Allied Tube & Conduit Corporation, Triangle PWC, or equal.

B. Steel conduit shall not be buried in earth without concrete encasement and additional corrosion protection. A half lapped rapping of 20 mil PVC based corrosion protection tape shall be used.

2.3 PVC COATED GALVANIZED RIGID STEEL (PVC-GRS)

A. PVC coated GRS conduit shall be installed where shown on the Drawings or elsewhere specified and shall conform to NEMA RN-1 and ANSI C80.1 Standards.

B. The zinc surface of the conduit shall remain intact and undisturbed on both the inside and the outside of the conduit throughout the preparation and application processing. A Polyvinyl Chloride (PVC) coating shall be bonded to the galvanized outer surface of the conduit. The bond between the PVC coating and the conduit surface shall be greater than the tensile strength of the plastic. The thickness of the PVC coating shall be a minimum of 0.040-inch (40 mil).

C. A loose coupling shall be furnished with each length of conduit. A PVC coating shall be bonded to the outer surface of the coupling and a PVC sleeve equal to the outside diameter of the uncoated conduit shall extend beyond both ends of the coupling approximately one pipe diameter or 1-1/2-inches, whichever is smaller. The wall thickness of the coating on the coupling and the sleeve shall be a minimum of 0.040-inch (40 mil).

D. A PVC coating shall be bonded to the inner and outer surface of all conduit bodies and fittings and a PVC sleeve shall extend from all hubs. The wall thickness of the coating on conduit bodies and fittings and the sleeve walls shall be identical to those on couplings in length and thickness. The covers on all conduit bodies shall be coated on both sides and shall be designed to be completely interchangeable. The inside of conduit bodies shall remain undisturbed in the processing.

E. Type 304 stainless steel screws shall be furnished and used to attach the cover to the conduit body. All coated material shall be installed and patched according to the manufacturer's recommended installation and patching instructions.

F. Conduit straps shall be PVC coated or stainless steel.

G. PVC coated conduit and fittings shall be as manufactured by Rob-Roy, or equal.

H. PVC coated flexible conduits shall be liquid and vaportight and manufactured in accordance with UL 360 Standards.

2.4 RIGID NONMETALLIC – PVC

A. Where specifically indicated on the Drawings, or elsewhere specified, conduit may be high density Schedule 40, 90° C, heavy-duty PVC. The conduit shall be manufactured from virgin polyvinyl chloride compound which meets ASTM D1784, NEMA TC-2, ANSI C33.91, and UL 651 Standards. Smoke emissions shall be limited to less than 6 grams per 100 grams of material tested.

B. Where conduit concrete encasement is indicated on the Drawings, conduit supports shall be installed at 5 foot intervals. PVC conduit shall be manufactured by Carlon, Triangle Conduit & Cable, or equal.

2.5 INTERMEDIATE METAL CONDUIT

A. Conduit and couplings shall be galvanized intermediate metal conduit manufactured in accordance with UL 1242 and as manufactured by Allied Tube & Conduit Corporation, Jones & Laughlin Steel Corporation, or equal.

B. Intermediate metal conduit shall not be buried without concrete encasement. Threadless couplings and connectors shall not be used.

2.6 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Liquidtight flexible metal conduit shall be liquid and vaportight, oil and ultraviolet ray resistant, and manufactured in accordance with UL 360 Standards. Liquidtight flexible metal conduit shall be formed of a continuous, spiral wound, galvanized steel core with an extruded PVC jacket. The PVC jacket shall be rated for high ambient heat applications, 90° Celsius.

B. For corrosive locations, liquidtight flexible metal conduit shall be formed of a continuous, spiral wound, aluminum core with an extruded PVC jacket. The PVC jacket shall be impervious to corrosive liquids and vapors.

C. An external bonding conductor shall be required for flexible conduit connections containing circuits rated at 60 amps or greater and for sizes 1-1/2-inches or larger. Flexible conduit and connectors for 1-1/4-inches and smaller shall be listed for grounding.

D. Connectors for liquidtight flexible conduit shall be PVC Coated, furnished with a sealing ring and locknut, and suitable for corrosive or wet locations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Conduit runs are schematic only, and shall be modified as required to suit field conditions, subject to review and acceptance by the ENGINEER.

B. Conduit shall run continuously between outlets and shall be provided with junction boxes where connections are made. Couplings, connectors, and fittings shall be acceptable types designed and manufactured for the purpose, and shall provide a firm mechanical assembly, and electrical conductivity throughout.

C. Conduit runs shall be straight and true. Elbows, offsets, and bends shall be uniform and symmetrical. Changes in direction shall be made with long radius bends, or with fittings of the condulet type.

D. Conduit runs in buildings and structures shall be exposed except as specifically noted or accepted by the ENGINEER.

E. Conduit runs shall not interfere with the proper and safe operation of equipment, and shall not block or interfere with ingress or egress, including equipment removal hatches.

F. Exposed conduits shall be securely fastened with clamps, or straps, intended for conduit use. All exposed conduit shall be run on the walls and ceiling only and shall be parallel to the planes of the walls or ceiling. No diagonal runs will be permitted. Flexible conduit shall be used only for short lengths required to facilitate connections between rigid conduit to motors from junction boxes, or control equipment.

G. Conduit runs on water-bearing walls shall be supported 1-inch away from the wall on an accepted channel. When channel galvanizing, or other coating, is cut or otherwise damaged, it shall be field coated to original condition. No conduit shall be run in water-bearing walls, unless specifically designated otherwise.

H. Conduit shall be thoroughly reamed to remove burrs. IMC or GRS shall be reamed during the threading process, and rigid nonmetallic PVC shall be reamed before applying fittings. A zinc rich cold galvanizing shall be used to restore corrosion protection on field cut threads. Bushings and lock nuts or hubs shall be

used at conduit termination's. The total number of bends in any run between pull points shall not exceed 360 degrees. Junction boxes and pull boxes shall be installed at points acceptable to the ENGINEER. Conduit ends shall be plugged to prevent the entrance of moisture or debris during construction. All spare conduits shall be adequately capped and shall contain a suitable pull string.

I. Joints shall be set up tight. Hangers and fastenings shall be secure, and of a type appropriate in design, and dimensions, for the particular application.

J. Conduit runs shall be cleaned and internally sized (obstruction tested) so that no foreign objects, or obstructions remain in the conduit prior to pulling in conductors.

K. After installation of complete conduit runs 2-inches and larger, conduits shall be snaked with a conduit cleaner equipped with a cylindrical mandrel of a diameter not less than 85% of the nominal diameter of the conduit. Conduits through which the mandrel will not pass shall not be used.

L. Expansion fittings shall be installed across all expansion joints and at other locations where necessary to compensate for thermal expansion and contraction.

M. Provide trenching, backfill, and compaction for conduits installed underground.

N. Unless approved in advance by the ENGINEER, all conduits which transition from underground to aboveground will utilize galvanized rigid steel conduit for the bend from horizontal to vertical and for the extension above the ground. Factory 90 degree GRS bends shall be used. GRS bends and conduits shall be half lapped with 20 mil PVC tape in non-corrosive areas and shall be PVC coated rigid steel in corrosive areas. Tape wrapping shall extend a minimum 6-inches above top of slab or above finished grade.

O. Liquid tight flexible metallic conduit 1-1/2-inch and larger shall be provided with grounding style bushings and shall have an external ground wire sized and installed in accordance with the NEC.

END OF SECTION

SECTION 16123

600 VOLT CLASS CABLE

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section covers the furnishing and installation of 600 volt class cables and conductors, terminations and splicing, and pulling lubricants.

1.2 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, General Electrical Requirements, and elsewhere in the Contract Documents, prior to installation.

1.3 REFERENCES

A. Insulated Cable Engineers Association/National Electrical Manufacturers Association (ICEA/NEMA):
   1. S-68-516/WC 8, ethylene-propylene rubber-insulated wire and cable for the transmission and distribution of electrical energy.
   2. S-61-402/WC 5, thermoplastic-insulated wire and cable for the transmission and distribution of electrical energy.
   3. S-66-524/WC 7, cross-linked thermosetting-polyethylene-insulated wire and cable for transmission and distribution of electrical energy.

B. Underwriters Laboratory, Inc.
   1. 44, rubber insulated wires and cables.
   2. 83, thermoplastic-insulated wires and cables.
   3. 486A, wire connectors and soldering lugs for use with copper conductors.
   4. 486B, wire connectors for use with aluminum conductors.
   5. 510, insulating tape.

C. National Electric Code.

D. Insulated Cable Engineers Association.

PART 2 - PRODUCTS

2.1 ACCEPTED MANUFACTURERS

A. Conductors and Multi Conductor Cables (MCC), subject to compliance with Contract Documents, the following manufacturers are acceptable: American Insulated Wire Corporation, Cablec Corporation, Okonite Company, Southwire Company, or equal.

2.2 CONDUCTORS

A. Wire sizes shall be American Wire Gauge (AWG) sizes with Class B stranded construction. No. 2 AWG and smaller shall be factory color coded with a separate color for each phase and neutral, which shall be used consistently throughout the system. Larger cables shall be coded by the use of colored tape. Conductors sized No. 1 and larger shall be Type 2, rated for 90° C. All circuit conductors, #6 or smaller shall be "THWN" stranded copper. All other conductors shall be "XHHW" stranded copper.

B. Individual or multiple conductor cables for power, control, and alarm circuits of 480 volts or less shall be insulated for not less than 600 volts and shall have insulation type as indicated on the Drawings. "THHW" shall conform to ICEA S-61-402/NEMA WC 5 and UL 83 and "XHHW" shall conform to ICEA S-66-524/NEMA WC 7 and UL 44. Where wire size is not indicated, they shall be of the size required by the NEC, except that no wire external to panels and motor control centers shall be less than No. 12 AWG, unless specifically noted on the Drawings. Panel control wiring shall not be less than No. 14 AWG.

C. All wiring shall be as indicated on the Drawings. Wires shall be new and shall be soft drawn copper with not less than 97% conductivity. The wire and cable shall have size, grade of insulation, voltage, and manufacturer's name permanently marked on the outer covering at not more than 2 foot intervals. All wires shall conform to the latest Standards of the ASTM, and ICEA, and shall be tested for their full length by these Standards. Insulation thickness shall be not less than that specified by the National Electrical Code.

2.3 TERMINATIONS AND SPLICES

A. Cable shall be rated 600 volts. Other parts of cable systems such as splices and terminations shall be rated at not less than 600 volts. Splicing shall join conductors mechanically and electrically to provide a complete circuit prior to installation of insulation.

B. Splices in wires No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, Type I, Class 1, Grade B, Style G, or Type II, Class 1 of FS W-S-610 and conforming to the applicable requirements of UL 486A.

C. Splices in wires No. 8 AWG and larger shall be made with non-insulated, solderless, pressure type connector, Type II, Class 2 of FS W-S-610, conforming to the applicable requirements of UL 486A and UL 486B. They shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket.

D. Insulated conductor splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

E. Bare conductor splices in wet locations or below grade shall be of the exothermic type.

2.4 PULLING LUBRICANT

A. All cables shall be properly coated with pulling compound such as ClearGluide, Aqua Gel, Polywater, or equal before being pulled into conduits so as to prevent mechanical damage to the cables during installation. "Yellow 77" is not acceptable.

B. Other lubricants to be substituted must be accompanied by a statement from the cable manufacturer as to its acceptable use with the cable being installed.

2.5 IDENTIFICATION

A. All conductors shall be numbered with "tube sleeve" type tags with heat impressed letters and numbers.

B. Color code all wiring as follows:
   1. Lighting and Power Wiring:

Conductor	**120/208 VAC**	**480VAC**	**24V DC**	**120 VAC Control/ Power**
Phase 1	Black	Brown	Blue	Red
Phase 2	Red	Orange	(-) Blue w/ white stripe	
Phase 3	Blue	Yellow		
Neutrals	White	White		White

   2. Color code ends of feeder phase conductors only.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The pulling tension and side-wall pressures, as recommended by the cable manufacturer, shall not be exceeded.

B. As far as practical, all circuits shall be continuous from origin to termination without splices in intermediate pull boxes. Sufficient slack shall be left at the termination to make proper connections. In no case shall a splice be pulled into the conduit. Conductor splicing shall not be permitted without the ENGINEER'S approval.

C. Install all cables in conduit.

D. Each feeder and branch circuit shall be installed in its own individual conduit, unless combining feeder and branch circuits is permitted as defined in the following:
   1. As specifically indicated on the Drawings.
   2. For lighting, multiple branch circuits may be installed in a conduit as allowed by the NEC and with the wire ampacity derated in accordance with the requirements of the NEC. Conduit fill shall not exceed the limits established by the NEC.
   3. When field conditions dictate and written permission is obtained from the ENGINEER.

E. Feeder and branch circuits shall be isolated from each other and from all instrumentation and control circuits.

F. Control circuits shall be isolated from all other feeder, branch and instrumentation circuits, except as noted below:
   1. 12 VDC, 24 VDC and 48 VDC control circuits may be combined in common conduit.
   2. 125 VDC control circuits shall be isolated from all other DC and AC control circuits.
   3. 120 VAC control circuits shall be isolated from all DC control circuits.

G. Make splices only at pull or junction boxes.
   1. Crimp or indented-type connectors are not allowed, except for control circuits landed on terminal strips.

3.2 TESTING

A. In accordance with Specification 16920Electrical Acceptance Testing.

END OF SECTION

SECTION 16124

INSTRUMENTATION CLASS CABLE

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section covers cable use for process signal and controls.

1.2 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, General Electrical Requirements, and elsewhere in the Contract Documents, prior to installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with Contract Documents, the instrumentation cable shall be as manufactured by Belden, Okonite, or equal.

2.2 INSTRUMENTATION CABLE

A. Instrument cable shall be Type TC, and have the number of individually shielded twisted pairs indicated on the Drawings and shall be insulated for not less than 600 volts. Unless otherwise indicated, conductor size shall be No. 16 AWG minimum. Shielded, grounded instrumentation cable shall be used for all analog signals.

B. The jacket shall be flame retardant with 90° C temperature rating. The cable shield shall be a minimum of 2.3 mil aluminum or copper tape overlapped to provide 100% coverage and a tinned copper drain wire.

C. The conductors shall be bare soft annealed copper, Class B, 7 strand minimum concentric lay with 15 mils nominal thickness, nylon jacket, 4 mil nominal thickness, 90° C temperature rating. One conductor within each pair shall be numerically identified.

D. Pairs shall be assembled with a nominal 2-inch lay and shall then be group shielded with a minimum of 1.3 mil aluminum or copper tape overlapped to

provide 100% coverage. All group shields shall be completely isolated from each other.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Feeder and branch circuits shall be isolated from each other and from instrumentation and control circuits. Instrumentation cables shall be installed in separate raceways from other cables and wiring. This includes portions running through manholes. Instrumentation cable shall be continuous between instruments or between field devices and instrument enclosures. There shall be no intermediate splices or terminal boards, unless otherwise shown on the Drawings.

B. Maintain electrical continuity of the shield when splicing twisted shielded pair conductors. Drain wires shall be terminated inside enclosures at grounded terminal blocks. Only one end of each instrument loop cable drain wire shall be grounded. Ground drain wire of shielded conductors at one end only.

C. Terminate instrumentation and control wiring, including spare wires, at control panels and motor control centers on terminal boards mounted inside the equipment.
   1. Contractor shall supply terminal boards as required.
   2. Do not field wire directly to devices.

END OF SECTION

SECTION 16130

OUTLET, PULL, AND JUNCTION BOXES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes outlet, pull and junction boxes.

B. Related Sections include but are not necessarily limited to:
   1. Division 0, Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1, General Requirements.
   3. Section 16000, General Electrical Requirements.
   4. Section 16111, Conduits.
   5. Section 16141, Wiring Devices.
   6. Section 16170, Grounding.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Refer to Section 16000, General Electrical Requirements.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Refer to the Contract Documents and Section 16000, General Electrical Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. See Section 16000, General Electrical Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Sheet Metal Boxes for Indoor and Non-classified Areas:
      a. Hoffman Engineering Co.
      b. Rittal.

2. Boxes for Outdoor and Corrosion Areas:
   a. Hoffman Engineering Co.
   b. Rittal.
3. Hazardous Location Boxes (Class I, II & III):
   a. Appleton Electric Co.
   b. Crouse-Hinds.
   c. Killark.
   d. O-Z/Gedney.
4. Raintight and Watertight Boxes:
   a. Appleton Electric Co.
   b. Crouse-Hinds.
5. Terminal Boxes:
   a. Hoffman Engineering Co.
6. Boxes in Sidewalk:
   a. Appleton Electric Co.
   b. Crouse-Hinds.
   c. O-Z/Gedney.
7. Boxes in Earth:
   a. Carlon Electric Products.
8. Exposed Switch and Receptacle Boxes:
   a. Appleton Electric Co.
   b. Crouse-Hinds.
   c. Killark.

B. Submit requests for substitution in accordance with the General Conditions.

2.2 MATERIALS

A. Pull and Junction Boxes for Offices and other Dry Architecturally Finished Areas:
   1. Material: 14 gauge, galvanized steel.
   2. Concentric knockouts on all four sides.
   3. Flat cover fastened with screws.
   4. NEMA 1 Classification.
   5. UL listed.

B. Pull and Junction Boxes for General Use Indoors in Unclassified Areas:
   1. Material: 14 gauge galvanized steel with seams continuously welded, ground smooth and no knockouts.
   2. Zinc rich coating on all seams.
   3. Stainless steel captivated cover screws threaded into sealed wells.
   4. Flat door with oil resistant gasket.
   5. NEMA 12 Classification.
   6. UL listed.

C. Pull and Junction Boxes for Outdoor and Corrosive Areas:

1. Material: 316 Stainless Steel.
2. Stainless Steel boxes:
3. Seams continuously welded, ground smooth, no knockouts.
4. Rolled lip around all sides.
5. Hinged door.
6. Captivated stainless steel door screws.
7. Flat door with oil-resistant gasket.
8. NEMA 4X Classification.
9. UL listed.

D. Pull and Junction Boxes for Hazardous Areas:
   1. Material: Cast gray iron alloy or copper-free cast aluminum.
   2. Drilled and tapped openings or tapered threaded hub equipped.
   3. Flat bolted down or threaded cover with neoprene gasket.
   4. Stainless steel hex head screws.
   5. Explosion proof, UL listed for Class 1, Groups C and D.

E. Pull and Junction Boxes for Sidewalks:
   1. Cast iron box and cover, hot-dip galvanized.
   2. Flange for flush mounting.
   3. Checkered cover with neoprene gasket, pry bar slots, and stainless steel screws.
   4. UL listed.
   5. Drilled and tapped holes.
   6. Watertight NEMA 4 Classification.

F. Large Pull and Junction Boxes (100 cubic inches and larger):
   1. Located in offices and other dry architecturally finished areas where EMT is utilized:
      a. NEMA 1 gasketed without knockouts.
   2. Located in general use areas:
      a. NEMA 12 construction:
         1) Welded steel.
         2) Furnished with gray enamel inside and out over phosphatized surfaces.
   3. Located in wet and corrosive areas:
      a. NEMA 4X with stainless steel screws.
      b. Type 304 L welded stainless steel:
   4. Constructed of 14 gauge steel with seams continuously welded, ground smooth, no knockouts.
   5. Rolled lip around all sides.
   6. Rigid handles for covers larger than 9 sq. ft. or heavier than 25 lbs.
   7. Split covers when heavier than 25lbs.

G. Terminal Boxes:

1. Galvanized 16 gauge steel box provided with plain blank screw cover, subpanel, and terminal points.
2. Refer to Drawing for dimensions and number of terminals.
3. Terminal blocks shall be screw-post barrier-type, white center marker strip.
4. Rated 20 ampere, minimum 600 V.

H. Fiberglass Cable-Pulling Enclosure:
1. Use: Access points to facilitate pulling of electrical cables in buried conduit runs.
2. Size and quantity: As shown on Drawings.
3. Type: Rectangular fiberglass composite, suitable for direct burial pedestrian traffic on top, -50° F, chemical, sunlight, and weather resistant.
4. Provide matching top with "ELECTRIC" logo.

I. Outlet Boxes:
1. Use: Installation of wiring devices.
2. Boxes for Exposed Wiring:
   a. Cadmium plated, cast, ferrous metal, with threaded hubs.
3. Boxes for Concealed Wiring:
   a. Code gage, hot-dip galvanized steel.
   b. Include bar hangers for metal stud partitions.
   c. Provide barriers between switches in boxes with 277 V switches on opposite phases.
   d. Use extension and plaster rings where required.
   e. Provide grounding screw.

J. Fiber Optic Pull Boxes
1. Provide No. 7 or No. 9 fiber optic pull boxes as indicated on the Contract Drawings.
2. No. 7 Fiber Optic Pull Box:
   a. All No. 7 FO Pull boxes to include an extension.
   b. Lids shall be rated HS 20-44 loading.
   c. Lids shall be embossed with "Fiber Optic"
   d. Backfill to the bottom of the Pull Box with No. 57 aggregate.
   e. Use 30 lb. Felt Paper to block the opening between conduits and around the base to prevent backfill material from entering the box.
3. No. 9 Fiber Optic Pull Box:
   a. All No. 9 Pull Boxes shall be furnished with Racks and Hooks installed.
   b. Lids shall be rated HS 20-44 loading.
   c. Lids shall be embossed with "Fiber Optic"
   d. Backfill to the bottom of the Pull Box with No. 57 aggregate.
   e. Lids shall be easily opened and closed by one person. The maximum force required to open/close = 30 lbs.
   f. Lids shall include torsion assist with spring mechanism.
   g. Lids shall include locking hardware.

h. Provide grounding lug on the lid and connect to ground rod with the ground grid.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use locknut and bushing for boxes in non-classified areas.

B. Use cast metal boxes with threaded conduit hubs in hazardous areas.

C. Use Type FS and FD boxes in wet areas and where exposed rigid steel conduit is required.

D. Use epoxy resin coated, stainless steel, cast aluminum or fiberglass boxes for corrosive areas.

E. Fill unused punched-out, tapped, or threaded hub openings with insert plugs.

F. Use outlet boxes sized to accommodate quantity of conductors enclosed.

G. Use boxes sized to accommodate conduit tying into box.

H. Install pull boxes or junction boxes in conduit runs where indicated or required to facilitate pulling of wires or making connections.
   1. Make covers of boxes accessible.

I. Install pull boxes or junction boxes rated for the area classification.

J. Install rigid conduit squarely into boxes which do not have hubs or are drilled and tapped.

K. Install with locknut on the outside and bushing on inside.

L. Install conduit into boxes with hubs, or that are tapped, using thread lubricant.

M. Do not use back-to-back boxes on this Project.

N. Seal all points of conduit entry into fiberglass cable-pulling enclosures for a waterproof installation.

O. Support outlet boxes for incandescent fixtures and other ceiling-mounted devices in lay-in acoustical tile ceilings by bar hangers anchored to ceiling construction members which do not interfere with tile removal.

END OF SECTION

SECTION 16141

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Light switches, receptacles, device plates, dimmers, plug-in strips and tele-power poles.

B. Related Sections include but are not necessarily limited to:
   1. Division 0, Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 1, General Requirements.
   3. Section 16000, General Electrical Requirements.
   4. Section 16130 ,Outlet, Pull, and Junction Boxes.
   5. Section 16170 ,Grounding.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Refer to Section 16000, General Electrical Requirements.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Refer to the Contract Documents and Section 16000, General Electrical Requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Light Switches (except explosion proof):
      a. Hubbell.
      b. Slater.
      c. P&S.
      d. Arrow Hart.
      e. General Electric.
      f. Leviton.

2. Explosion-Proof Light Switches:
   a. Crouse-Hinds.
   b. Appleton Electric Co.
   c. Killark.
3. Door Switches:
   a. General Electric.
   b. Slater.
   c. P&S.
   d. Arrow Hart.
   e. Micro-switch.
4. Receptacles (except explosion proof):
   a. Hubbell.
   b. Slater.
   c. P&S.
   d. Arrow Hart.
   e. General Electric.
   f. Leviton.
5. Explosion-Proof Receptacles:
   a. Crouse-Hinds.
   b. Appleton Electric Co.
   c. Killark.
6. Welding Receptacles:
   a. Crouse-Hinds.
   b. Appleton Electric Co.
7. Tele-power Poles:
   a. Wiremold.
   b. Walker.
8. Dimmers:
   a. Lutron.
   b. General Electric.
   c. P&S.
9. Plug-in Strip:
   a. Wiremold.
   b. Walker.

B. Submit requests for substitution in accordance with the General Conditions.

2.2 MATERIALS

A. Light Switches for Unclassified Areas:
   1. Toggle type, quiet action, specification grade with grounding terminal.
   2. Back and side wired.
   3. Solid silver cadmium oxide contacts.
   4. One-piece switch arm rated 20 A, 120/277 VAC.
   5. UL listed.
   6. Color: Ivory.

7. Wall plate: Type 304 stainless steel.
8. Type: As indicated on Drawings.

B. Receptacles for Unclassified Areas:
1. Straight blade, grounding type, specification grade.
2. Back and side wired with wrap-around bridge.
3. Rated 20 A, 125 VAC.
4. UL listed.
5. Color:
   a. For use on normal power: Ivory.
   b. For use on UPS systems: Red.
   c. For use on isolated ground systems: Orange.
6. Wall plate: Type 304 stainless steel.
7. Type: As indicated on Drawings.

C. Light Switches for Wet Areas:
1. Presswitch type, quiet action, specification grade, with grounding terminal.
2. Back and side wired.
3. Solid silver cadmium oxide contacts.
4. One-piece switch arm rated 20 A, 120/277 VAC.
5. UL listed.
6. Color: Ivory.
7. Wall plate: Gray weatherproof presswitch type.
8. Type: As indicated on Drawings.

D. Receptacles for Wet Areas:
1. Straight blade, grounding type, specification grade.
2. Back and side wired with wrap around bridge.
3. Rated 20 A, 125 VAC.
4. UL listed.
5. Color: Ivory.
6. Wall Plate: Weatherproof, cast aluminum, UL listed, WDL open and closed.
7. Type: As indicated on Drawings.

E. Ground Fault Circuit Interrupter Receptacles:
1. Straight blade, grounding type, specification grade.
2. Rated 20 A, 125 VAC.
3. UL listed.
4. Test and reset buttons.
5. Wall plate: Indoor or weatherproof as required.
6. Feed-through type.

F. Light Switches for Corrosive Areas:
1. Corrosion-resistant NEMA 4X enclosure with switch consisting of:
   a. NEMA 4X Stainless Steel enclosure.

b. Stainless Steel gasketed wall plate with built-in toggle lever switch with stainless steel shaft.
c. Grounding bushing.
d. Rated 20 A, 125 VAC.
e. UL listed.
f. Type: As indicated on Drawings.
g. Color: Yellow.

2. Optional: Corrosion-resistant enclosure and switch consisting of:
   a. Cast copper-free aluminum "FS" or "FD" ridge type hub box.
   b. Toggle type, quiet action, specification grade with grounding terminal.
   c. Rated 20 A, 125 VAC with solid silver cadmium oxide contacts.
   d. UL listed.
   e. Neoprene gasket.
   f. Cast aluminum cover with stainless steel screws and lever to activate switch.
   g. Type: As indicated on Drawings.
   h. Color: Yellow.

G. Receptacles for Corrosive Areas:
1. Corrosion-resistant straight blade, grounding type, specification grade.
2. Back and side wired with wrap-around bridge.
3. Rated 20 A, 125 VAC.
4. UL listed.
5. Color: Yellow.
6. Box: "FS" or "FD" ridge type cast hub box of copper-free aluminum.
7. Gasket: Neoprene.
8. Wall plate: Weatherproof, cast aluminum, UL listed, WDL open or closed.
9. Type: As indicated on Drawings.

H. Explosion-proof Light Switches for Use in Hazardous Areas:
1. Explosion-proof, UL listed for Class I, Division 1 and 2, Groups B, C, and D; and Class II, Division 1 and 2 areas, Groups E, F, and G.
2. EDS factory sealed.
3. Malleable iron body and cover.
4. Aluminum sealing chamber.
5. Front operated handle with stainless steel shaft.
6. Rated 20 A, 125 VAC.
7. With grounding screw.
8. Type: As indicated on Drawings.

I. Explosion proof Receptacles for Use in Hazardous Areas:
1. Explosion-proof, UL listed for Class I, Division 1 and 2, Groups B, C, and D; and Class II, Division 1 and 2, Groups F and G.
2. Factory-sealed malleable iron receptacle with spring-loaded cover.
3. Malleable iron mounting box.
4. Rated 20 A, 125 VAC.

5. "Dead-front" construction requiring plug to be inserted and rotated to activate receptacle.
6. Type: As indicated on Drawings.

J. Welding Receptacles:
1. 60 A, 480 V, 3-pole, 4-wire, grounding type.

K. Plug-In Strip: Surface steel raceway plug-in strip with single 15 A, 125 V, 3-wire grounding-type receptacles spaced 18-inch on center.
1. Prewired with two #12 TW and one #12 TW green insulated ground.
2. Minimum 1-1/4-inch wide by 3/4-inch deep.
3. Suitable fittings and snap-in cover.
4. Finish:
   a. Stainless steel.
5. Receptacle Color:
   a. For use on normal power: Ivory.
   b. For use on UPS systems: Red.
   c. For use on isolated ground systems: Orange.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount devices where indicated on the Drawings and as scheduled in Section 16010, Electrical: Basic Requirements.

B. Surface-mount receptacles and light switches in concrete construction.

C. In masonry and metal stud construction, recess-mount receptacles and light switches unless device precludes recessed mounting or unless otherwise noted on the Drawings.

D. Where more than one receptacle is installed in a room, they shall be symmetrically arranged.

E. Set switches and receptacles plumb and vertical to the floor.

F. Set recess-mounted switches and receptacles flush with face of walls.

G. Do not connect dimmers to loads in excess of 80% of the rating of the dimmer.

H. Provide blank plates for empty outlets.

END OF SECTION

SECTION 16143

TERMINAL BLOCKS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section covers terminal blocks for control and other wiring.

1.2 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, General Electrical Requirements, and elsewhere in the Contract Documents, prior to installation.

1.3 MANUFACTURERS

A. Terminal blocks shall be Entrelec, Phoenix Contact, Allen-Bradley, or equal.

B. Surge protection blocks shall be Phoenix Contact, Termitrab or equal.

C. Power distribution blocks shall be Gould, Allen-Bradley Corporation, or equal.

PART 2 - PRODUCTS

2.1 TERMINAL BLOCKS

A. Terminal blocks shall mount on standard DIN rail, and be of the size required for conductors therein. A minimum of 25% spares shall be provided in each terminal box. No more than two conductors shall be allowed per termination. Jumper bar assemblies shall be installed for interconnecting terminal blocks, distributing power, and signal commons. Terminal blocks shall be UL rated for 600 volts and 30 amps, minimum.

B. Grounding terminal blocks shall be provided for instrumentation cable shields. The terminal blocks shall have distinctive two-color bodies, and shall be mounted to the DIN rail with metal screw down type clamps, providing a positive ground connection. One grounding terminal block shall be installed for every two instrument cables terminated. Grounding terminal blocks shall be UL rated for 600 volts, and 20 amps, minimum.

C. Terminal blocks shall be available in a variety of colors, including red, green, blue, gray, black, yellow, and orange.

D. DIN mount fuse holders shall have blown fuse indicators for DC and AC circuits. Fuse holders shall be of the compression clamp type. Fuse holders shall be UL listed and rated for 600 volts. Fuse sizes shall not exceed the UL current rating for the fuse holders.

E. DIN rail shall be prepunched, zinc bichromate plated steel. Symmetrical DIN rail shall be 35mm by 7.5mm, minimum.

F. Terminal blocks for 4 to 20 milliamp signals shall have knife disconnect switches, and accessible test points for testing and measurement of current loop signals, without the need for removing wire terminations.

2.2 SURGE PROTECTION BLOCKS (SPB)

A. Analog inputs and outputs shall be terminated at surge protection blocks (SPB). The SPBs shall be designed for a working voltage of 32 volts, and shall be fused with separate terminal blocks.

B. SPBs shall provide full hybrid line to line protection, and shall have a GDT rating of 10,000 A (8/20μs pulse waveform).

C. SPBs shall be UL94 V-2 listed.

2.3 POWER DISTRIBUTION BLOCKS (PDB)

A. PDBs shall be electro-tin plated and manufactured from high strength 6061-T6 aluminum alloy.

B. PDBs shall be UL Recognized rated 90° C and CSA Certified.

C. PDBs shall provide flexibility in using the connector as an in line splice or to reduce conductor size.

D. PDBs shall be rated for 600 volts and dual rated for copper and aluminum conductor.

E. PDBs shall have the sizes and ratings as shown on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Each terminal block and fuse holder shall be identified with the circuit number, or conductor number, corresponding to the identification appearing on the Shop Drawings for the equipment or system.

B. Terminal block and fuse holder markers shall be computer printed plastic-type, with permanent markings.

C. End clamps and end sections shall be installed on each terminal block and fuse holder assembly.

D. Terminal blocks for DC voltages shall be blue and AC voltages shall be gray.

END OF SECTION

SECTION 16161

CONTROL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Control panels.
   2. Products shall be submitted for review in accordance with Section 16000, General Electrical Requirements, and elsewhere in the Contract Documents, prior to installation.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society for Testing and Materials (ASTM):
      a. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
   2. Joint Industrial Council (JIC):
      a. EMP-1, Mass Production Equipment.
   3. National Electrical Manufacturers Association (NEMA):
      a. ICS 4, Terminal Blocks for Industrial Use.
      b. ICS 6, Enclosures for Industrial Controls and Systems.
      c. 250, Enclosures for Electrical Equipment (1000 V Maximum).
   4. National Fire Protection Association (NFPA):
      a. National Electric Code (NEC).

B. Miscellaneous:
   1. Prior to placement of conduit feeds, assure approved control panel layouts available.
   2. Assure completely matching color tones for any individual color specified.
   3. Provide panel with the required NEMA rating per NEMA Publication No. 250 to meet classifications shown on Drawings or Specifications.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Provide a complete As-Built Panel Drawing Package for all modified PLC Panels including, but not limited to the following:
      a. Cover Sheet, including the Panel Name, Panel Builder's Contact information, Project Number, UL Number, and Project Title.

b. Scaled front panel face and subpanel face instrument and nameplate layout drawings. Identifying devices according to the Bill of Materials.
c. Complete panel and subpanel Bill of Materials.
d. Panel and subpanel dimensions.
e. Nameplate schedule.
f. Panel existing and proposed Conduit entry locations.
g. External wiring and Termination drawings.
h. Complete Schematic Diagram.
i. Loop Diagrams.
j. Heat load calculations and Air Conditioners (if Required), ensuring temperature sensitive devices are protected.

B. Operation and Maintenance Manuals.

1.4 SCOPE OF WORK

A. Conference Room PLC Panel (PCP-710-901) :
1. Install new Managed Ethernet Switch.
2. Install new Fiber Optic Patch Panel.
3. Modify PLC Components:
   a. Replace existing Quantum CPU with new Quantum Unity CPU.
   b. Remove connections to RIO at Headworks (Drop 2) and Effluent (Drop 3).
4. Modify Software:
   a. Convert existing program to Unity platform.
   b. Remove code associated with the Effluent Pump Station (Node 3).
   c. Remove code associated with the Headworks (Node 2)
   d. 100 existing points
5. Organize and identify field wiring.
6. Provide as-built panel drawings per 1.3, A.

B. Belt Filter Press PLC Panel (PCP-630-902):
1. Install new Managed Ethernet Switch.
2. Install new Fiber Optic Patch Panel.
3. Remove and replace interior panel with new interior panel with new components:
   a. New Unity M340 CPU with MODBUS TCP and MODBUS PLUS ports.
   b. Provide new discrete input cards.
      1) 48 existing points.
   c. Provide new discrete output cards.
      1) 32 existing points.
   d. Provide new analog input cards.
      1) 2 existing points.

2) Existing points are transmitted via a Discrete/Analog converter. Modify program to send analog signals to the Filter Belt VFDs.

e. Provide new analog output cards
   1) 8 existing Channels
   2) Existing points are transmitted via and Analog/Discrete converter. Modify program to function with analog signals.

f. Associated power supply, rack and miscellaneous components to provide a completely functional PLC panel.

4. Modify Software:
   a. Convert existing program to Unity platform.
5. Organize and identify field wiring.
6. Provide as-built panel drawings per 1.3, A.

C. RTU-SOCS (PCP-440-903):
1. Install new Managed Ethernet Switch.
2. Install new Fiber Optic Patch Panel.
3. Replace existing Quantum CPU with new Quantum Unity CPU.
4. Modify software:
   a. Convert existing program to Unity platform.
   b. 44 existing points
   c. Modify program for communicating to the network via Modbus TCP.
   d. Modify program to transmit PH and ORP levels to RTU-POCS.
5. Organize and identify field wiring.
6. Provide as-built panel drawings per 1.3, A.

D. Switchgear PLC Panel (PCP-120-904):
1. Install new Managed Ethernet Switch.
2. Install new Fiber Optic Patch Panel.
3. Modify software:
   a. Modify program to allow one generator to run. Reference Section 17454 – Control Descriptions for details.
4. Organize and identify field wiring.
5. Provide as-built panel drawings per 1.3, A.

E. South Solids Handling PLC Panel (PCP-630-905):
1. Install new Managed Ethernet Switch.
2. Install new Fiber Optic Patch Panel.
3. Remove and replace interior panel with new interior panel with new components:
   a. New Unity M340 CPU with MODBUS TCP and MODBUS PLUS ports.
   b. Associated power supply, rack and miscellaneous components to provide a completely functional PLC panel.
4. Modify software:
   a. Convert existing program to Unity platform.

b. 188 existing I/O points.
c. Delete points associated with the MLR pumps. The control code for the MLR pumps will be relocated to the RAS/WAS PLC.

5. Organize and identify field wiring.
6. Provide as-built panel drawings per 1.3, A.

F. Intel Pump Station PLC Panel (PCP-540-906):
1. Install new Managed Ethernet Switch.
2. Install new Fiber Optic Patch Panel.
3. Replace existing Momentum CPU with new Momentum Unity CPU.
4. Modify Software:
   a. Convert existing program to Unity platform.
   b. 2 existing I/O points.
   c. VFDs communicate to the processor via Modbus Plus.
5. Organize and identify field wiring.
6. Provide as-built panel drawings per 1.3, A.

G. RTU-GRIC(PCP-540-907):
1. Install new Managed Ethernet Switch.
2. Install new Fiber Optic Patch Panel.
3. Replace existing Quantum CPU with new Quantum Unity CPU.
4. Modify Software:
   a. Convert existing program to Unity platform.
   b. 72 existing I/O points.
5. Organize and identify field wiring.
6. Provide as-built panel drawings per 1.3, A.

H. PLC-100 (PCP-540-908):
1. Install new Managed Ethernet Switch.
2. Install new Fiber Optic Patch Panel.
3. Replace existing Momentum CPU with new Momentum Unity CPU.
4. Modify Software:
   a. 120 existing I/O points.
   b. Convert existing program to Unity platform.
5. Organize and identify field wiring.
6. Provide as-built panel drawings per 1.3, A.

I. Low/High Pressure Pumps PLC Panel (PCP-540-909):
1. Install new Managed Ethernet Switch.
2. Install new Fiber Optic Patch Panel.
3. Remove and replace interior panel with new interior panel with new components:
   a. New Unity M340 CPU with MODBUS TCP and MODBUS PLUS ports.

b. Relocate I/O points from existing Quantum RIO drop to new I/O cards in new PLC panel.
c. Provide new discrete input cards.
   1) 48 existing points.
   2) 64 relocated from Quantum RIO drop.
d. Provide new discrete output cards.
   1) 32 existing points.
   2) 32 relocated from Quantum RIO drop
e. Provide new analog input cards.
   1) 2 existing points.
   2) 8 relocated from Quantum RIO drop.
f. Provide new analog output cards.
   1) 8 existing Channels.
   2) 8 relocated from Quantum RIO drop.
g. Associated power supply, rack and miscellaneous components to provide a completely functional PLC panel.

4. Modify Software:
   a. Convert existing program to Unity platform.
   b. Modify program to include relocated code from the existing Quantum RIO.
5. Organize and identify field wiring.
6. Provide as-built panel drawings per 1.3, A.

J. Headworks PLC Panel (PCP-220-910):
1. Install new Managed Ethernet Switch.
2. Install new Fiber Optic Patch Panel.
3. Modify PLC components:
   a. Replace existing Quantum CPU with new Quantum Unity CPU.
   b. Replace Hot Standby Quantum CPU with new Quantum Unity CPU.
   c. Provide associated wiring and accessories for termination of new I/O points.
4. Convert existing program to Unity platform.
   a. 128 I/O points (includes new I/O.
   b. Modify program for the new Influent Valves
5. Organize and identify field wiring.
6. Provide as-built panel drawings per 1.3, A.

K. RTU-POCS (PCP-230-911):
1. Install new Managed Ethernet Switch.
2. Install new Fiber Optic Patch Panel.
3. Modify PLC Components:
   a. Replace existing Quantum CPU with new Quantum Unity CPU.
   b. Install new I/O cards in existing rack.
      1) 1 new Analog Input Card (match existing for make and model)
      2) 1 new Analog Output Card (match existing for make and model)

3) Provide all accessories to accommodate new cards and I/O points including terminal blocks, fuses and labeling.

4. Convert existing program to Unity platform.
   a. 102 I/O points (includes new I/O)
   b. Modify program to accommodate new I/O cards
   c. Modify program for the Temporary Sodium Hypochlorite Facility.
   d. Modify program for communicating to the network via Modbus TCP.
5. Organize and identify field wiring.
6. Provide as-built panel drawings per 1.3, A.

L. Return/Waste Sludge Pump PLC Panel (PCP-630-912):
1. Install new Managed Ethernet Switch.
2. Install new Fiber Optic Patch Panel.
3. Modify PLC Components:
   a. Replace existing Quantum CPU with new Quantum Unity CPU.
   b. Replace Hot Standby Quantum CPU with new Quantum Unity CPU.
   c. Install new I/O cards in existing rack.
      1) 1 new Discrete Input Card (match existing for make and model)
      2) 2 new Discrete Output Cards (match existing for make and model)
      3) Provide all accessories to accommodate new cards and I/O points including terminal blocks, fuses and labeling.
4. Convert existing program to Unity platform.
   a. 204 I/O points (includes new I/O)
   b. Modify program to accommodate new I/O cards
   c. Modify program for the new Aeration Basin Mixers.
   d. Modify program for the relocation of the MLR pump control code.
   e. Modify program for the new Drain Pump Stations
   f. Modify program for Secondary Clarifier #4
   g. Modify program for the Anoxic Basin Analyzers
   h. Modify program for communicating to the network via Modbus TCP.
5. Organize and identify field wiring.
6. Provide as-built panel drawings per 1.3, A.

M. Main Blower PLC Panel (PCP-430-913):
1. To be replaced with new M340 Unity PLC panel.
2. Provide as-built panel drawings per 1.3, A

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Enclosures:

a. Hoffman.
b. Rittal.
c. Hammond.
d. Or equal.

B. Submit requests for substitution in accordance with the Contract Documents.

2.2 MATERIALS

A. Front Panel, Subpanel or Front Door: Steel.

B. Frame and Bottom Angles: Steel.

C. Top, Sides, Back, Sides, and Back Door: Steel.

D. Hinges: Stainless steel.

E. Nameplates: Phenolic.

F. Filler Panels: Steel.

2.3 ACCESSORIES

A. Control Panels:
1. Single Function Pilot Lights:
   a. Flush, non-protruding.
   b. Heavy-duty LED lights with glass lenses.
   c. Colors:
      1) Red: "ON" or "RUNNING".
      2) Blue: "REQUIRED" or "STAND-BY".
      3) Amber: "Alarm".
      4) Green: "OFF" or "STOPPED".
      5) White: "Power On".
   d. Lens-type with LED illumination.

B. Panel Nameplates and Identification:
1. Identify each item on the control panel with rectangular nameplates.
2. Provide nameplates with black letters on white background.
3. Minimum letter height is 1/2-inch for instrument description and 1/4-inch height for instrument tag number.
4. For all panels which have a panel identification number, provide 2-inch high white nameplate with black, 1-inch high lettering with panel identification number.

2.4 FABRICATION

A. General:
   1. Fabricate panels with instrument arrangements as shown on the Drawings.
   2. Prime control panels with rust inhibitive shop applied primer and paint with two coats of UV resistant white water-based paint.
   3. Finish interior of panel with epoxy glass white.
   4. Provide control panel which meets the following requirements:
   5. Panel depth per JIC EMP-1-1967, E7.1.4.
   6. Door opening per JIC EMP-1-1967, E7.1.5.
   7. Data pocket per JIC EMP-1-1967, E7.1.6.
   8. Rigidity per JIC EMP-1-1967, E7.1.7.
   9. Door alignment and reinforcement per JIC EMP-1-1967, E7.1.8.
   10. Panel holes and openings per JIC EMP-1-1967, E7.3.2, E7.3.3, and E7.3.4.
   11. Doors per JIC EMP-1-1967, E7.5.
   12. Clear panel mounting space per JIC EMP-1-1967, E8.2.9.
   13. Panel mounted control device location per JIC EMP-1-1967, E8.3.4.
   14. Clearances in enclosures per JIC EMP-1-1967, E8.4.

B. Free-Standing Panels:
   1. Minimum construction thicknesses:
      a. Front panel, subpanel, or front door with cutouts: 0.123-inch.
      b. Top, sides, back, filler plates and side or doors with no cutouts: Minimum thickness per, NEMA ICS 6, Tables 3-8, 9.
   2. Welded construction.
   3. Completely enclosed, self-supporting, and gasketed dusttight.
   4. Edges turned back minimum of 2-inch.
   5. Seams and corners welded and ground smooth to touch and smooth in visual appearance.
   6. Arrange control panel faces continuous and flush with face of adjacent electrical motor control centers.
   7. Provide filler panels where necessary to close gaps between panels or back of panel and wall. Provide full length flush pan doors.
   8. Provide full length piano hinges rated for 1.5 times door plus instrument weight.
   9. Furnish doors with keyed alike locking handles and three point catch.
   10. Provide appropriate conduit, wiring, and instrument openings in accordance with best panel design.
   11. After cutouts have been made, finish opening edges to smooth and true surface condition.
   12. Provide each panel with lifting eyebolts. Furnish hot-dipped galvanized steel base channels.
   13. Slotted bolt holes in base, 1-1/2 long for field adjustment.

C. Wall Mounted Panels:

1. Minimum construction thicknesses:
   a. Front panel, subpanel or door with cutouts:
      1) Width or height not exceeding 42-inches: 0.093-inch.
      2) Width or height exceeding 42-inches: 0.123-inch.
   b. Side, top, back and doors without cutouts: minimum thickness per NEMA ICS 6, Tables 3-8,9.
2. Seams continuously welded and ground smooth.
3. Body stiffeners for extra rigidity if either height or width exceeds 28 IN.
4. Rolled lip around all sides of enclosure door opening.
5. Gasketed dust tight.
6. Three-point latching mechanism operated by oil tight key-locking handle.
7. Key doors alike.
8. Continuous heavy gauge hinge pin on doors.
9. Hinges rated for 1.5 times door, plus instrument weight.
10. After cutouts have been made, finish opening edges to smooth and true surface condition.
11. Front full opening door.
12. Brackets for wall mounting.

D. Panel Front Construction:
   1. Minimum Construction Thicknesses: Per NEMA ICS 6, Tables 3-8, 9.
   2. Welded construction.
   3. Edges turned and ground smooth to touch and visual appearance.
   4. At joints where panel face meets side walls, provide dustproof sponge rubber gasket entire height and face.
   5. Use full length piano hinges rated for 1.5 times door weight for panel access door.
   6. Equip doors with locking devices and handle and three point catches.
   7. Finish all instrument cutouts smooth and true.

E. Panel Wiring and Piping:
   1. Factory pipe and wire panels to identified terminal blocks equipped with screw type lugs.
   2. Install all wiring without splicing in factory in raceways:
      a. Size raceways per the requirements of NEC Article 312.
      b. Raceways shall have removable covers.
   3. Wire bending space shall be in accordance with Tables 307B, C in NEMA ICS 6.
   4. Keep AC power lines separate from low-level DC lines, I/O power supply cables, and all I/O rack interconnect cables.
   5. Keep AC signal wires separate from DC signal wires.
   6. When I/O wiring must cross AC power wiring, it shall only do so at right angles.
   7. Arrange circuits on terminal blocks plus any spare conductors on adjacent terminals.

8. Provide necessary power supplies for control equipment.
9. Equip each panel with a main thermal magnetic circuit breaker. Limit load to maximum of 80% of circuit breaker rating.
10. Provide all necessary stabilizing voltage transformers, balancing potentiometers and rectifiers as necessary for specific instrument requirements.
11. Assure each panel mounted device is bonded or otherwise grounded to panel or panel grounding system by means of locknuts or pressure mounting methods.
    a. Equip panel with grounding terminals.
12. Arrange wiring with sufficient clearance for all leads.
13. Wiring to subpanels or rotary switches shall be individually bundled and installed with a "flexible loop" of sufficient length to permit the component to be removed from panel for maintenance without disconnecting wiring.
14. Identify all wires with plastic sleeve type wire markers at each end. Markers shall:
    a. Identify circuit numbers.
    b. Identify function and polarity.
15. Provide all wiring according to color code as follows:

Color of Insulation	120 V, 60 Hz Service	Low Voltage DC Service
Black	Phase Conductor	
Red	Signal Wire	
White	Neutral	
Brown		DC Common
Orange		24 VDC/12 VDC Power
Blue		Signal Wires
Green	Ground	Ground

    a. For intrinsically safe instruments, provide uniform and compatible additional color scheme.
16. Termination Requirements:
    a. Terminal block markings, mechanical characteristics and electrical characteristics shall be in accordance with NEMA ICS 4.
    b. Terminals shall facilitate wire sizes as follows:
        1) 120 VAC applications: Wire size 12 AWG and smaller.
        2) Other: Wire size 14 AWG and smaller.
    c. Provide terminal blocks with continuous marking strip.
    d. Tag each I/O terminal to indicate tag number of the connected device.
    e. Provide terminals for individual termination of each signal shield.
    f. No more than two conductors shall be allowed per termination. Jumper bar assemblies shall be installed for interconnecting terminal blocks, distributing power, and signal commons.

g. Provide 20% excess terminals for future expansion.

17. Pneumatic tubes and appurtenances:
    a. Provide 1/4-inch OD pneumatic control tubing.
    b. Main headers within panels shall be minimum 1-inch.
    c. Compression-type pressure fittings.
    d. Equip panel instrument leads with globe type isolation valve.
    e. Connection to devices not in the panel shall be terminated on tubing terminal plate.
    f. Install tubing neatly and mount securely.
    g. Do not route tubing in front of or in wiring raceways.
    h. Code terminal plates.
    i. Supply and install dual function filter regulator to serve pneumatic devices.

F. Panel Lighting and Power:
1. Receptacles:
    a. Panels less than 4 feet long:
        1) One electrical outlet.
        2) One incandescent light fixture with switch(es) and separate circuit breakers.
    b. Panels or panel faces greater than 4 feet long:
        1) One electrical outlet per 6 feet of length.
        2) Continuous fluorescent lighting strip with switches and separate circuit breakers.

G. Environmental Controls:
1. Furnish circulation fans and filters near hot spots where required to prevent temperature from exceeding instrument rating.
2. Over-temperature switches shall be utilized to provide special cooling if required to maintain operating temperatures within the manufacturer's specified range.
3. Air conditioning applications shall include means of preventing moisture condensation.
4. For panels or control cabinets located outside, or in area classification requiring a NEMA 4X rating:
    a. Provide Stainless Steel Air Conditioners.
    b. Provide printed circuit boards with "Humiseal" conformal coating, covering entire components on both side of board except over adjustable components.
    c. Condenser fins and copper pipes shall be protected against caustic environments with Heresite type coatings.
    d. Furnish gold plated edge connectors on circuit board and socket contacts.
    e. Install thermostatically controlled condensation protection heaters or 10 cubic inch desiccant packs in enclosures housing electronic equipment.

1) Provide one pack for each 10 cubic feet of panel capacity.

H. Acceptable Manufacturers:
   1. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   2. Air Conditioners and Exhaust Filters:
      a. Hoffman.
      b. Pfannenburg.
      c. Or equal.

2.5 MAINTENANCE MATERIALS

A. Extra Materials:
   1. Replacement Bulbs. Provide minimum 25% or 25 bulbs, whichever is greater, for replacement indicating light bulbs for each type of indicator furnished in this Project.
   2. Replacement Fuses. Provide minimum 25% or on Box Fuses, whichever is greater, replacement for each type of Fuse furnished in this Project.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install free-standing panels on concrete pads as detailed on the Drawings.

B. Anchor panel fronts rigidly into wall system with approved anchorage devices.

END OF SECTION

SECTION 16170

GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1, General Requirements, Specification Sections apply to this Section.

1.2 SUMMARY

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Data: For the following:
   1. Ground rods.
   2. Grounding conductors and cables.
   3. Connector products.

C. Submit Shop Drawings identifying each ground rod location, distance between Ground Rods and ground rod assemblies and other grounding electrodes. Identify each by letter in alphabetical order, add a key legend including GPS coordinates.

D. Qualification Data: For firms and persons specified in Paragaph 1.4 of this Specification.

E. Field Test Reports: Submit written test reports to include the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having

jurisdiction, and marked for intended use.
1. Comply with UL 467.

B. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.

C. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Grounding Conductors, Cables, Connectors, and Rods:
   a. Apache Grounding/Erico, Inc.
   b. Chance/Hubbell.
   c. Copperweld Corp.
   d. Dossert Corp.
   e. Erico, Inc.; Electrical Products Group.
   f. Framatome Connectors/Burndy Electrical.
   g. Galvan Industries, Inc.
   h. Kearney/Cooper Power Systems.
   i. Korns: C. C. Korns Co.; Division of Robroy Industries.
   j. O-Z/Gedney Co.; a business of the EGS Electrical Group.
   k. Raco, Inc.; Division of Hubbell.
   l. Superior Grounding Systems, Inc.
   m. Thomas & Betts, Electrical.

2.2 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Sections 16123 and 16124, Conductors and Cables.

B. Material: Copper.

C. Equipment Grounding Conductors: Insulated with green-colored insulation.

D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.

E. Grounding Electrode Conductors: Stranded cable.

F. Underground Conductors: Bare, tinned copper, stranded, unless otherwise indicated.

G. Bare Copper Conductors: Comply with the following:
   1. Solid Conductors: ASTM B3.
   2. Assembly of Stranded Conductors: ASTM B8.
   3. Tinned Conductors: ASTM B33.

H. Copper Bonding Conductors: As follows:
   1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4-inch in diameter.
   2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
   3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8-inches wide and 1/16-inch thick.
   4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8-inches wide and 1/16-inch thick.

I. Grounding Bus: Bare, annealed copper bars of rectangular cross-section, with insulators.

2.3 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted pressure-type connectors, or compression type.

C. Welded Connectors: Exothermic welded type, in kit form, and selected per manufacturer's written instructions.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel.
   1. Size: 3/4-inch in diameter by 120-inches long.

B. Ground Rods: Sectional type; copper-clad steel.
   1. Size: 3/4-inch in diameter by 120-inches long.

PART 3 - EXECUTION

3.1 APPLICATION

A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

B. In raceways, use insulated equipment grounding conductors.

C. Exothermic Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.

D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

E. Ground Rod Clamps at Test Wells: Use bolted pressure clamps with at least two bolts.

F. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Use insulated spacer, space 1-inch from wall and support from wall 6-inches above finished floor, unless otherwise indicated.
   2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the specified height above the floor.

G. Underground Grounding Conductors: Use copper conductor, No. 4/0 AWG minimum. Bury at least 24-inches below grade or bury 12-inches above duct bank when installed as part of the duct bank.

3.2 EQUIPMENT GROUNDING CONDUCTORS

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install equipment grounding conductors in all feeders and circuits.
   1. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by NEC:
   2. Feeders and branch circuits.
   3. Lighting circuits.
   4. Receptacle circuits.
   5. Single-phase motor and appliance branch circuits.
   6. 3-phase motor and appliance branch circuits.
   7. Flexible raceway runs.
   8. Armored and metal-clad cable runs.

C. Busway Supply Circuits: Install insulated equipment grounding conductor from the grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

D. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power distribution units.

E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a non-metallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate equipment grounding conductor. Isolate equipment grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

G. Non-metallic Raceways: Install an equipment grounding conductor in non-metallic raceways unless they are designated for telephone or data cables.

H. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
   1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-inch by 2-inch by 12-inch grounding bus.
   2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

I. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch circuit conductors.

3.3 COUNTERPOISE

A. Ground the steel framework of the building with a driven ground rod at the base of every corner column and at intermediate exterior columns at distances not more than 60 feet apart. Provide a grounding conductor (counterpoise), electrically connected to each ground rod and to each steel column, extending around the perimeter of the building. Use tinned-copper conductor not less than No. 4/0 AWG for counterpoise and for tap to building steel. Bury counterpoise not less than 18-inches below grade and 24-inches from building foundation.

3.4 INSTALLATION

A. Ground Rods: Install at least three rods spaced at least one rod length from each other, and located at least the same distance from other grounding electrodes.
   1. Drive ground rods until tops are 2-inches below finished floor or final grade, unless otherwise indicated.
   2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.

B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

D. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

E. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

F. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

G. Bond each aboveground portion of gas piping system upstream from equipment shut-off valve.

H. Install test wells as indicated on the Contract Documents.

3.5 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
   1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.

2. Make connections with clean bare metal at points of contact.
3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.

F. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

H. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.6 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

A. Duct Banks: Install a grounding conductor with at least 50% ampacity of the largest phase conductor in the ductbank.

B. Manholes and Handholes: Install a driven ground rod close to wall and set rod depth to 4-inches above handhole or manhole floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole

wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2-inches above to 6-inches below concrete. Seal floor opening with waterproof, non-shrink grout.

C. Connections to Manhole Components: Connect exposed-metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise circling pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Use tinned-copper conductor not less than No. 4/0 AWG for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18-inches below grade and 6-inches from the foundation.

3.7 FIELD QUALITY CONTROL

A. See Specification 16920, 3.1, Qualifications, for Independent Third Party Testing organization requirements.

B. Testing: Perform the following field quality control testing:
   1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
   2. Test completed grounding system at each location where a maximum ground resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the fall-of-potential method according to IEEE 81.
   3. Provide Drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
      a. Equipment Rated 500 kVA and Less: 10 ohms.
      b. Equipment Rated 500 to 1,000 kVA: 5 ohms.
      c. Equipment Rated More Than 1,000 kVA: 3 ohms.

d. Substations and Pad-Mounted Switching Equipment: 5 ohms.
e. Manhole Grounds: 10 ohms.

4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 16190

SUPPORTING DEVICES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Supports, anchors, sleeves, and seals are indicated on the Drawings, schedules, and specified in other Sections of these Specifications.

B. Types of supports, anchors, sleeves and seals specified in this Section include the following:
   1. One-hole conduit straps.
   2. One-hole conduit straps with clamp backs.
   3. Two-hole conduit straps.
   4. Conduit hangers.
   5. I-beam clamps.
   6. Channel clamps.
   7. Round steel rods.
   8. Drop-in anchors.
   9. Wedge type anchor bolts.
   10. Lead expansion anchors.
   11. Toggle bolts.
   12. Wall and floor seals.
   13. Cable supports.
   14. U-Channel strut system.
   15. Sleeves.

1.2 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, General Electrical Requirements, and elsewhere in the Contract Documents, prior to installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following: Abbeon Cal Inc., Ackerman Johnson Fastening Systems Inc., Elcen Metal Products Co., Ideal Industries, Inc., Josyln Mfg and Supply Co., McGraw Edison Co., Rawlplug Co. Inc., Star Expansion

Co., U.S. Expansion Bolt Co., Allied Tube and Conduit Corp., B-Line Systems, Inc., Greenfield Mfg Co., Inc., Midland-Ross Corp., O-Z/Gedney Div; General Signal Corp., Power-Strut Div.; Van Huffel Tube Corp., and Unistrut Div; GTE Products Corp., and Robroy Industries.

2.2 GENERAL

A. Provide supporting devices that comply with manufacturers standard materials, design, and construction, in accordance with published product information, and as required for complete installations, and as specified herein.

2.3 SUPPORTS

A. Provide supporting devices of types, sizes, and materials indicated, and having the following construction features:
   1. One-Hole Conduit Straps: For supporting electrical metallic tubing, and liquidtight flexible conduit; zinc plated steel, stainless steel or galvanized steel; snap-on, heavy duty.
   2. One-Hole Conduit Straps with Clamp Backs: For supporting rigid metal conduit, and intermediate metal conduit; cast galvanized steel.
   3. Two-Hole Conduit Straps: For supporting electrical metallic tubing, rigid metal conduit, and intermediate metal conduit; zinc plated steel, stainless steel or galvanized steel.
   4. Conduit Hangers: For supporting electrical metallic tubing, rigid metal conduit, and intermediate metal conduit; zinc plated steel, stainless steel or galvanized steel.
   5. I-Beam Clamps: Electroplated zinc or hot-dipped galvanized malleable iron.
   6. Channel Clamps: Electroplated zinc or hot-dipped galvanized steel.
   7. Round Steel Rod: National coarse thread, electroplated.

2.4 ANCHORS

A. Provide anchors of types, sizes, and materials indicated, with the following construction features:
   1. Lead Expansion Anchors: For CMU walls, 1/4-inch-20 threads, set tool required.
   2. Toggle Bolts: Electroplated steel, size as required.
   3. Drop-in Anchors: Stainless steel, size as required.
   4. Anchor Bolts: Stainless steel, size as required.
   5. Half-round head, non-removable anchor bolts shall not be used.

2.5 SEALS

A. Provide seals of types, sizes, and materials indicated, with the following construction features:

1. Wall and Floor Seals: Provide factory-assembled watertight wall and floor seals, of types and sized indicated; suitable for sealing around conduit, pipe, or tubing passing through concrete floors and walls. Construct seals with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.
2. Conduit sealing bushings shall be manufactured by O-Z/Gedney, Model CSMI, or equal.
3. The conductor sealing bushings shall be manufactured by O-Z/Gedney, Model CSBG, or equal.

2.6 CONDUIT CABLE SUPPORTS

A. Provide cable supports with insulating wedging plug for non-armored type electrical cables in risers; construct 2-inch rigid metal conduit; 3-wires, type wire as indicated; construct body of malleable-iron casting with hot-dip galvanized finish.

2.7 U-CHANNEL STRUT SYSTEM

A. Provide U-channel strut system for supporting electrical equipment, 12 gauge hot-dip galvanized steel, of types and sizes indicated; construct with 9/16-inch diameter holes, 8-inch o.c. on top surface, with the following fittings that mate and match with U-channel:
   1. Fixture hangers.
   2. Channel hangers.
   3. End caps.
   4. Beam clamps.
   5. Wiring stud.
   6. Thinwall conduit clamps.
   7. Rigid conduit clamps.
   8. Post bases.
   9. U-bolts.

2.8 PIPE SLEEVES

A. Provide pipe sleeves from the following:
   1. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.

2.9 PVC COATED U-CHANNEL STRUT SYSTEM

A. Provide PVC Coated U-channel strut system for supporting electrical equipment, 20 mil PVC coated steel, of types and sizes indicated; construct with 9/16-inch diameter holes, 8-inch o.c. on top surface, with all stainless steel hardware, and the following fittings that mate and match with PVC coated U-channel:
   1. PVC coated strut nut.

2. PVC coated pipe straps.
3. Touch up compound (gray).

2.10 STAINLESS STEEL U-CHANNEL STRUT SYSTEM

A. Provide stainless steel U-channel strut system for supporting electrical equipment, of types and sizes indicated; construct with 9/16-inch diameter holes, 8-inch o.c. on top surface, with all stainless steel hardware, and the following stainless steel fittings that mate and match with stainless steel U-Channel:
   1. Fixture hangers.
   2. Channel hangers.
   3. End caps.
   4. Beam clamps.
   5. Wiring stud.
   6. Post bases.
   7. Rigid conduit clamps.
   8. U-bolts.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install hangers, anchors, sleeves, and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NECA and NEC for installation of supporting devices.

B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

C. Install hangers, supports, clamps and attachments to support piping properly from building structure. Arrange for grouping of two or more parallel runs of conduits to be supported together on channel type hangers where possible. Install supports with spacing indicated and in compliance with NEC requirements.

D. Torque sleeve seal nuts, complying with manufacturer's recommended values. Ensure that sealing grommets expand to form watertight seal.

E. Comply with manufacturer's recommendations for touch up of field cut ends or damaged PVC coated U-channel and fittings.

F. Remove burrs and apply a cold zinc galvanizing paint to field cut galvanized U-channel strut.

END OF SECTION

SECTION 16195

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Electrical identification work specified in this Section covers the following:
   1. Buried cable warnings.
   2. Electrical power, control and communication conductors.
   3. Operational instructions and warnings.
   4. Danger signs.
   5. Equipment/system identification signs.

1.2 SUBMITTALS

A. Submittals to the ENGINEER shall include the following:
   1. Manufacturers' data on electrical identification materials and products.
   2. Samples of each color, lettering style, and other graphic representation required for each identification material or system.

1.3 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering electrical identification products maybe incorporated in the Work include, but not limited to, the following:
   1. Brady, W.H. Co.
   2. Ideal Industries, Inc.
   3. Panduit Corp.
   4. Or equal.

1.4 QUALITY COMPLIANCE

A. Comply with applicable requirements of UL Std. 969, "Marking and Labeling Systems", pertaining to electrical identification systems.

B. Comply with applicable requirements of NEMA Std. No's WC-1 and WC-2 pertaining to identification of power and control conductors.

PART 2 - PRODUCTS

2.1 GENERAL

A. Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is installer's option, but provide single selection for each application.

2.2 CONDUIT MARKERS

A. Conduit tags shall be yellow, 1-1/2-inch diameter, round, aluminum tags, laser engraved or standard engraving with the conduit number as shown on the Conduit and Cable Schedule. Punched or stamped lettering is not allowed. Font shall be 1/4-inch Arial or Helvetica. The conduit tags shall be manufactured by Brady, Catalog No. 49900, Or Equal.

B. Each tag shall be attached with nylon-coated 48-mil stainless steel wire and fasteners, as manufactured by Brady, Catalog No. 38091, and zinc wire clamps, double ferrule design, as manufactured by Brady Catalog No. 38090 to secure the stainless steel wire. Where this method is not practical, fasten to the adjacent masonry by means of expansion bolts.

2.3 CABLE AND CONDUCTOR WIRE MARKERS

A. Cable and conductor wire markers shall be self laminating vinyl on white background, printed using a Seton printer, a Brady TLS2200 printer or equal. Handwritten wire markers are not acceptable.

2.4 SELF-ADHESIVE PLASTIC SIGNS

A. Provide manufacturer's standard, self-adhesive or pressure-sensitive, pre-printed, flexible vinyl signs for operational instructions or warnings; of sizes suitable for application areas and adequate for visibility, with proper wording for each application, e.g., 208 V, EXHAUST FAN, RECTIFIER.

B. Unless otherwise indicated or required by governing regulations, provide white signs with black lettering.

2.5 LETTERING AND GRAPHICS

A. Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of electrical systems and equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letters and numbers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install electrical identification products as indicated, in accordance with manufacturer's written instructions and requirements of NEC.

B. Where identification is to be applied to surfaces that require finish, install identification after completion of painting.

C. Comply with governing regulations and requests of governing authorities for identification of electrical work.

3.2 CONDUIT IDENTIFICATION

A. Tag all conduits at the ends and in all intermediate boxes, chambers, hand holes and other enclosures.

3.3 CABLE/CONDUCTOR IDENTIFICATION

A. Apply cable/conductor identification, including voltage, phase and feeder number, on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present, except where another form of identification (such as color-coded conductors) is provided. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for Project's electrical work.

3.4 EQUIPMENT/SYSTEM IDENTIFICATION

A. Install engraved plastic-laminate sign on each major unit of electrical equipment in building; including central or master unit of each electrical system including communication-control-signal systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide single line of text, 1/2-inch high lettering on 1-1/2-inch high sign (2-inch high where two lines are required), white lettering in black field. Provide text matching terminology and numbering of the contract documents and shop drawings. Provide signs for each unit of the following categories of electrical work:
   1. Panelboards, electrical cabinets and enclosures.
   2. Access panel/doors to electrical facilities.
   3. Major electrical switchgear.

B. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and

maintenance of equipment. Secure to substrate with brass or stainless steel screws, except use adhesive where screws should not or cannot penetrate the substrate.

3.5 CIRCUIT IDENTIFICATION

A. The 3-phase wires shall be identified at the switchgear, panelboards and motor control centers as Phases A, B, and C. At 277/480 V, Phase A shall be brown, Phase B shall be orange, and Phase C shall be yellow. The neutral shall be gray.

B. In addition to color coding all conductors, each conductor shall be identified in each pull box, manhole, panelboard, cable tray, or termination with circuit identification markers. This identification is applicable to all power, control, alarm, and instrumentation conductors and these markings shall be recorded on the Record Documents. Markers shall be slip-on PVC sleeve type as manufactured by Brady, Seton, or equal.

C. Markers for other cabling shall be B-292 vinyl as manufactured by Brady, Seton, or equal.

D. Exposed medium voltage conduits shall be labeled at 50 foot intervals with 1-inch letters stating the voltage - example – "12,470 volts". Labels shall be vinyl plastic as manufactured by Brady, Seton, or equal.

3.6 AUTOMATIC EQUIPMENT WARNING SIGNS

A. Permanent warning signs shall be mounted at all mechanical equipment that may be started automatically or from remote locations. Signs shall be in accordance with OSHA Regulations and shall be suitable for exterior use. The warning signs shall be fastened with round head brass screws or bolts, located and mounted in a manner acceptable to the ENGINEER.

B. Warning signs shall be 7-inches high by 10-inches wide, colored yellow and black, on not less than 18 gauge vitreous enameling stock. Sign shall read:

CAUTION
THIS EQUIPMENT STARTS
AUTOMATICALLY
BY REMOTE CONTROL

3.7 HIGH VOLTAGE WARNING SIGNS

A. Permanent and conspicuous warning signs shall be mounted on all equipment, doorways to equipment rooms, pull boxes, manholes, where the voltage exceeds 600 volts.

B. Signs shall be in accordance with OSHA regulation, and shall be suitable for exterior use. The warning signs shall be fastened with round head brass screws or bolts, located and mounted in a manner acceptable to the ENGINEER.

C. Signs shall be 7-inches high by 10-inches wide, colored red and white, on not less than 18 gauge vitreous enameling stock. Sign shall read:

WARNING
HIGH VOLTAGE
KEEP OUT

3.8 CONDUCTOR FASTENERS

A. Glue-on type conductor fasteners shall not be used in any panels, panelboards, switchboards, switchgear, motor control centers, or other enclosures containing electrical devices and/or conductors.

END OF SECTION

SECTION 16440

DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section covers electrical disconnecting switches.

1.2 SUBMITTALS

A. Products shall be submitted in accordance with Section 16000, General Electrical Requirements, and elsewhere in the Contract Documents, prior to installation.

PART 2 - PRODUCTS

2.1 DISCONNECT SWITCHES

A. Disconnect switches shall be heavy-duty safety switches with a quick-make, quick-break operating mechanism, with full cover interlock, and indicator handle. The disconnect switches shall be furnished with fuses of the size indicated on the Drawings. One set of spare fuses shall be furnished for each fused disconnect switch. Disconnect switches shall be NEMA Type HD heavy duty construction, UL 98 listed.

B. Enclosures shall be rated NEMA 12 for indoor use and NEMA 4X for outdoor and corrosive areas, unless otherwise indicated on the Drawings.

C. Enclosures shall be rated NEMA 7/9 for use hazardous locations as indicated on the Drawings.

D. Disconnect switch handle shall be padlockable.

E. Disconnect switches shall be as manufactured by Square D, Cutler Hammer, Allen-Bradley, General Electric, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Disconnect switches shall be installed as indicated on the Drawings.

B. Provide grounding per NEC and Section 16170, Grounding and Bonding.

3.2 TESTING

A. Test in accordance with Specification 16920, Electrical Acceptance Testing.

END OF SECTION

SECTION 16470

PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1, General Requirements, Specification Sections apply to this Section.

1.2 SUMMARY

A. This Section includes load centers and panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600 volt and less for the following types:
   1. Lighting and appliance branch-circuit panelboards.
   2. Distribution panelboards.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. RFI: Radio frequency interference.

D. RMS: Root mean square.

E. SPDT: Single-pole, double throw.

F. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Dimensioned Plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
   a. Enclosure types and details for types other than NEMA 250, Type 1.
   b. Bus configuration, current, and voltage ratings.
   c. Short-circuit current rating of panelboards and overcurrent protective devices.
   d. UL listing for series rating of installed devices.
   e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined for the Project. Include the following:
   1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. The term "withstand" means "the unit will remain in place without separation of internal and external parts during a seismic event and the unit will be fully operational after the event".
   3. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   4. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in Paragraph 1.5 of this Specification.

E. Field Test Reports: Submit written test reports and include the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

G. Maintenance Data: For panelboards and components to include in maintenance manuals specified in Division 1, General Requirements. In addition to requirements specified in Section 01700, Contract Closeout, include the following:
   1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NEMA PB 1.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Panelboards, overcurrent protective devices, controllers, contactors, and accessories:
      a. Eaton Corp., Cutler-Hammer Products, or pre-approved equal.

2.2 FABRICATION AND FEATURES

A. Enclosures: Flush and surface mounted cabinets. NEMA PB 1, Type 1, to meet environmental conditions at installed location.
   1. Outdoor Locations: NEMA 250, Type 3R, with intrusion switch.
   2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4X.
   3. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

B. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

C. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

D. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.

E. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.

F. Bus: Hard-drawn copper, 98% conductivity.

G. Main and Neutral Lugs: Mechanical-type suitable for use with conductor material.

H. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.

I. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.

J. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

K. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.

L. Split Bus: Vertical buses divided into individual vertical sections.

M. Gutter Barrier: Arrange to isolate individual panel sections.

N. Feed-through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

2.3 PANELBOARD SHORT CIRCUIT RATING

A. Fully rated to interrupt symmetrical short circuit current available at terminals.

2.4 LOAD CENTERS

A. Overcurrent Protective Devices: Bolt-on, full-module circuit breaker.

B. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

2.5 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Doors: Front-mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.6 DISTRIBUTION PANELBOARDS

A. Doors: Front-mounted, except omit in fused-switch panelboards; secured with vault-type latch with tumbler lock; keyed alike.

B. Main Overcurrent Protective Devices: Circuit breaker.

C. Branch Overcurrent Protective Devices shall be one of the following:
   1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
   2. For Circuit Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.7 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit breaker frame sizes 250 A and larger.
   2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
      Instantaneous trip.
      a. Long- and short-time pickup levels.
      b. Long- and short-time time adjustments.
      c. Ground-fault pickup level, time delay, and I2t response.
   4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let through ratings less than NEMA FU 1, RK-5.

B. Molded Case Circuit Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.
   1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.

2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

2.8 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: To test functions of solid-state trip devices without removal from panelboard.

C. Fungus Proofing: Permanent fungicidal treatment for panelboard interior, including overcurrent protective devices and other components.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Mounting Heights: Top of trim 74-inches above finished floor, unless otherwise indicated.

C. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

D. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

E. Install filler plates in unused spaces.

F. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 16075, Electrical Identification.

B. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

A. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.
B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Prepare for Acceptance Tests as follows:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
   1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded case circuit breakers. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:
   1. Measure as directed during period of normal system loading.
   2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24 hour services such as fax machines and on-line data-processing, computing, transmitting, and receiving equipment.
   3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
   4. Tolerance: Difference exceeding 20% between phase loads within a panelboard is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
3. Record of Infrared Scanning: Prepare a certified report that identifies panelboards checked and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Set field-adjustable switches and circuit breaker trip ranges.

3.6 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION

SECTION 16920

ELECTRICAL ACCEPTANCE TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for electrical acceptance testing of electrical equipment and materials.
   2. It is the intent of the tests described herein to assure that all electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications.
   3. Acceptance testing performed by equipment vendors at the point of manufacturer must conform to all requirements of this specification. Testing performed at the point of manufacture which conforms to generally accepted industry practices is also acceptable so long as adequate test result documentation is provided.

B. Scope:
   1. All of the Acceptance Tests are required to be performed whether they are described in this Section or other applicable Sections. At a minimum, the following electrical systems are to be tested:
      a. Service entrance section.
      b. Main distribution panel.
      c. Motor control centers.
      d. Switchgear, low and medium voltage.
      e. Panelboards, power and lighting/receptacle.
      f. Transformers, dry type and oil filled.
      g. Feeders.
      h. Cables rated 600 volts and higher.
      i. Transfer switches, manual and automatic.
      j. Transient voltage surge suppression systems.
      k. Grounding and bonding system.
      l. Lighting fixtures and associated controls.
      m. Other systems as listed under Part 3 of this Specification.

C. Related Documents:
   1. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and other Division 1, General Requirements, Specification Sections, apply to the Work of this section.
   2. All work performed under this Section of the Work is subject to all

requirements contained under Section 16000, General Electrical Requirements".

3. All Division 16, Electrical, Specifications for electrical equipment provided for this Project that requires electrical acceptance testing.

1.2 References

A. NETA ATS, Acceptance Testing Specifications, 2003 edition.

B. NFPA 70, National Electrical Code, 2002 edition.

C. Incorporated by reference all Codes, Standards, and Specifications referred to in the "Applicable References" section of NETA ATS-2003.

1.3 DEFINITIONS

A. NETA, InterNational Electrical Testing Association Inc.

B. NEC, National Electrical Code.

1.4 SYSTEM DESCRIPTION

A. Conditions:
   1. Provide all items, articles, materials, operations, or methods listed, mentioned, or scheduled on Drawings and/or herein including all labor, materials, equipment, and incidentals necessary and required for Electrical Acceptance Testing.
   2. Following established procedures, equipment shall be energized after certification by the testing organization that the installation is satisfactory.
   3. Correct or replace any current-carrying circuit, electrical equipment, or system which is defective or grounded and correct all other troubles encountered by these tests. All defects, whether through faulty workmanship or materials furnished, shall be corrected under this Section at the CONTRACTOR'S expense.

1.5 SUBMITTALS

A. Test Report Forms:
   1. All test reports shall be submitted using NETA or approved similar format and, where appropriate, test forms. Reports shall be legible using permanent ink. Pencil is not acceptable.
   2. Provide for ENGINEER'S review and approval a copy of each test form to be used on the Project. No testing shall be started prior to approval of all test forms.

3. All test reports shall include the following information:
   a. Summary/description of the Project.
   b. Description of equipment tested.
   c. Description of the tests.
   d. Test data and analysis of the data indicating whether the equipment passed or failed the test.
4. All test data records shall include the following minimum requirements:
   a. Equipment identification, including tag numbers.
   b. Humidity, temperature, and other conditions that may affect the results of the tests and/or calibrations.
   c. Date of inspections, tests, maintenance, and/or calibrations.
   d. Identification of the testing technician and their employer.
   e. Indication of inspections, tests, maintenance, and/or calibrations to be performed and recorded.
   f. Indication of expected results when calibrations are to be performed.
   g. Indication of "as-found" and "as-left" results, as applicable.
   h. Sufficient spaces to allow all results and comments to be indicated.

B. Closeout Submittals:
   1. Provide one copy each to ENGINEER and OWNER of all testing reports organized as follows:
      a. Bind report in 3-ring binder(s).
      b. Identify Project name, description, testing organizations name, and submittal date on front face and back cover of binder.
      c. Provide all test reports, organized by equipment tag number.
      d. Separate different equipment numbers with colored or numbered tabs.
      e. Provide an index/table of contents.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Any materials provided as part of the testing shall be new, unused, and in manufacturer's original packing.

2.2 TEST INSTRUMENT CALIBRATION

A. Contractor performing the testing shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy for each test instrument calibrated.

B. Contractor performing the testing shall maintain up-to-date instrument calibration instructions and procedures for each test instrument calibrated.

C. It is preferred that instrument calibration accuracy be directly traceable to the national Institute of Standards and Technology (NIST).
D. Instruments shall be calibrated in accordance with the following frequency schedule:
   1. Field Instruments: Analog, six months maximum. Digital, 12 months maximum
   2. Laboratory Instruments: 12 months maximum
   3. Leased Specialty Equipment: 12 months maximum.

E. Dated calibration labels shall be visible on all test equipment.

F. Records, which show date and results of instruments calibrated or tested, must be kept up to date.

G. Calibrating standard shall be better accuracy than that of the instrument tested.

PART 3 - EXECUTION

3.1 QUALIFICATIONS

A. The testing organization shall be an independent, third party entity which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems being evaluated. When such testing organization is used, it must meet the following requirements:
   1. The testing organization shall be regularly engaged in the testing of electrical equipment, devices, installations, and systems.
   2. The testing organization shall use technicians who are regularly employed for testing purposes.
   3. The testing organization shall be a member of NETA or be able to prove qualifications equal to or better than required for membership in NETA.
   4. Submit appropriate documentation demonstrating that the testing organization meets the requirements listed above.
   5. Technicians performing these electrical tests and inspections shall be trained and experienced concerning the apparatus and systems being evaluated. These individuals shall be capable of conducting the tests in a safe manner and with complete knowledge of the hazards involved. They must evaluate the test data and make a judgment on the serviceability of the specific equipment.
   6. Technicians shall be certified in accordance with ANSI/NETA ETT-2000, "Standard for Certification of Electrical Testing Personnel". Each on-site crew leader shall hold a current certification, Level III or higher, in electrical testing.

B. CONTRACTOR may perform the electrical acceptance testing under the following conditions:
   1. CONTRACTOR'S personnel performing the testing and their testing equipment meets all other requirements of this Specification.
   2. Written approval is received from ENGINEER after review of testing personnel qualifications. At a minimum, CONTRACTOR'S testing personnel must have specific instruction on the testing instruments, accessories, and tests being performed and must be able to evaluate the test results.

3.2 NOTIFICATION

A. Notify ENGINEER and Construction Manager at least two days prior to testing so that they may be present during testing.

3.3 SAFETY AND PRECAUTIONS

A. Safety practices shall include, but are not limited to, the following requirements:
   1. Occupational Safety and Health Act OSHA.
   2. Accident Prevention Manual for Industrial Operations, National Safety Council, Chapter 4.
   3. Applicable State and local safety operating procedures.
   4. NETA Safety/Accident Prevention Program.
   5. National Fire Protection Association - NFPA 70E.
   6. ANSI Z244.1 American National Standards for Personnel Protection.

B. All tests shall be performed with apparatus de-energized, except where otherwise specifically specified.

C. The testing firm shall have a designated safety representative on the Project to supervise operations with respect to safety.

3.4 EQUIPMENT TESTING REQUIREMENTS

A. The intent of this Specification is not to duplicate testing performed at the point of manufacture or to impose additional burden on the CONTRACTOR which does not benefit the Project. The intent is to verify that electrical equipment has been securely fastened down, supported, and installed in accordance with the manufacturer's requirements. The intent is also to verify that all electrical connections are correctly torqued, properly aligned, properly insulated, and properly supported and that equipment is clean and ready for operation.

B. Except as noted below or as approved by engineer, test the following equipment and assemblies in full accordance with NETA-ATS 2003.

C. Switchgear and switchboard assemblies.

D. Transformers, dry type, air-cooled, low-voltage, small.
E. Transformers, dry type, air-cooled, large.

F. Transformers, liquid-filled.

G. Cables, low-voltage, 600 volt maximum.
   1. Perform tests only on cables Size #4 AWG and larger.

H. Cables, medium-voltage and high-voltage.

I. Metal-enclosed busways.

J. Switches, air, low-voltage:
   1. Perform tests only on switches rated 100 amps or higher.

K. Switches, air, medium-voltage, metal-enclosed.

L. Switches, oil, medium-voltage.

M. Switches, vacuum, medium-voltage.

N. Switches, Cutouts:
   1. Perform tests only on equipment rated 100 amps or higher.

O. Circuit Breakers, Air, Insulated-Case, Molded-Case:
   1. Perform visual and mechanical inspections in accordance with NETA for all circuit breakers.
   2. Perform electrical tests only on circuit breakers rated 100 amps or higher provided in power distribution and lighting/receptacle panelboards.
   3. No testing is required for circuit breakers provided as part of any of the following:
      a. A UL listed control panel.
      b. UL listed factory supplied motor control centers.
      c. Stand-alone combination motor starters.

P. Circuit breakers, air, medium voltage.

Q. Circuit breakers, oil, medium voltage and high voltage.

R. Circuit breakers, vacuum, medium voltage.

S. Circuit switchers.

T. Network protectors, 600 volt class.

U. Protective relays.
V. Metering devices.

W. Regulating apparatus, voltage, step and induction voltage regulators.

X. Regulating apparatus, load tap-changers.

Y. Grounding systems.

Z. Ground-fault protection systems, low-voltage.

AA. Rotating Machinery, AC Motors, and Generators:
1. Motors provided as part of valve actuators do not require testing.
2. Perform visual and mechanical inspections on all motors.
3. Perform rotation tests on all motors.
4. Perform electrical tests only on motors 50 horsepower and larger.

BB. Motor control, motor starters, low-voltage.

CC. Motor control, motor starters, medium-voltage.

DD. Adjustable speed drive systems.

EE. Direct-current systems, batteries, flooded and valve-regulated lead-acid.

FF. Direct-current systems, chargers.

GG. Surge arresters, low-voltage surge protection devices.

HH. Surge arresters, medium and high-voltage surge protection devices.

II. Capacitors and reactors - all types.

JJ. Outdoor bus structure.

KK. Emergency and standby power systems, engine generator.

LL. Emergency and standby power systems, UPS.

MM. Emergency and standby power systems, automatic transfer switches.

NN. Fiber-optic cables.

3.5 CONSTRUCTION

A. Interface with Other Work:
   1. Coordinate all testing activities with other disciplines. Retest any equipment disturbed or damaged in any manner after initial testing.

3.6 CLOSEOUT REPORT

A. Provide comprehensive bound test report in accordance with Part 1 of this Specification.

END OF SECTION

SECTION 17000

INSTRUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Provide complete instrumentation and control systems as indicated on the Drawings, in the Specifications, and as required by other Contract Documents. These documents include descriptions of functional operation and performance, as well as standards, but do not necessarily enumerate detailed specifications for all components and devices which are necessary. However, all components and devices shall be furnished and installed as required to provide complete and operable systems for accomplishing the functions and meeting the performance requirements.
   2. Scope of Work includes:
      a. Provide all instruments.
      b. Provide all control panels, programmable logic controllers (PLC) panels, SCADA consoles.
      c. Provide all communication equipment required to make the control system fully operational including, but not limited to, radios, antennas, switches, routers, hubs, protocol converters, communication cables, and communication racks and power supplies.
      d. Provide all conduit, conductors, enclosures, materials, and labor to fully interconnect and make operational all control system components.
      e. Provide power at proper voltage and amperage to all system components.
      f. Provide programming for the PLC and SCADA components.
      g. Provide start-up and commissioning assistance.
      h. Train OWNER'S personnel on proper use and maintenance of the control systems.
      i. Other equipment, materials, and work as necessary to achieve a fully tested and operational control system.

B. Products Supplied But Not Installed Under This Section:
   1. None.

C. Products Installed But Not Supplied Under This Section:
   1. Instruments and controls provided loose for field installation by packaged equipment or skid-mounted equipment vendors.

D. Related Sections:
   1. All Division 16 Specifications provided for this Project.

2. All Division 17 Specifications provided for this Project.
3. Other division Specifications provided for this project as they relate to Submittals, concrete, structural, piping/plumbing, mechanical, and HVAC systems.

E. Allowances:
1. Not applicable this Section.

F. Unit Prices:
1. Not applicable this Section.

G. Measurement Procedures:
1. Not applicable this Section.

H. Special Payment Procedures:
1. Not applicable this Section.

I. Alternates/Alternatives:
1. All alternates, alternatives, or proposed substitutions of materials or equipment must be approved by ENGINEER.

1.2 REFERENCES

1.3 DEFINITIONS

A. The word "provide" means "furnish and install".

B. PLC means Programmable Logic Controller.

C. SCADA means Supervisory Control and Data Acquisition System.

1.4 SYSTEM DESCRIPTION

A. Design Requirements:
1. Using sound engineering principals and current best design practices, provide engineering Drawings, and design documents specifying system components and detailing their interconnection and installation.

B. Performance Requirements:
1. The instrumentation and control systems shall be furnished and installed complete and ready to operate, including all necessary interconnections and connections to sources of electrical power, air, water, drains and vents, with all required valves, switches and accessories as specified or as recommended for best operation by the manufacturer of the equipment furnished.

1.5 SUBMITTALS

A. General:
   1. Submittals for the equipment shall be provide in accordance with Section 16000, General Electrical Requirements, and as required elsewhere in the Contract Documents.

B. Product Data:
   1. Detailed catalog information for all system components in sufficient detail so that ENGINEER has sufficient information to determine if the equipment is acceptable for the intended purpose. Minimum information shall be:
      a. Instrument or equipment tag number.
      b. Manufacturer.
      c. Model number.
      d. Materials of construction.
      e. Materials in contact with process fluids.
      f. Dimensional information.
      g. Weight.
      h. Power consumption with required voltage and ampacity.
      i. Heat dissipation if greater than 200 watts.
      j. Process connection information detailing connection size, and type (threaded, flanged, socket weld, etc.).
      k. Recommended mounting details.
      l. Recommended spare parts for one year of operation.
      m. Instrument Data Sheets in ISA S20 format for all instruments.

C. Shop Drawings:
   1. For complex control systems consisting of mechanical, electrical, and control components, provide the following:
      a. A piping and instrument diagram in ISA format.
      b. Electrical load calculations with conduit and conductor sizing.
   2. For integrated control panels or control assemblies, provide the following:
      a. Dimensioned layout of the control enclosure and mounted equipment and instruments.
      b. Full bill of material for all components with detailed catalog information on all components.
      c. 11-inch by 17-inch fully developed schematic diagram(s) showing power and control wiring, terminal block assignments, and identifying field and enclosure wiring. Provide a drawing index and symbols and legend sheet with all schematics. Show all Input/Output (I/O) card details including rack, slot, channel numbers, field termination points, and control power wiring. Label all conductors and identify conductor size and color. Identify all field devices by tag number and by description. Provide over current protection in accordance with NEC requirements.

d. 11-inch by 17-inch instrument loop drawings in ISA format for all analog control loops. Alternatively, multiple loops may be combined on a single analog input or analog output I/O card schematic diagram.
e. Nameplate legend.
f. Paint color and type for painted assemblies.

3. Any special installation details.

D. Samples:
1. Not applicable for this Section.

E. Quality Assurance/Control Submittals:
1. Design Data, Test Reports:
a. Submit calibration sheets for all field instruments containing the following information:
1) Instrument tag number.
2) Instrument manufacturer and model number.
3) Person who performed the calibration.
4) Manufacturer, model, and serial number of the calibrating device.
5) Date that calibrating device was last calibrated.
6) For analog instruments, process range and associated analog signal in at least five increments (For example: 4 mA DC/0 psig, 8 mA DC/25 psig, 12 mA DC/50 psig, 16 mA DC/75 psig, 20 mA DC/100 psig).
7) For switches, process values at which the switch changes state and at which the switch resets.
8) For instruments calibrated by manufacturer, manufacturer's calibration report is acceptable as proof of calibration.
b. Factory acceptance test reports on all fabricated control panels or assemblies containing the following information:
1) Date of test.
2) Test participants.
3) Visual inspection of components.
4) Successful application of power.
5) Validation of all internal wiring.
6) Validation of correct control operation.
7) Validation of screen graphics or alarm operation (if applicable)
8) Validation of program installation into PLC's and that I/O is functioning properly (if applicable).
2. Certificates, Manufacturer's:
a. UL 508 certification for all assembled control panels and assemblies.
3. Instructions, Manufacturer's Field:
a. Furnish a complete Operations and Maintenance Manual for all assembled control panels and assemblies.
4. Reports:
a. Not applicable to this Section.

F. Closeout Submittals:
   1. Furnish Operations and Maintenance Manuals in 3-ring binders complete with the following:
      a. On front and spine of binders provide the project name, OWNER'S name and Project number.
      b. Within the binder, identify the CONTRACTOR and provide contact information.
      c. Inside binders, provide a volume index and table of contents for each binder. Each instrument or control component tag number must be cross-referenced to a specific binder tab.
      d. Furnish manufacturers complete operations and maintenance manuals for all discrete instruments and controls.
      e. Furnish custom operations and maintenance Section for each custom control system, control panel, or fabricated assembly.
      f. Furnish "As-Built" loop and wiring diagrams.
      g. Furnish the written warranty.
   2. Turn over all spare parts to OWNER with documentation showing which instrument or control system the spare parts are for.

G. Schedule:
   1. Submit a detailed Work schedule showing start/finish dates, task duration, task sequencing, critical path, and available float. Identify task predecessors and identify coordination activities with other trades.

H. Start-up and Commissioning Plan:
   1. Submit a detailed start-up and commissioning plan for review by OWNER and ENGINEER. Plan should include the following information:
      a. The order in which the various plant systems will be started up
      b. What work must be performed prior to the start-up
      c. What documentation will be maintained by the CONTRACTOR and provided to the OWNER validating that the start-up was performed in a safe and efficient manner.

1.6 QUALITY ASSURANCE

A. Qualifications:
   1. CONTRACTOR performing the Work shall have a minimum five years experience performing similar work in similar industries. All CONTRACTOR'S personnel shall be trained and experienced in best current construction practices.

B. Regulatory Requirements:
   1. Perform all Work in accordance with all applicable national and local codes.

C. Certifications:
   1. Not applicable this Section.

D. Field Samples:
   1. Not applicable this Section.

E. Mock-Ups:
   1. Not applicable this Section:

F. Pre-Installation Meetings:
   1. Not applicable this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading:
   1. Perform these activities in a manner which assures instruments and equipment will arrive undamaged and in proper working order. Replace any instrument or equipment damaged upon arrival at no additional cost to OWNER.

B. Acceptance at Site:
   1. Maintain a comprehensive log by instrument or equipment tag number of all received instruments or equipment.

C. Storage and Protection:
   1. Store all instruments and equipment as recommended by manufacturer. Protect from physical damage, moisture, dirt/dust, or extremes of temperature.

1.8 PROJECT/SITE COORDINATIONS

A. Environmental Requirements
   1. Follow any and all environmental requirements pertaining to the site.
   2. Maintain a safe and clean job site.
   3. Dispose of all trash and construction debris in an approved manner.

B. Existing Conditions:
   1. CONTRACTOR is to examine the site and be thoroughly familiar with any site requirements which may affect the Work or storage of instruments or equipment.

1.9 SEQUENCING

A. Coordinate all Work with other trades.

1.10 SCHEDULING

A. Provide and maintain a detailed schedule for performance of the Work identifying start/finish dates, durations, required preceding activities, and coordination with

other trades. Organize procurement, deliveries, and staff labor to meet the overall construction schedule and to assure that other trades are not delayed.

1.11 WARRANTY

A. Instrumentation:
   1. One year from system acceptance by OWNER for all discrete instrumentation, control devices, or equipment. During this period, replace any defective or malfunctioning device with 15 working days after notification by OWNER.
   2. One year from system acceptance by OWNER for the performance of the overall control system. Correct the defect within 15 working days after notification by OWNER. Warranty repair work includes but is not limited to the following:
      a. Improper sequencing or interlocking of equipment control systems.
      b. Wiring errors or omissions.
      c. Improper calibration of field instruments.
      d. Improper operation of programmable logic controllers or operator interface terminals.
      e. Improper operation of communications systems installed as part of the overall control system.
      f. Unsafe operations or maintenance conditions.
      g. Other system malfunctions which prevent or impair the plant from operating at design capacity, requires excessive operator intervention, or results in unsafe operating conditions.

1.12 SYSTEM START-UP/COMMISSIONING

A. General:
   1. Provide labor, tools, and equipment to start up the facility in a safe and efficient manner.
   2. Plant shall be started up by system. A system is defined as a collection of mechanical, electrical, and controls equipment configured to perform a specific function or purpose. Examples may be a UV disinfection system, a dissolved oxygen blower system, a grit removal system, etc. The order in which the systems will be started shall be submitted by CONTRACTOR in the start-up Plan and approved by OWNER and ENGINEER. Any variance in this schedule must be approved by OWNER and ENGINEER.
   3. Unless approved otherwise by OWNER and ENGINEER, CONTRACTOR is to follow the start-up sequence detailed below. The following Work must be complete prior to beginning the start-up:
      a. All mechanical equipment installed and tested in accordance with manufacturer's recommendations.
      b. All motors must have been rotation checked.
      c. Electrical power is available and wired to all mechanical equipment.

d. All instruments must have been calibrated and installed in accordance with the manufacturer's recommendations.
e. Control system communication systems are installed and fully operational. This includes DH+ networks, Modbus+ networks, Ethernet networks, radio telemetry systems, telephone systems, etc.
f. All power and control wiring must be installed, rung out, and validated to be in accordance with approved Construction Drawings.
g. Programmable logic controllers, SCADA computers, and Operator Interface Terminals all are installed, have their programs installed, and these devices are fully operational and functioning in their design configuration.

B. System Start-up Sequence:
1. By manipulation of the instrument or direct signal injection at the instrument, verify that the control signal (discrete or analog) is received at the programmable logic controller or by the hard wired control circuit.
2. For motorized equipment, disconnect the power leads at the starter, VFD, or solid state motor controller.
3. Completely exercise the control circuit in Manual, Remote, and Automatic modes and verify that all interlocks and permissives are functioning correctly.
4. Verify that the programmable logic controller can start and stop the motor in Auto or Remote. Motors may be "bumped" by forcing PLC outputs but these program forces must be removed immediately afterward.
5. Verify that run status, signal levels, and alarms display properly on the OIT and the SCADA screens.
6. Reconnect the motor power leads.
7. Verify PID loop operating correctly (either direct or reverse) and adjust gain constants to achieve critically damped operation.
8. Configure the mechanical system for normal operation and leave system ready for normal operation.
9. Utilize colored tagging scheme to identify start-up condition. Red is not ready for start-up, yellow is mechanically and electrically ready but not yet tested or started up, and green is fully tested and ready for normal operation. Place these tags on all mechanical, electrical, instrumentation, and control components of each system.
10. As plant systems are started up, coordinate and remedy any coordination or interface issues between systems.

C. Remedies for Damages:
1. CONTRACTOR is liable for any and all damage done to mechanical or electrical equipment due to improper start-up procedures and shall repair or replace any damaged equipment at OWNER'S discretion without additional cost to OWNER.
2. CONTRACTOR is forbidden to jumper around any process or safety interlock either with wiring or within a PLC program without the express

written permission of both the OWNER and ENGINEER. All jumpers, hardwired and programmed, must be maintained in a log book. Entries shall include:

a. Name of person placing the jumper.
b. Date of installation.
c. Reason for installation.
d. Approval of OWNER and ENGINEER.
e. Date of removal.
f. Name of person removing the jumper.

1.13 OWNER'S INSTRUCTIONS

A. Not applicable this Section.

1.14 MAINTENANCE

A. Extra Materials:
   1. Not required this Section.

B. Maintenance Service:
   1. Not required this Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved manufacturers are listed in the other electrical and instrument Specification Sections.

2.2 EXISTING PRODUCTS

A. Not applicable this Section.

2.3 MATERIALS

A. All materials are to be new and the manufacturer's most current model.

2.4 MANUFACTURED UNITS

A. Manufactured units are to be fully assembled and tested at the point of manufacture and delivered to the job site ready for installation and start-up.

B. Regulated DC power supplies for instrument loops shall be designed and arranged so that loss of one supply does not affect more than one instrument loop or system. Power supplies shall be suitable for an input voltage variation of ±10%,

and the supply output shall be fused or short circuit protected. Output voltage regulation shall be as required by the instrumentation equipment being supplied. Multi-loop, or multi-system power supplies, will be acceptable if backup power supply units are provided which will automatically supply the load upon failure of the primary supply. The backup supply systems shall be designed so that either the primary or backup supply can be removed, repaired, and returned to service without disrupting the instrument system operation.

C. The power distribution from multi-loop supplies shall be selectively fused such that a fault in one instrument loop will be isolated from the other loops being fed from the same supply. Fuses shall be clearly labeled and located for easy access. Multi-loop supply systems shall be oversized for an additional 10% future load. Failure of a multi-loop supply shall be indicated on the respective instrument panel or enclosure.

2.5 EQUIPMENT

A. All equipment is to be new and the manufacturers most current model. All instruments and control devices and assemblies shall be standard devices constructed of corrosion-resistant materials enclosed in a water and dust proof case and mounted as specified in the individual application. Enclosures shall be manufacturer's standard color unless specified otherwise.

2.6 COMPONENTS

A. Not applicable this Section.

2.7 ACCESSORIES

A. Not applicable this Section.

2.8 MIXES

A. Not applicable this Section.

2.9 FABRICATION

A. Shop Assembly:
   1. Fabricate assemblies in accordance with approved Drawings. Notify ENGINEER and OWNER at least five working days prior to start of testing so that they may witness the testing if they choose to do so.

2.10 FINISHES

A. General:

1. Finishes for all components, equipment, and fabricated assemblies must take into account the environment in which they will be installed. NEMA ratings must be appropriate for the environment. Ratings for corrosive areas must be NEMA 4X, for outdoor areas NEMA 4 or 3R, indoor dusty areas may be NEMA 12.

B. Shop Finishing:
   1. Where called for in other sections, sandblast, prime, and paint assemblies.

2.11 SOURCE QUALITY CONTROL

A. Fabrication/Tolerances:
   1. In accordance with generally accepted manufacturing standards.

B. Tests, Inspections:
   1. In accordance with generally accepted manufacturing standards.

C. Verification of Performance:
   1. Not applicable this Section.

PART 3 - EXECUTION

3.1 ACCEPTABLE INSTALLERS

A. CONTRACTORS having a minimum five years experience in the design, procurement, and construction of industrial water/wastewater instrumentation and control systems.

3.2 EXAMINATION

A. Site Verification of Conditions:
   1. Visit job site and ascertain any environmental or physical conditions which may affect the performance of the Work or the equipment requirements.

3.3 PREPARATION

A. Protection:
   1. Not applicable this Section.

B. Surface Preparation:
   1. Not applicable this Section.

3.4 ERECTION

A. Provide 4-inch tall reinforced concrete housekeeping pads for all control panels and floor-mounted fabricated control assemblies and consoles. Dowel into concrete base and extend a minimum of 2-inches past edges of equipment.

B. Provide Unistrut or fabricated structural supports for heavy equipment or assemblies. Prime and paint supports so that they are unaffected by the environment in which they are installed.

C. Securely fasten all panels and assemblies to their housekeeping pads or structural supports.

D. All interconnecting wiring shall be run in conduit in accordance with the Division 16 Electrical, Sections requirements.

3.5 INSTALLATION

A. Install all instruments and controls in accordance with manufacturer's recommendations and all applicable electrical codes and standards. Connect all required utilities including electrical power, air, hydraulics, etc.

B. Provide stainless steel tags for each instrument engraved with instrument tag number. Attach to instrument with stainless steel wire.

C. Provide engraved nameplates for all panel-mounted instruments. Attach to panel with stainless steel screws.

3.6 APPLICATION

A. Not applicable this Section.

3.7 CONSTRUCTION

A. Special Techniques:
   1. In accordance with manufacturers recommended installation procedure.

B. Interface with Other Work:
   1. Coordinate with all other trades.

C. Sequences of Operation:
   1. Not applicable this Section.

D. Site Tolerances:
   1. Not applicable this Section.

3.8 REPAIR/RESTORATION

A. Repair any damages caused by the installation or erection to original condition.

3.9 INSTALLATION

A. Not applicable this Section.

3.10 FIELD QUALITY CONTROL

A. Site Tests:
   1. Test and calibrate instrumentation in accordance with other parts of this Section.

B. Inspection
   1. Not required this Section.

C. Manufacturer's Field Services:
   1. If recommended by manufacturer, have equipment/control systems inspected, tested, and started up by manufacturer's representative.

3.11 ADJUSTING

A. Not required this Section.

3.12 CLEANING

A. Remove and dispose of construction debris daily. Wipe down and vacuum out all enclosures.

3.13 DEMONSTRATION/TRAINING

A. In accordance with the Start-up part of this Section.

B. Provide training of personnel in the operation and maintenance of the furnished control systems.

C. Training shall be provided as required elsewhere in the Contract Documents, but shall consist of at least eight hours, in a single, or multiple sessions, to accommodate the personnel schedules.

D. Coordinate with the ENGINEER, and the OWNER, to schedule the training sessions at least five workings days in advance.

3.14 PROTECTION

A. Protect instrumentation and control equipment from environmental damage and from damage by other trades.

3.15 SCHEDULES

A. Not applicable this Section.

END OF SECTION

SECTION 17137

FLOW FIELD INSTRUMENTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section covers the flow field instruments to be provided where indicated on the Drawings. The flow meters shall consist of two parts with manufacturer supplied interconnecting wiring, the field installed flow element and the flow indicating transmitter.

B. Related Work specified elsewhere includes, but is not limited to Section 16000, General Electrical Requirements. Also, refer to requirements of Contract Documents for testing, adjusting, and balancing of systems.

1.2 QUALITY ASSURANCE

A. Equipment to be furnished under this Section shall be the product of firms regularly engaged in the design and manufacture of this type of equipment. Manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed as relieving the CONTRACTOR from responsibility for the proper installation and functioning of the Work.

1.3 SUBMITTALS

A. The following material shall be submitted to the ENGINEER prior to installation, in accordance with Section 16000, General Electrical Requirements, and as required elsewhere in the Contract Documents:
   1. Where applicable, provide complete manufacturer's part number, identifying scaling, operating range, housing and wetted parts materials, NEMA rating, product options, consumable materials, and other pertinent information.
   2. Prior to Final Acceptance of the Work, the CONTRACTOR shall provide Operations and Maintenance Manuals, in accordance with the Contract Documents.

PART 2 - PRODUCTS

2.1 MAGNETIC FLOW METERS

A. Acceptable Manufacturers:
   1. Toshiba LF654

B. Materials:
   1. All mounting hardware shall be 316 stainless steel, the instrument enclosure shall be rated NEMA 4X, the flow sensor liner shall be polyurethane lined, and the electrode material shall be 316 stainless steel.

C. Design and Fabrication:
   1. Utilize characterized field principle of electromagnetic induction to produce signal directly proportional to flow rate.
   2. Provide flanged end connections, per ANSI B16, rated for piping system operating and test conditions.
   3. Operating Pressure: 100 psi.
   4. Operating Temperature: 122° F.
   5. Grounding Requirements:
      a. Non-metallic or Lined Pipe:
         1) Inlet and outlet grounding rings of same material as electrode.
      b. Conductive Piping:
         1) Conductive path between the meter and the piping flanges.
   6. Provide cable between magnetic flow meter and transmitter.
   7. Pulsed DC magnetic field excitation.
   8. Automatic zero.
   9. Adjustable low flow cutoff.
   10. 16-character alphanumeric display shall indicate user-defined flow units and total flow. All menu advice and commands shall be viewed on this display.
   11. Minimum signal lock (empty tube zero) to prevent false measurement when tube is empty.
   12. Accuracy:
      a. ±0.5% at 1D installation.
      b. ±0.5% of rate above 1 fps.
      c. ±0.01 fps below 1.0 fps.
      d. 4mA to 20 mA DC isolated output into maximum 800 ohms.
      e. Scaled frequency output, 24 VDC.
      f. Power supply: 117 V ±10%, 60 HZ.
      g. Meter operable as specified in liquids with 5.0 micro-ohm/cm or more conductivity.
   13. Electrodes shall be self-cleaning.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment and materials specified in this Section shall be installed and connected as specified, and as shown on the Drawings. The CONTRACTOR shall

coordinate the installation with the other trades, to insure proper installation of the flow element, transmitter, and associated conduit and cables.

B. The CONTRACTOR shall calibrate the instruments to the proper ranges, as required by the OWNER and the ENGINEER. Where analog signals are connected to local, or remote monitoring equipment, the CONTRACTOR shall verify that the calibrated ranges and scaling of the local and remote indicators are correct.

3.2 ACCEPTANCE

A. Prior to Final Acceptance of the Work, the CONTRACTOR shall certify the equipment and installation included under this Section to be free of defects, and suitable for trouble-free operation under the conditions set forth in these Specifications. This requirement is in addition to the manufacturer's guarantee.

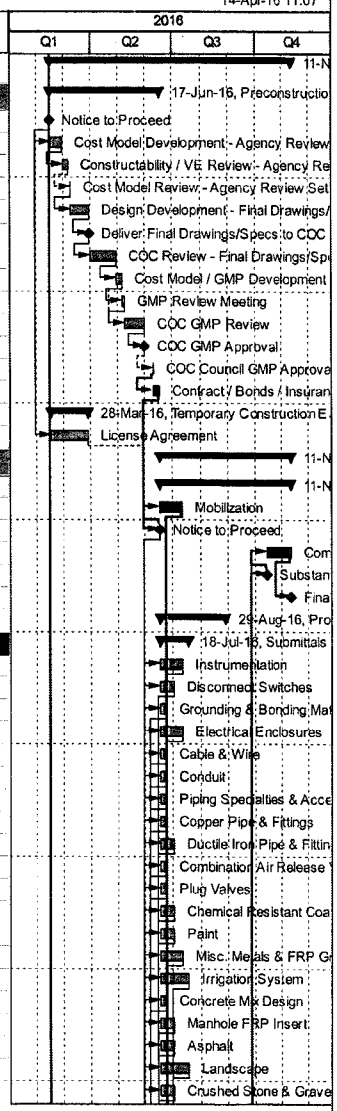
3.3 SPARE PARTS

A. Provide the OWNER with a list of the manufacturers' recommended spare parts.

END OF SECTION

EXHIBIT E
SCHEDULE

Activity ID	Activity Name	Original Duration	Remaining Duration	Total Float	Activity % Complete	Start	Finish	Early Start	Early Finish	Late Start	Late Finish	Actual Start	Actual Finish
Manganaro Lift Station Improvements - Cofferdam Option REV 2(		191	191	-1		16-Feb-16	11-Nov-16	16-Feb-16	11-Nov-16	17-Feb-16	10-Nov-16	16-Feb-1	
Precon/Direction Services													
PRECON - 1000	Notice to Proceed	0	0		100%	16-Feb-16		16-Feb-16		17-Feb-16		16-Feb	
PRECON - 1010	Cost Model Development - Agency Review Set	10	10	1	0%	16-Feb-16	29-Feb-16	16-Feb-16	29-Feb-16	17-Feb-16	01-Mar-16		
PRECON - 1020	Constructability / VE Review - Agency Review Set	5	5	1	0%	01-Mar-16	07-Mar-16	01-Mar-16	07-Mar-16	02-Mar-16	08-Mar-16		
PRECON - 1030	Cost Model Review - Agency Review Set	1	1	0	0%	09-Mar-16*	09-Mar-16	09-Mar-16	09-Mar-16	09-Mar-16	09-Mar-16		
PRECON - 1040	Design Development - Final Drawings/Specs	15	15	7	0%	10-Mar-16	30-Mar-16	10-Mar-16	30-Mar-16	21-Mar-16	08-Apr-16		
PRECON - 1050	Deliver Final Drawings/Specs to COC	0	0	7	0%		30-Mar-16		30-Mar-16		08-Apr-16		
PRECON - 1060	COC Review - Final Drawings/Specs	30	30	11	0%	31-Mar-16	29-Apr-16	31-Mar-16	29-Apr-16	11-Apr-16	10-May-16		
PRECON - 1070	Cost Model / GMP Development	5	5	7	0%	29-Apr-16	06-May-16	29-Apr-16	06-May-16	10-May-16	17-May-16		
PRECON - 1080	GMP Review Meeting	1	1	7	0%	06-May-16	09-May-16	06-May-16	09-May-16	17-May-16	18-May-16		
PRECON - 1090	COC GMP Review	15	15	7	0%	09-May-16	31-May-16	09-May-16	31-May-16	18-May-16	09-Jun-16		
PRECON - 1100	COC GMP Approval	0	0	7	0%		31-May-16		31-May-16		09-Jun-16		
PRECON - 1110	COC Council GMP Approval	1	1	0	0%	09-Jun-16*	10-Jun-16	09-Jun-16	10-Jun-16	09-Jun-16	10-Jun-16		
PRECON - 1120	Contract / Bonds / Insurance Execution	5	5	-1	0%	10-Jun-16	17-Jun-16	10-Jun-16	17-Jun-16	10-Jun-16	16-Jun-16		
Temporary Construction Easement		30	30	57		16-Feb-16	28-Mar-16	16-Feb-16	28-Mar-16	05-May-16	16-Jun-16		
TCE - 1000	License Agreement	30	30	57	0%	16-Feb-16	28-Mar-16	16-Feb-16	28-Mar-16	05-May-16	16-Jun-16		
Construction Services													
General Conditions		103	103	-1		17-Jun-16	11-Nov-16	17-Jun-16	11-Nov-16	17-Jun-16	10-Nov-16		
GC - 1000	Mobilization	15	15	-1	0%	17-Jun-16	11-Jul-16	17-Jun-16	11-Jul-16	17-Jun-16	08-Jul-16		
GC - 1010	Notice to Proceed	0	0	-1	0%	17-Jun-16		17-Jun-16		17-Jun-16			
GC - 1020	Commissioning	20	20	-1	0%	14-Oct-16	11-Nov-16	14-Oct-16	11-Nov-16	14-Oct-16	10-Nov-16		
GC - 1030	Substantial Completion	0	0	-1	0%		14-Oct-16		14-Oct-16		13-Oct-16		
GC - 1040	Final Completion	0	0	-1	0%		11-Nov-16		11-Nov-16		10-Nov-16		
Procurement		50	50	32		17-Jun-16	29-Aug-16	17-Jun-16	29-Aug-16	21-Jun-16	13-Oct-16		
Submittals		20	20	47		17-Jun-16	18-Jul-16	17-Jun-16	18-Jul-16	21-Jun-16	22-Sep-16		
SUBM - 1000	Instrumentation	15	15	28	0%	17-Jun-16	11-Jul-16	17-Jun-16	11-Jul-16	29-Jul-16	18-Aug-16		
SUBM - 1010	Disconnect Switches	10	10	33	0%	17-Jun-16	01-Jul-16	17-Jun-16	01-Jul-16	05-Aug-16	18-Aug-16		
SUBM - 1020	Grounding & Bonding Materials	5	5	53	0%	17-Jun-16	24-Jun-16	17-Jun-16	24-Jun-16	02-Sep-16	09-Sep-16		
SUBM - 1030	Electrical Enclosures	15	15	38	0%	17-Jun-16	11-Jul-16	17-Jun-16	11-Jul-16	12-Aug-16	01-Sep-16		
SUBM - 1040	Cable & Wire	5	5	53	0%	17-Jun-16	24-Jun-16	17-Jun-16	24-Jun-16	02-Sep-16	09-Sep-16		
SUBM - 1050	Conduit	5	5	53	0%	17-Jun-16	24-Jun-16	17-Jun-16	24-Jun-16	02-Sep-16	09-Sep-16		
SUBM - 1060	Piping Specialties & Accessories	5	5	3	0%	17-Jun-16	24-Jun-16	17-Jun-16	24-Jun-16	23-Jun-16	29-Jun-16		
SUBM - 1070	Copper Pipe & Fittings	5	5	48	0%	17-Jun-16	24-Jun-16	17-Jun-16	24-Jun-16	26-Aug-16	01-Sep-16		
SUBM - 1080	Ductile Iron Pipe & Fittings	10	10	3	0%	17-Jun-16	01-Jul-16	17-Jun-16	01-Jul-16	23-Jun-16	07-Jul-16		
SUBM - 1090	Combination Air Release Valves	5	5	33	0%	17-Jun-16	24-Jun-16	17-Jun-16	24-Jun-16	05-Aug-16	11-Aug-16		
SUBM - 1100	Plug Valves	5	5	33	0%	17-Jun-16	24-Jun-16	17-Jun-16	24-Jun-16	05-Aug-16	11-Aug-16		
SUBM - 1110	Chemical Resistant Coatings	10	10	12	0%	17-Jun-16	01-Jul-16	17-Jun-16	01-Jul-16	07-Jul-16	20-Jul-16		
SUBM - 1120	Paint	10	10	48	0%	17-Jun-16	01-Jul-16	17-Jun-16	01-Jul-16	26-Aug-16	09-Sep-16		
SUBM - 1130	Misc. Metals & FRP Grating	15	15	34	0%	17-Jun-16	11-Jul-16	17-Jun-16	11-Jul-16	08-Aug-16	26-Aug-16		
SUBM - 1140	Irrigation System	20	20	32	0%	17-Jun-16	18-Jul-16	17-Jun-16	18-Jul-16	04-Aug-16	31-Aug-16		
SUBM - 1150	Concrete Mix Design	5	5	9	0%	17-Jun-16	24-Jun-16	17-Jun-16	24-Jun-16	01-Jul-16	08-Jul-16		
SUBM - 1160	Manhole FRP Insert	10	10	7	0%	17-Jun-16	01-Jul-16	17-Jun-16	01-Jul-16	29-Jun-16	13-Jul-16		
SUBM - 1170	Asphalt	10	10	44	0%	17-Jun-16	01-Jul-16	17-Jun-16	01-Jul-16	22-Aug-16	02-Sep-16		
SUBM - 1180	Landscape	20	20	32	0%	17-Jun-16	18-Jul-16	17-Jun-16	18-Jul-16	04-Aug-16	31-Aug-16		
SUBM - 1190	Crushed Stone & Gravel	10	10	46	0%	17-Jun-16	01-Jul-16	17-Jun-16	01-Jul-16	24-Aug-16	07-Sep-16		



Actual Work | Critical Remaining Work | Summary
Remaining Work | Milestone

TASK filter: All Activities

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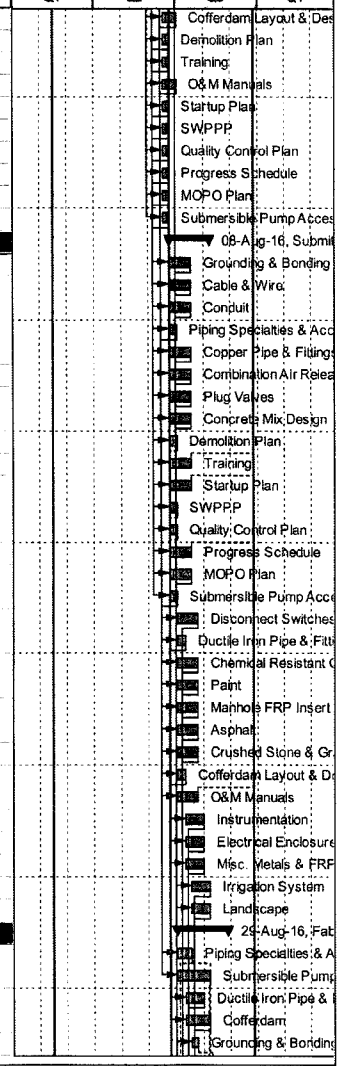
Activity ID	Activity Name	Original Duration	Remaining Duration	Total Float	Activity % Complete	Start	Finish	Early Start	Early Finish	Late Start	Late Finish	Actual Start	Actual Finish
SUBM - 1200	Cofferdam Layout & Design	10	10	1	0%	17-Jun-16	01-Jul-16	17-Jun-16	01-Jul-16	21-Jun-16	05-Jul-16		
SUBM - 1210	Demolition Plan	5	5	5	0%	17-Jun-16	24-Jun-16	17-Jun-16	24-Jun-16	27-Jun-16	01-Jul-16		
SUBM - 1220	Training	5	5	62	0%	17-Jun-16	24-Jun-16	17-Jun-16	24-Jun-16	16-Sep-16	22-Sep-16		
SUBM - 1230	O&M Manuals	10	10	57	0%	17-Jun-16	01-Jul-16	17-Jun-16	01-Jul-16	09-Sep-16	22-Sep-16		
SUBM - 1240	Startup Plan	5	5	62	0%	17-Jun-16	24-Jun-16	17-Jun-16	24-Jun-16	16-Sep-16	22-Sep-16		
SUBM - 1250	SWPPP	5	5	5	0%	17-Jun-16	24-Jun-16	17-Jun-16	24-Jun-16	27-Jun-16	01-Jul-16		
SUBM - 1260	Quality Control Plan	5	5	5	0%	17-Jun-16	24-Jun-16	17-Jun-16	24-Jun-16	27-Jun-16	01-Jul-16		
SUBM - 1270	Progress Schedule	5	5	62	0%	17-Jun-16	24-Jun-16	17-Jun-16	24-Jun-16	16-Sep-16	22-Sep-16		
SUBM - 1280	MOPO Plan	5	5	12	0%	17-Jun-16	24-Jun-16	17-Jun-16	24-Jun-16	07-Jul-16	13-Jul-16		
SUBM - 1290	Submersible Pump Accessories	5	5	14	0%	17-Jun-16	24-Jun-16	17-Jun-16	24-Jun-16	11-Jul-16	15-Jul-16		
Submittal Review		30	30	47		24-Jun-16	08-Aug-16	24-Jun-16	08-Aug-16	30-Jun-16	13-Oct-16		
REV - 1020	Grounding & Bonding Materials	15	15	53	0%	24-Jun-16	18-Jul-16	24-Jun-16	18-Jul-16	12-Sep-16	30-Sep-16		
REV - 1040	Cable & Wire	15	15	53	0%	24-Jun-16	18-Jul-16	24-Jun-16	18-Jul-16	12-Sep-16	30-Sep-16		
REV - 1050	Conduit	15	15	53	0%	24-Jun-16	18-Jul-16	24-Jun-16	18-Jul-16	12-Sep-16	30-Sep-16		
REV - 1060	Piping Specialties & Accessories	5	5	3	0%	24-Jun-16	01-Jul-16	24-Jun-16	01-Jul-16	30-Jun-16	07-Jul-16		
REV - 1070	Copper Pipe & Fittings	15	15	48	0%	24-Jun-16	18-Jul-16	24-Jun-16	18-Jul-16	02-Sep-16	23-Sep-16		
REV - 1090	Combination Air Release Valves	15	15	33	0%	24-Jun-16	18-Jul-16	24-Jun-16	18-Jul-16	12-Aug-16	01-Sep-16		
REV - 1100	Plug Valves	15	15	33	0%	24-Jun-16	18-Jul-16	24-Jun-16	18-Jul-16	12-Aug-16	01-Sep-16		
REV - 1150	Concrete Mix Design	15	15	9	0%	24-Jun-16	18-Jul-16	24-Jun-16	18-Jul-16	11-Jul-16	29-Jul-16		
REV - 1210	Demolition Plan	5	5	5	0%	24-Jun-16	01-Jul-16	24-Jun-16	01-Jul-16	05-Jul-16	11-Jul-16		
REV - 1220	Training	15	15	62	0%	24-Jun-16	18-Jul-16	24-Jun-16	18-Jul-16	23-Sep-16	13-Oct-16		
REV - 1240	Startup Plan	15	15	62	0%	24-Jun-16	18-Jul-16	24-Jun-16	18-Jul-16	23-Sep-16	13-Oct-16		
REV - 1250	SWPPP	5	5	5	0%	24-Jun-16	01-Jul-16	24-Jun-16	01-Jul-16	05-Jul-16	11-Jul-16		
REV - 1260	Quality Control Plan	5	5	5	0%	24-Jun-16	01-Jul-16	24-Jun-16	01-Jul-16	05-Jul-16	11-Jul-16		
REV - 1270	Progress Schedule	15	15	62	0%	24-Jun-16	18-Jul-16	24-Jun-16	18-Jul-16	23-Sep-16	13-Oct-16		
REV - 1280	MOPO Plan	15	15	12	0%	24-Jun-16	18-Jul-16	24-Jun-16	18-Jul-16	14-Jul-16	03-Aug-16		
REV - 1290	Submersible Pump Accessories	5	5	14	0%	24-Jun-16	01-Jul-16	24-Jun-16	01-Jul-16	18-Jul-16	22-Jul-16		
REV - 1010	Disconnect Switches	15	15	33	0%	01-Jul-16	25-Jul-16	01-Jul-16	25-Jul-16	19-Aug-16	09-Sep-16		
REV - 1080	Ductile Iron Pipe & Fittings	5	5	3	0%	01-Jul-16	11-Jul-16	01-Jul-16	11-Jul-16	08-Jul-16	14-Jul-16		
REV - 1110	Chemical Resistant Coatings	15	15	12	0%	01-Jul-16	25-Jul-16	01-Jul-16	25-Jul-16	21-Jul-16	10-Aug-16		
REV - 1120	Paint	15	15	48	0%	01-Jul-16	25-Jul-16	01-Jul-16	25-Jul-16	12-Sep-16	30-Sep-16		
REV - 1160	Manhole FRP Insert	15	15	7	0%	01-Jul-16	25-Jul-16	01-Jul-16	25-Jul-16	14-Jul-16	03-Aug-16		
REV - 1170	Asphalt	15	15	44	0%	01-Jul-16	25-Jul-16	01-Jul-16	25-Jul-16	06-Sep-16	26-Sep-16		
REV - 1190	Crushed Stone & Gravel	15	15	46	0%	01-Jul-16	25-Jul-16	01-Jul-16	25-Jul-16	08-Sep-16	28-Sep-16		
REV - 1200	Cofferdam Layout & Design	5	5	1	0%	01-Jul-16	11-Jul-16	01-Jul-16	11-Jul-16	06-Jul-16	12-Jul-16		
REV - 1230	O&M Manuals	15	15	57	0%	01-Jul-16	25-Jul-16	01-Jul-16	25-Jul-16	23-Sep-16	13-Oct-16		
REV - 1000	Instrumentation	15	15	28	0%	11-Jul-16	01-Aug-16	11-Jul-16	01-Aug-16	19-Aug-16	09-Sep-16		
REV - 1030	Electrical Enclosures	15	15	38	0%	11-Jul-16	01-Aug-16	11-Jul-16	01-Aug-16	02-Sep-16	23-Sep-16		
REV - 1130	Misc. Metals & FRP Grating	15	15	34	0%	11-Jul-16	01-Aug-16	11-Jul-16	01-Aug-16	29-Aug-16	19-Sep-16		
REV - 1140	Irrigation System	15	15	32	0%	18-Jul-16	08-Aug-16	18-Jul-16	08-Aug-16	01-Sep-16	22-Sep-16		
REV - 1180	Landscape	15	15	32	0%	18-Jul-16	08-Aug-16	18-Jul-16	08-Aug-16	01-Sep-16	22-Sep-16		
Fabrication		40	40	29		01-Jul-16	29-Aug-16	01-Jul-16	29-Aug-16	08-Jul-16	10-Oct-16		
FAB - 1060	Piping Specialties & Accessories	10	10	3	0%	01-Jul-16	18-Jul-16	01-Jul-16	18-Jul-16	08-Jul-16	21-Jul-16		
FAB - 1210	Submersible Pump Accessories	25	25	14	0%	01-Jul-16	08-Aug-16	01-Jul-16	08-Aug-16	25-Jul-16	26-Aug-16		
FAB - 1080	Ductile Iron Pipe & Fittings	15	15	3	0%	11-Jul-16	01-Aug-16	11-Jul-16	01-Aug-16	15-Jul-16	04-Aug-16		
FAB - 1200	Cofferdam	20	20	1	0%	11-Jul-16	08-Aug-16	11-Jul-16	08-Aug-16	13-Jul-16	09-Aug-16		
FAB - 1020	Grounding & Bonding Materials	5	5	53	0%	18-Jul-16	25-Jul-16	18-Jul-16	25-Jul-16	03-Oct-16	07-Oct-16		



Actual Work | Critical Remaining Work | Summary
Remaining Work | Milestone

TASK filter: All Activities

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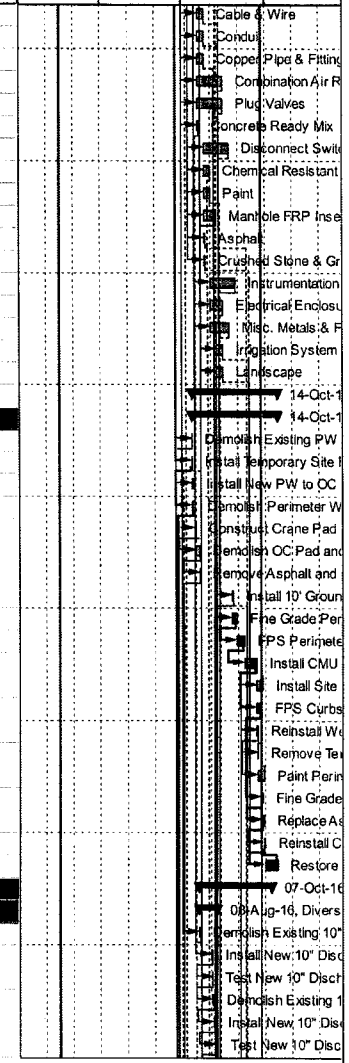
Activity ID	Activity Name	Original Duration	Remaining Duration	Total Float	Activity % Complete	Start	Finish	Early Start	Early Finish	Late Start	Late Finish	Actual Start	Actual Finish
FAB - 1040	Cable & Wire	5	5	53	0%	18-Jul-16	25-Jul-16	18-Jul-16	25-Jul-16	03-Oct-16	07-Oct-16		
FAB - 1050	Conduit	5	5	53	0%	18-Jul-16	25-Jul-16	18-Jul-16	25-Jul-16	03-Oct-16	07-Oct-16		
FAB - 1070	Copper Pipe & Fittings	5	5	48	0%	18-Jul-16	25-Jul-16	18-Jul-16	25-Jul-16	26-Sep-16	30-Sep-16		
FAB - 1090	Combination Air Release Valves	20	20	33	0%	18-Jul-16	15-Aug-16	18-Jul-16	15-Aug-16	02-Sep-16	30-Sep-16		
FAB - 1100	Plug Valves	20	20	33	0%	18-Jul-16	15-Aug-16	18-Jul-16	15-Aug-16	02-Sep-16	30-Sep-16		
FAB - 1150	Concrete Ready Mix	1	1	9	0%	18-Jul-16	19-Jul-16	18-Jul-16	19-Jul-16	01-Aug-16	01-Aug-16		
FAB - 1010	Disconnect Switches	20	20	33	0%	25-Jul-16	22-Aug-16	25-Jul-16	22-Aug-16	12-Sep-16	07-Oct-16		
FAB - 1110	Chemical Resistant Coatings	5	5	12	0%	25-Jul-16	01-Aug-16	25-Jul-16	01-Aug-16	11-Aug-16	17-Aug-16		
FAB - 1120	Paint	5	5	48	0%	25-Jul-16	01-Aug-16	25-Jul-16	01-Aug-16	03-Oct-16	07-Oct-16		
FAB - 1160	Manhole FRP Insert	10	10	7	0%	25-Jul-16	08-Aug-16	25-Jul-16	08-Aug-16	04-Aug-16	17-Aug-16		
FAB - 1170	Asphalt	1	1	44	0%	25-Jul-16	26-Jul-16	25-Jul-16	26-Jul-16	27-Sep-16	27-Sep-16		
FAB - 1190	Crushed Stone & Gravel	1	1	46	0%	25-Jul-16	26-Jul-16	25-Jul-16	26-Jul-16	29-Sep-16	29-Sep-16		
FAB - 1000	Instrumentation	20	20	28	0%	01-Aug-16	29-Aug-16	01-Aug-16	29-Aug-16	12-Sep-16	07-Oct-16		
FAB - 1030	Electrical Enclosures	10	10	38	0%	01-Aug-16	15-Aug-16	01-Aug-16	15-Aug-16	26-Sep-16	07-Oct-16		
FAB - 1130	Misc. Metals & FRP Grating	15	15	34	0%	01-Aug-16	22-Aug-16	01-Aug-16	22-Aug-16	20-Sep-16	10-Oct-16		
FAB - 1140	Irrigation System	5	5	32	0%	08-Aug-16	15-Aug-16	08-Aug-16	15-Aug-16	23-Sep-16	29-Sep-16		
FAB - 1180	Landscape	5	5	32	0%	08-Aug-16	15-Aug-16	08-Aug-16	15-Aug-16	23-Sep-16	29-Sep-16		
Construction		68	68	19		11-Jul-16	14-Oct-16	11-Jul-16	14-Oct-16	11-Jul-16	10-Nov-16		
Lift Station Site Work		68	68	19		11-Jul-16	14-Oct-16	11-Jul-16	14-Oct-16	11-Jul-16	10-Nov-16		
SITE - 1000	Demolish Existing PW to OC	1	1	85	0%	11-Jul-16	12-Jul-16	11-Jul-16	12-Jul-16	09-Nov-16	09-Nov-16		
SITE - 1010	Install Temporary Site Fence	1	1	-1	0%	11-Jul-16	12-Jul-16	11-Jul-16	12-Jul-16	11-Jul-16	11-Jul-16		
SITE - 1020	Install New PW to OC	1	1	85	0%	12-Jul-16	13-Jul-16	12-Jul-16	13-Jul-16	10-Nov-16	10-Nov-16		
SITE - 1030	Demolish Perimeter Wall	2	2	-1	0%	12-Jul-16	14-Jul-16	12-Jul-16	14-Jul-16	12-Jul-16	13-Jul-16		
SITE - 1040	Construct Crane Pad	1	1	17	0%	14-Jul-16	15-Jul-16	14-Jul-16	15-Jul-16	09-Aug-16	09-Aug-16		
SITE - 1050	Demolish OC Pad and Abondoned Piping	2	2	29	0%	15-Jul-16	19-Jul-16	15-Jul-16	19-Jul-16	26-Aug-16	29-Aug-16		
SITE - 1060	Remove Asphalt and Bollards	1	1	29	0%	19-Jul-16	20-Jul-16	19-Jul-16	20-Jul-16	30-Aug-16	30-Aug-16		
SITE - 1070	Install 10' Ground Rod	1	1	20	0%	25-Aug-16	26-Aug-16	25-Aug-16	26-Aug-16	26-Sep-16	26-Sep-16		
SITE - 1080	Fine Grade Perimeter Wall Footings	3	3	-1	0%	25-Aug-16	30-Aug-16	25-Aug-16	30-Aug-16	25-Aug-16	29-Aug-16		
SITE - 1090	FPS Perimeter Wall Footings	5	5	-1	0%	30-Aug-16	07-Sep-16	30-Aug-16	07-Sep-16	30-Aug-16	06-Sep-16		
SITE - 1100	Install CMU Perimeter Wall	10	10	-1	0%	07-Sep-16	21-Sep-16	07-Sep-16	21-Sep-16	07-Sep-16	20-Sep-16		
SITE - 1110	Install Site Lighting & Receptacles	5	5	11	0%	21-Sep-16	28-Sep-16	21-Sep-16	28-Sep-16	07-Oct-16	13-Oct-16		
SITE - 1120	FPS Curbs	3	3	-1	0%	21-Sep-16	26-Sep-16	21-Sep-16	26-Sep-16	21-Sep-16	23-Sep-16		
SITE - 1130	Reinstall West Access Gate	1	1	10	0%	21-Sep-16	22-Sep-16	21-Sep-16	22-Sep-16	06-Oct-16	06-Oct-16		
SITE - 1140	Remove Temporary Site Fence	1	1	14	0%	22-Sep-16	23-Sep-16	22-Sep-16	23-Sep-16	13-Oct-16	13-Oct-16		
SITE - 1150	Paint Perimeter Wall & Gates	5	5	10	0%	22-Sep-16	29-Sep-16	22-Sep-16	29-Sep-16	07-Oct-16	13-Oct-16		
SITE - 1160	Fine Grade for Asphalt	2	2	-1	0%	26-Sep-16	28-Sep-16	26-Sep-16	28-Sep-16	26-Sep-16	27-Sep-16		
SITE - 1170	Replace Asphalt	1	1	-1	0%	28-Sep-16	29-Sep-16	28-Sep-16	29-Sep-16	28-Sep-16	28-Sep-16		
SITE - 1180	Reinstall Chain Link Fence	1	1	-1	0%	29-Sep-16	30-Sep-16	29-Sep-16	30-Sep-16	29-Sep-16	29-Sep-16		
SITE - 1190	Restore Landscaping	10	10	-1	0%	30-Sep-16	14-Oct-16	30-Sep-16	14-Oct-16	30-Sep-16	13-Oct-16		
Wet Well Rehab		58	58	1		18-Jul-16	07-Oct-16	18-Jul-16	07-Oct-16	04-Aug-16	10-Oct-16		
Divers - Partial Discharge Piping Replacement		15	15	3		18-Jul-16	08-Aug-16	18-Jul-16	08-Aug-16	04-Aug-16	11-Aug-16		
WW RH - 1000	Demolish Existing 10" Discharge Piping & Supports at Pump #4	1	1	12	0%	18-Jul-16	19-Jul-16	18-Jul-16	19-Jul-16	04-Aug-16	04-Aug-16		
WW RH - 1020	Install New 10" Discharge Piping & Supports at Pump #4	1	1	3	0%	01-Aug-16	02-Aug-16	01-Aug-16	02-Aug-16	05-Aug-16	05-Aug-16		
WW RH - 1030	Test New 10" Discharge Piping at Pump #4 & Recommission Pump	1	1	3	0%	02-Aug-16	03-Aug-16	02-Aug-16	03-Aug-16	08-Aug-16	08-Aug-16		
WW RH - 1050	Demolish Existing 10" Discharge Piping & Supports at Pump #3	1	1	3	0%	03-Aug-16	04-Aug-16	03-Aug-16	04-Aug-16	09-Aug-16	09-Aug-16		
WW RH - 1060	Install New 10" Discharge Piping & Supports at Pump #3	1	1	3	0%	04-Aug-16	05-Aug-16	04-Aug-16	05-Aug-16	10-Aug-16	10-Aug-16		
WW RH - 1070	Test New 10" Discharge Piping at Pump #3 & Recommission Pump	1	1	3	0%	05-Aug-16	08-Aug-16	05-Aug-16	08-Aug-16	11-Aug-16	11-Aug-16		



Actual Work | Critical Remaining Work | Summary
Remaining Work | Milestone

TASK filter: All Activities

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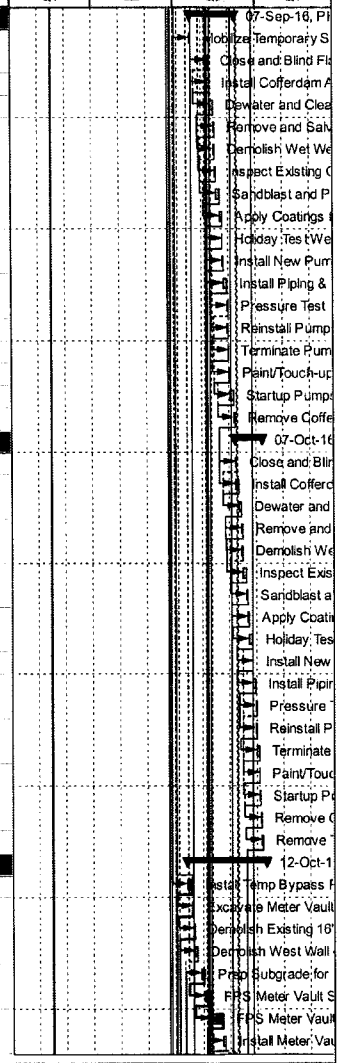
Activity ID	Activity Name	Original Duration	Remaining Duration	Total Float	Activity % Complete	Start	Finish	Early Start	Early Finish	Late Start	Late Finish	Actual Start	Actual Finish
PHASE 1 - Pumps 1 & 2		35	35	1		19-Jul-16	07-Sep-16	19-Jul-16	07-Sep-16	08-Aug-16	08-Sep-16		
WW RH - 1010	Mobilize Temporary Standby Pump & Piping	2	2	13	0%	19-Jul-16	21-Jul-16	19-Jul-16	21-Jul-16	08-Aug-16	09-Aug-16		
WW RH - 1080	Close and Blind Flange Existing 10" Plug Valves	1	1	3	0%	08-Aug-16	09-Aug-16	08-Aug-16	09-Aug-16	12-Aug-16	12-Aug-16		
WW RH - 1040	Install Cofferdam Around Pumps 1 & 2	3	3	1	0%	08-Aug-16	11-Aug-16	08-Aug-16	11-Aug-16	10-Aug-16	12-Aug-16		
WW RH - 1090	Dewater and Clean Inside Cofferdam	2	2	1	0%	11-Aug-16	15-Aug-16	11-Aug-16	15-Aug-16	15-Aug-16	16-Aug-16		
WW RH - 1100	Remove and Salvage Wet Well Pumps & Floats	1	1	1	0%	15-Aug-16	16-Aug-16	15-Aug-16	16-Aug-16	17-Aug-16	17-Aug-16		
WW RH - 1110	Demolish Wet Well Piping & Appurtenances at Pumps 1 & 2	1	1	3	0%	15-Aug-16	16-Aug-16	15-Aug-16	16-Aug-16	19-Aug-16	19-Aug-16		
WW RH - 1120	Inspect Existing Coatings	2	2	1	0%	16-Aug-16	18-Aug-16	16-Aug-16	18-Aug-16	18-Aug-16	19-Aug-16		
WW RH - 1130	Sandblast and Prep Wet Well Surfaces	2	2	1	0%	18-Aug-16	22-Aug-16	18-Aug-16	22-Aug-16	22-Aug-16	23-Aug-16		
WW RH - 1140	Apply Coatings to Wet Well	2	2	1	0%	22-Aug-16	24-Aug-16	22-Aug-16	24-Aug-16	24-Aug-16	25-Aug-16		
WW RH - 1150	Holiday Test Wet Well	1	1	1	0%	24-Aug-16	25-Aug-16	24-Aug-16	25-Aug-16	26-Aug-16	26-Aug-16		
WW RH - 1160	Install New Pump Bases	1	1	1	0%	25-Aug-16	26-Aug-16	25-Aug-16	26-Aug-16	29-Aug-16	29-Aug-16		
WW RH - 1170	Install Piping & Supports in Wet Well	2	2	1	0%	26-Aug-16	30-Aug-16	26-Aug-16	30-Aug-16	30-Aug-16	31-Aug-16		
WW RH - 1180	Pressure Test Piping	1	1	3	0%	30-Aug-16	31-Aug-16	30-Aug-16	31-Aug-16	06-Sep-16	06-Sep-16		
WW RH - 1190	Reinstall Pumps	1	1	1	0%	30-Aug-16	31-Aug-16	30-Aug-16	31-Aug-16	01-Sep-16	01-Sep-16		
WW RH - 1200	Terminate Pumps and Instrumentation	1	1	1	0%	31-Aug-16	01-Sep-16	31-Aug-16	01-Sep-16	02-Sep-16	02-Sep-16		
WW RH - 1210	Paint/Touch-up Piping in Wet Well	1	1	1	0%	01-Sep-16	02-Sep-16	01-Sep-16	02-Sep-16	06-Sep-16	06-Sep-16		
WW RH - 1220	Startup Pumps	1	1	1	0%	02-Sep-16	06-Sep-16	02-Sep-16	06-Sep-16	07-Sep-16	07-Sep-16		
WW RH - 1230	Remove Cofferdam Around Pumps 1 & 2	1	1	1	0%	06-Sep-16	07-Sep-16	06-Sep-16	07-Sep-16	08-Sep-16	08-Sep-16		
PHASE 2 - Pumps 3 & 4		22	22	1		07-Sep-16	07-Oct-16	07-Sep-16	07-Oct-16	09-Sep-16	10-Oct-16		
WW RH - 1240	Close and Blind Flange Existing 10" Plug Valves	1	1	3	0%	07-Sep-16	08-Sep-16	07-Sep-16	08-Sep-16	13-Sep-16	13-Sep-16		
WW RH - 1250	Install Cofferdam Around Pumps 3 & 4	3	3	1	0%	07-Sep-16	12-Sep-16	07-Sep-16	12-Sep-16	09-Sep-16	13-Sep-16		
WW RH - 1260	Dewater and Clean Inside Cofferdam	2	2	1	0%	12-Sep-16	14-Sep-16	12-Sep-16	14-Sep-16	14-Sep-16	15-Sep-16		
WW RH - 1270	Remove and Salvage Wet Well Pumps & Floats	1	1	1	0%	14-Sep-16	15-Sep-16	14-Sep-16	15-Sep-16	16-Sep-16	16-Sep-16		
WW RH - 1280	Demolish Wet Well Piping & Appurtenances at Pumps 3 & 4	1	1	3	0%	14-Sep-16	15-Sep-16	14-Sep-16	15-Sep-16	20-Sep-16	20-Sep-16		
WW RH - 1290	Inspect Existing Coatings	2	2	1	0%	15-Sep-16	19-Sep-16	15-Sep-16	19-Sep-16	19-Sep-16	20-Sep-16		
WW RH - 1300	Sandblast and Prep Wet Well Surfaces	2	2	1	0%	19-Sep-16	21-Sep-16	19-Sep-16	21-Sep-16	21-Sep-16	22-Sep-16		
WW RH - 1310	Apply Coatings to Wet Well	2	2	1	0%	21-Sep-16	23-Sep-16	21-Sep-16	23-Sep-16	23-Sep-16	26-Sep-16		
WW RH - 1320	Holiday Test Wet Well	1	1	1	0%	23-Sep-16	26-Sep-16	23-Sep-16	26-Sep-16	27-Sep-16	27-Sep-16		
WW RH - 1330	Install New Pump Bases	1	1	1	0%	26-Sep-16	27-Sep-16	26-Sep-16	27-Sep-16	28-Sep-16	28-Sep-16		
WW RH - 1340	Install Piping & Supports in Wet Well	2	2	1	0%	27-Sep-16	29-Sep-16	27-Sep-16	29-Sep-16	29-Sep-16	30-Sep-16		
WW RH - 1350	Pressure Test Piping	1	1	3	0%	29-Sep-16	30-Sep-16	29-Sep-16	30-Sep-16	05-Oct-16	05-Oct-16		
WW RH - 1360	Reinstall Pumps	1	1	1	0%	29-Sep-16	30-Sep-16	29-Sep-16	30-Sep-16	03-Oct-16	03-Oct-16		
WW RH - 1370	Terminate Pumps and Instrumentation	1	1	1	0%	30-Sep-16	03-Oct-16	30-Sep-16	03-Oct-16	04-Oct-16	04-Oct-16		
WW RH - 1380	Paint/Touch-up Piping in Wet Well	1	1	1	0%	03-Oct-16	04-Oct-16	03-Oct-16	04-Oct-16	05-Oct-16	05-Oct-16		
WW RH - 1390	Startup Pumps	1	1	1	0%	04-Oct-16	05-Oct-16	04-Oct-16	05-Oct-16	06-Oct-16	06-Oct-16		
WW RH - 1400	Remove Cofferdam Around Pumps 3 & 4	1	1	1	0%	05-Oct-16	06-Oct-16	05-Oct-16	06-Oct-16	07-Oct-16	07-Oct-16		
WW RH - 1410	Remove Temporary Standby Pump & Piping	1	1	1	0%	06-Oct-16	07-Oct-16	06-Oct-16	07-Oct-16	10-Oct-16	10-Oct-16		
Meter Vault		63	63	1		14-Jul-16	12-Oct-16	14-Jul-16	12-Oct-16	14-Jul-16	13-Oct-16		
MV - 1000	Install Temp Bypass Piping from Meter Vault to MH No. 4	3	3	-1	0%	14-Jul-16	19-Jul-16	14-Jul-16	19-Jul-16	14-Jul-16	18-Jul-16		
MV - 1010	Excavate Meter Vault	2	2	-1	0%	19-Jul-16	21-Jul-16	19-Jul-16	21-Jul-16	19-Jul-16	20-Jul-16		
MV - 1020	Demolish Existing 16" Discharge Piping to MH No. 5	1	1	-1	0%	21-Jul-16	22-Jul-16	21-Jul-16	22-Jul-16	21-Jul-16	21-Jul-16		
MV - 1030	Demolish West Wall of Existing Meter Vault	1	1	3	0%	22-Jul-16	25-Jul-16	22-Jul-16	25-Jul-16	28-Jul-16	28-Jul-16		
MV - 1040	Prep Subgrade for Meter Vault SOG	2	2	-1	0%	29-Jul-16	02-Aug-16	29-Jul-16	02-Aug-16	29-Jul-16	01-Aug-16		
MV - 1050	FPS Meter Vault SOG	5	5	-1	0%	02-Aug-16	09-Aug-16	02-Aug-16	09-Aug-16	02-Aug-16	08-Aug-16		
MV - 1060	FPS Meter Vault Walls	10	10	-1	0%	09-Aug-16	23-Aug-16	09-Aug-16	23-Aug-16	09-Aug-16	22-Aug-16		
MV - 1070	Install Meter Vault Piping & Appurtenances	3	3	27	0%	23-Aug-16	26-Aug-16	23-Aug-16	26-Aug-16	03-Oct-16	05-Oct-16		



Actual Work | Critical Remaining Work | Summary
Remaining Work | Milestone

TASK filter: All Activities

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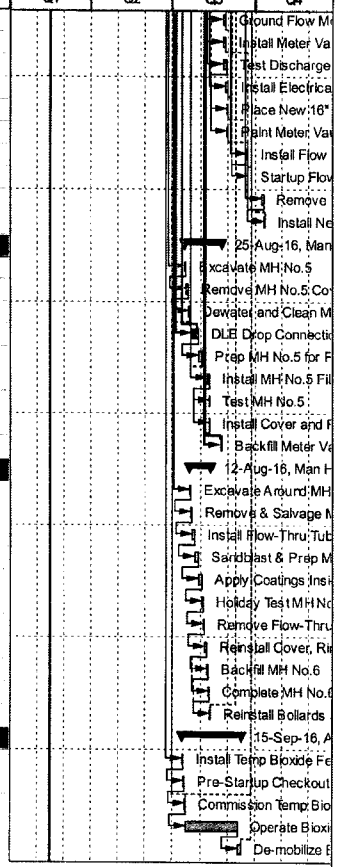
Activity ID	Activity Name	Original Duration	Remaining Duration	Total Float	Activity % Complete	Start	Finish	Early Start	Early Finish	Late Start	Late Finish	Actual Start	Actual Finish
MV - 1080	Ground Flow Meter & Test	1	1	20	0%	26-Aug-16	29-Aug-16	26-Aug-16	29-Aug-16	27-Sep-16	27-Sep-16		
MV - 1090	Install Meter Vault Access Ladders	1	1	30	0%	26-Aug-16	29-Aug-16	26-Aug-16	29-Aug-16	11-Oct-16	11-Oct-16		
MV - 1100	Test Discharge Piping	2	2	27	0%	26-Aug-16	30-Aug-16	26-Aug-16	30-Aug-16	06-Oct-16	07-Oct-16		
MV - 1110	Install Electrical in Meter Vault	2	2	28	0%	29-Aug-16	31-Aug-16	29-Aug-16	31-Aug-16	10-Oct-16	11-Oct-16		
MV - 1120	Place New 16" Discharge Piping to MH No. 5 into Service	1	1	27	0%	30-Aug-16	31-Aug-16	30-Aug-16	31-Aug-16	10-Oct-16	10-Oct-16		
MV - 1130	Paint Meter Vault Piping & Appurtenances	2	2	27	0%	30-Aug-16	01-Sep-16	30-Aug-16	01-Sep-16	10-Oct-16	11-Oct-16		
MV - 1140	Install Flow Meter Transmitter on Perimeter Wall	1	1	14	0%	21-Sep-16	22-Sep-16	21-Sep-16	22-Sep-16	12-Oct-16	12-Oct-16		
MV - 1160	Startup Flow Meter	1	1	14	0%	22-Sep-16	23-Sep-16	22-Sep-16	23-Sep-16	13-Oct-16	13-Oct-16		
MV - 1150	Remove Temp Bypass Piping from Meter Vault to MH No. 4	1	1	1	0%	07-Oct-16	10-Oct-16	07-Oct-16	10-Oct-16	11-Oct-16	11-Oct-16		
MV - 1170	Install New Grating at Meter Vault	2	2	1	0%	10-Oct-16	12-Oct-16	10-Oct-16	12-Oct-16	12-Oct-16	13-Oct-16		
Man Hole No. 5 Rehab		30	30	54		14-Jul-16	25-Aug-16	14-Jul-16	25-Aug-16	19-Jul-16	10-Nov-16		
MH5 - 1000	Excavate MH No.5	1	1	2	0%	14-Jul-16	15-Jul-16	14-Jul-16	15-Jul-16	19-Jul-16	19-Jul-16		
MH5 - 1010	Remove MH No.5 Cover, Rings & Cone	1	1	2	0%	15-Jul-16	18-Jul-16	15-Jul-16	18-Jul-16	20-Jul-16	20-Jul-16		
MH5 - 1020	Dewater and Clean MH No.5	1	1	2	0%	18-Jul-16	19-Jul-16	18-Jul-16	19-Jul-16	21-Jul-16	21-Jul-16		
MH5 - 1030	DLE Drop Connection to MH No.5	5	5	-1	0%	22-Jul-16	29-Jul-16	22-Jul-16	29-Jul-16	22-Jul-16	28-Jul-16		
MH5 - 1040	Prep MH No.5 for Fiberglass Insert	2	2	11	0%	29-Jul-16	02-Aug-16	29-Jul-16	02-Aug-16	16-Aug-16	17-Aug-16		
MH5 - 1050	Install MH No.5 Fiberglass Insert	2	2	7	0%	08-Aug-16	10-Aug-16	08-Aug-16	10-Aug-16	18-Aug-16	19-Aug-16		
MH5 - 1060	Test MH No.5	1	1	64	0%	10-Aug-16	11-Aug-16	10-Aug-16	11-Aug-16	10-Nov-16	10-Nov-16		
MH5 - 1070	Install Cover and Rings at MH No.5	1	1	7	0%	10-Aug-16	11-Aug-16	10-Aug-16	11-Aug-16	22-Aug-16	22-Aug-16		
MH5 - 1080	Backfill Meter Vault and MH No.5	2	2	-1	0%	23-Aug-16	25-Aug-16	23-Aug-16	25-Aug-16	23-Aug-16	24-Aug-16		
Man Hole No. 6 Rehab		17	17	29		20-Jul-16	12-Aug-16	20-Jul-16	12-Aug-16	31-Aug-16	23-Sep-16		
MH6 - 1000	Excavate Around MH No.6	1	1	29	0%	20-Jul-16	21-Jul-16	20-Jul-16	21-Jul-16	31-Aug-16	31-Aug-16		
MH6 - 1010	Remove & Salvage MH No.6 Cover, Rings & Cone	1	1	29	0%	21-Jul-16	22-Jul-16	21-Jul-16	22-Jul-16	01-Sep-16	01-Sep-16		
MH6 - 1020	Install Flow-Thru Tubes in MH No.6	1	1	29	0%	22-Jul-16	25-Jul-16	22-Jul-16	25-Jul-16	02-Sep-16	02-Sep-16		
MH6 - 1030	Sandblast & Prep MH No.6	4	4	29	0%	25-Jul-16	29-Jul-16	25-Jul-16	29-Jul-16	06-Sep-16	09-Sep-16		
MH6 - 1040	Apply Coatings Inside MH No.6	3	3	29	0%	29-Jul-16	03-Aug-16	29-Jul-16	03-Aug-16	12-Sep-16	14-Sep-16		
MH6 - 1050	Holiday Test MH No.6	1	1	29	0%	03-Aug-16	04-Aug-16	03-Aug-16	04-Aug-16	15-Sep-16	15-Sep-16		
MH6 - 1060	Remove Flow-Thru Tubes in MH No.6	1	1	29	0%	04-Aug-16	05-Aug-16	04-Aug-16	05-Aug-16	16-Sep-16	16-Sep-16		
MH6 - 1070	Reinstall Cover, Rings and Cone at MH No.6	1	1	29	0%	05-Aug-16	08-Aug-16	05-Aug-16	08-Aug-16	19-Sep-16	19-Sep-16		
MH6 - 1080	Backfill MH No.6	1	1	29	0%	08-Aug-16	09-Aug-16	08-Aug-16	09-Aug-16	20-Sep-16	20-Sep-16		
MH6 - 1090	Complete MH No.6 Rehab After Bypass Removal	1	1	29	0%	09-Aug-16	10-Aug-16	09-Aug-16	10-Aug-16	21-Sep-16	21-Sep-16		
MH6 - 1100	Reinstall Bollards at MH No.6	2	2	29	0%	10-Aug-16	12-Aug-16	10-Aug-16	12-Aug-16	22-Sep-16	23-Sep-16		
Amberwood		47	47	20		11-Jul-16	15-Sep-16	11-Jul-16	15-Sep-16	29-Jul-16	13-Oct-16		
AMBWD - 1010	Install Temp Bioxide Feed System Mechanical & Electrical	2	2	13	0%	11-Jul-16	13-Jul-16	11-Jul-16	13-Jul-16	29-Jul-16	01-Aug-16		
AMBWD - 1020	Pre-Startup Checkout & Fill Bioxide Storage Tank	1	1	13	0%	13-Jul-16	14-Jul-16	13-Jul-16	14-Jul-16	02-Aug-16	02-Aug-16		
AMBWD - 1030	Commission Temp Bioxide Feed System	1	1	13	0%	14-Jul-16	15-Jul-16	14-Jul-16	15-Jul-16	03-Aug-16	03-Aug-16		
AMBWD - 1040	Operate Bioxide Feed System (2 Month Duration)	40	40	20	0%	15-Jul-16	12-Sep-16	15-Jul-16	12-Sep-16	15-Aug-16	10-Oct-16		
AMBWD - 1050	De-mobilize Bioxide Feed System	3	3	20	0%	12-Sep-16	15-Sep-16	12-Sep-16	15-Sep-16	11-Oct-16	13-Oct-16		



Actual Work | Critical Remaining Work | Summary
Remaining Work | Milestone

TASK filter: All Activities

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EXHIBIT F
PERFORMANCE BOND

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"), 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 _____(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 _____, 2016 for construction of **MANGANARO LIFT STATION IMPROVEMENTS CITY PROJECT NO. WW1504.401** which contract is hereby referred to and made a part hereof as fully and to the same extent as if copies at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the Principal faithfully performs and fulfills all 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 guaranty required under the contract, and also performs and fulfills all 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 Contract.

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 _____, 2016.

_____
PRINCIPAL SEAL

_____
AGENT OF RECORD

By _____

_____
SURETY SEAL

_____
AGENT ADDRESS

EXHIBIT G
PAYMENT BOND

ARIZONA STATUTORY PAYMENT BOND
PURSUANT TO TITLES 28, 34, AND 41, OF THE 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 _____ (hereinafter "Obligee") in the amount of _____ (Dollars) ($_____), for the payment whereof, the 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 _____, 2016 for construction of MANGANARO LIFT STATION IMPROVEMENTS **CITY PROJECT NO.: WW1504.401** 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 THIS OBLIGATION IS SUCH, that if the Principal promptly pays all moneys 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 said 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 Contract.

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 _____, 2016.

_____
PRINCIPAL SEAL

_____
AGENT OF RECORD

By _____

_____
SURETY SEAL

_____
AGENT ADDRESS

CITY OF CHANDLER, ARIZONA

CERTIFICATE OF INSURABILITY

CITY OF CHANDLER PRIVILEGE TAX LICENSE

(Refer to Article 6.9, General Conditions; CONTRACTOR'S RESPONSIBILITIES)

PROJECT NAME: MANGANARO LIFT STATION IMPROVEMENTS

PROJECT NUMBER: WW1504.401

Please attach current certificate per Article 6.9 General Conditions.

CITY OF CHANDLER, ARIZONA
TRANSPORTATION & DEVELOPMENT DEPARTMENT

CONTRACTOR'S AFFIDAVIT REGARDING SETTLEMENT OF CLAIMS

_____, Arizona

Date _____

Project Name: **MANGANARO LIFT STATION IMPROVEMENTS**
Project No.: **WW1504.401**

To the City of Chandler, Arizona

Gentlemen:

This is to certify that all lawful claims for materials, rental of equipment and labor used in connection with the construction of the above project, whether by subcontractor or claimant in person, have been duly discharged.

The undersigned, for the consideration of $_____, as set out in the final pay estimate, as full and complete payment under the terms of the contract, hereby waives and relinquishes any and all further claims or right of lien under, in connection with, or as a result of the above described project. The undersigned further agrees to indemnify and save harmless the City of Chandler against any and all liens, claims or liens, suits, actions, damages, charges and expenses whatsoever, which said City may suffer arising out of the failure of the undersigned to pay for all labor performances and materials furnished for the performance of said installation.

Signed and dated at _____, this _____ day of _____ 20_____.

_____
CONTRACTOR

By _____

STATE OF ARIZONA)
) SS
COUNTY OF MARICOPA)

The foregoing instrument was subscribed and sworn to before me this _____ day of _____ 20 _____.

_____
Notary Public

_____
My Commission Expires

CITY OF CHANDLER, ARIZONA
TRANSPORTATION & DEVELOPMENT DEPARTMENT

CERTIFICATE OF COMPLETION

Project Name: **MANGANARO LIFT STATION IMPROVEMENTS**
Project No.: **WW1504.401**

(TO BE COMPLETED BY CONTRACTOR)

I HEREBY CERTIFY THAT ALL GOODS AND/OR SERVICES REQUIRED BY CITY OF CHANDLER PROJECT NO. WW1504.401 HAVE BEEN DELIVERED IN ACCORDANCE WITH THE CONTRACT DOCUMENTS AND BID SPECIFICATIONS AND ALL ACTIVITIES REQUIRED BY THE CONTRACTOR UNDER THE CONTRACT HAVE BEEN COMPLETED AS OF _____.
(Date)

FIRM NAME: _____

PRINCIPAL: _____
(Name)

_____
(Signature)

_____ DATE: _____
(Title)

CERTIFIED BY ENGINEER/CONSULTANT:

_____ DATE: _____
(Signature)

_____
(Firm Name)

PROJECT ACCEPTED BY USER DEPARTMENT

_____ DATE: _____
(Signature)

_____
(Dept./Div.)

_____ Date of Final Walk-Through

_____ Date As-Built Received

_____ City As-Built Number

City of Chandler
GENERAL CONDITIONS

GENERAL CONDITIONS

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ARTICLE 1 - DEFINITIONS

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

1.1 Addenda: Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change, the bidding Documents or the Contract Documents.

1.2 Agreement: same as Contract.

1.3 Application for Payment: The form prepared by and acceptable to CITY which must be used by CONTRACTOR to request progress or final payments and which must include supporting documentation such as updated Construction Progress Schedule as required by the Contract Documents.

1.4 Architect: The person, firm or corporation, including their representatives, retained by CITY to design and engineer the project, to draft specifications, plans and perform other project design functions. The Architect will generally be referred to as the Project Designer in these General Conditions.

1.5 Change Order: A written order to CONTRACTOR signed by CITY and agreed to in writing by CONTRACTOR, authorizing an addition, deletion or revision in the Work and/or a change in the Contract Price or the Contract Times, issued on or after the Effective Date of the Contract. A Change Order is the only mechanism for adjusting the Contract Price or the Contract Time of the Contract.

1.6 CITY: The City of Chandler, OWNER of the project.

1.7 City Engineer: The person named as such by the City of Chandler.

1.8 CITY REPRESENTATIVE: The person or firm authorized by the CITY to represent it during the performance of the Work by the CONTRACTOR; who is CONTRACTOR'S point of contact for the CITY. The CITY REPRESENTATIVE is also known as and may sometimes be referred to as CITY REP, the Engineer, Resident Engineer, or the Onsite Resident Project Representative.

1.9 Construction Progress Schedule: Sometimes referred to as the Work Schedule, is the schedule prepared and submitted by CONTRACTOR which tracks the progress of the Work as more fully explained and defined herein.

1.10 Contract: The entire and integrated written agreement, including all the Contract Documents, between the CITY and CONTRACTOR concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

1.11 Contract Documents: The Contract Documents are those documents listed in paragraph 3.1 herein.

1.12 Contract Price: The moneys payable by CITY to CONTRACTOR for completion of the Work in accordance with the Contract Documents as stated in the Contract (subject to the provisions of Paragraph 1.41 in the case of Unit Price Work).

1.13 Contract Time: The number of days or the date stated in the Contract to: (i) achieve Substantial Completion; (ii) to complete the Work through any designated milestones; and (iii) to complete the Work so that it is ready for final payment as evidenced by the written recommendation of the CITY REP for final payment.

1.14 CONTRACTOR: The person, firm or corporation with whom CITY has entered into the Contract. Whenever the Project is to be constructed under multiple direct contracts, the term "CONTRACTOR" shall mean the appropriate prime CONTRACTOR. Whenever a specific prime CONTRACTOR is referred to, terms such as "General CONTRACTOR", "Electrical CONTRACTOR", etc., will be used.

1.15 Day: A calendar day of twenty-four hours measured from midnight to the next midnight.

1.16 Drawings: That part of the Contract Documents prepared by the Project Designer which graphically shows the character, intent and scope of the Work to be performed by CONTRACTOR. Shop Drawings and other CONTRACTOR submittals are not Drawings as so defined.

1.17 Effective Date of the Contract: The date indicated in the Contract on which it becomes effective, but if no such date is indicated, it means the date on which the Contract is signed and delivered by the last of the two parties to sign and deliver.

1.18 Engineer: The person, firm or corporation, including their representatives, retained by CITY to design and engineer the project, to draft specifications, plans and perform other project design functions. The engineer will generally be referred to as the Project Designer in these General Conditions.

1.19 Field Order: A written order issued by CITY REP which requires CONTRACTOR to perform minor changes in the Work, but which does not involve a change in the Contract Price or the Contract Times.

1.20 General Requirements: Sections of Division 1 of the Specifications. The General Requirements pertain to all sections of the Specifications.

1.21 MAG Standard Specifications: The Uniform Standard Specifications for Public Works Construction sponsored and distributed by the Maricopa Association of Governments (MAG), latest edition in effect at the time of Bid Opening.

1.22 MAG Standard Details: The Uniform Standard Details for Public Works Construction sponsored and distributed by the Maricopa Association of Governments (MAG), latest edition in effect at the time of the Bid Opening.

1.23 Milestone: A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

1.24 Modifications:

a) A written amendment of the Contract Documents signed by both parties.
b) A Change Order.
c) A Field Order.

A Modification may only be issued after the Effective Date of the Contract.

1.25 Notice of Award: The written notice by CITY to the apparent successful Bidder stating that upon compliance by the apparent successful Bidder with the conditions precedent enumerated therein, within the time specified, CITY will sign the Contract.

1.26 Notice to Proceed: A written notice given by CITY to CONTRACTOR fixing the date on which the Contract Time will commence to run and on which CONTRACTOR shall start to perform their obligations under the Contract Documents.

1.27 Plans: Same as Drawings.

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

1.29 Project Designer: The person, firm or corporation retained by CITY to design and engineer the project, to draft specifications, plans and perform other project design functions. References in the Contract Documents to the Project Designer, Architect, Design Engineer or Engineer, all generally mean the Project Designer.

1.30 RFI: Request for Information. Document submitted by the general contractor to the CITY REP requesting additional information regarding project plans and specifications..

1.31 Samples: Physical examples furnished by the CONTRACTOR to illustrate materials, equipment or workmanship, and to establish standards by which some portions of the Work will be judged.

1.32 Schedule of Values: A list prepared by CONTRACTOR showing the Work divided into component parts including quantities and unit prices aggregating the Contract Price and showing the anticipated monthly progress payment amounts that will become due.

1.33 Shop Drawings: All drawings, diagrams, illustrations, schedules and other data which are specifically prepared by or for CONTRACTOR to illustrate some portion of the Work and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams and other information prepared by a manufacturer, fabricator, supplier or distributor and submitted by CONTRACTOR to illustrate material or equipment for some portion of the Work.

1.34 Special Provisions: Same as Supplementary (Special) Conditions.

1.35 Specifications: That part of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.

1.36 Subcontractor: An individual, firm or corporation having a direct contract with CONTRACTOR or with any other Subcontractor for the performance of a part of the Work at the site.

1.37 Substantial Completion: The time at which the Work (or specified part thereof) has progressed to the point where, in the opinion of the CITY REP, the Work (or specified part thereof) is sufficiently complete, in accordance with Contract Documents, so that the Work (or specified part thereof) can be utilized for the purposes for which it was intended. The terms "beneficial occupancy"/ "beneficial use" are sometimes used for Substantial Completion.

1.38 Supplementary Conditions: That part of the Contract Documents which amends or supplements these General Conditions sometimes referred to as Special Conditions.

1.39 Supplier: A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with CONTRACTOR or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by CONTRACTOR or any Subcontractor.

1.40 Underground Facilities: All underground pipelines, conduits, ducts, cables, fiber optic facilities, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including but not limited to those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

1.41 Unit Price Work: Work to be paid for on the basis of unit prices.

1.42 Warranty Period: One year from date of Final Acceptance (not Substantial Completion).

1.43 Work: The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents including any and all obligations, duties and responsibilities necessary to complete the construction assigned to, or undertaken by, the CONTRACTOR pursuant to the Contract Documents. Work is the result of performing services, furnishing labor and furnishing and incorporating materials and equipment into the construction, all as required by the Contract Documents.

1.44 Work Change Directive: Sometimes referred to as a Construction Change Directive. A written order to CONTRACTOR issued on or after the Effective date of the Contract and signed by CITY, ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive may not change the Contract Price or the Contract Times, but is evidence that if appropriate, the change ordered or documented by a Work Change Directive may be converted to a Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.45 Utility: Same as underground facility.

ARTICLE 2 - PRELIMINARY MATTERS

2.1 Delivery of Bonds, Insurance Certificates and Preliminary Schedule

A. Within ten days of Notice of Award, CONTRACTOR shall execute the Contract and deliver it together with those items listed below to CITY.

B. When CONTRACTOR delivers the executed Contract to CITY, CONTRACTOR shall also deliver to CITY such Bonds and certificates of insurance with endorsements (and other evidence of insurance requested by CITY) as CONTRACTOR may be required to furnish.

C. As evidence of Workmen's Compensation Insurance, CONTRACTOR shall provide a letter of certification from the Industrial Commission of Arizona that the CONTRACTOR is insured by the State Compensation Fund or is an authorized self-insurer or a certificate of insurance issued by an insurance company authorized by the Insurance Department of Arizona to write Workmen's Compensation and Occupational Disease Insurance in the State of Arizona.

2.2 Copies of Documents

CITY shall furnish to CONTRACTOR up to five copies (unless otherwise provided in the Contract Documents) of the Contract Documents as are reasonably necessary for the execution of the Work. Additional copies will be furnished, upon request, at the cost of reproduction.

2.3 Commencement of Contract Time/Notice to Proceed

Notice to Proceed may be given at any time within sixty days after the Notice of Award. The Contract Times will commence to run on the date indicated in the Notice to Proceed.

2.4 Contractor Review of Contract Documents.

Before commencing any work, CONTRACTOR shall carefully study and compare all the Contract Documents, Plans and Specifications and shall check and verify pertinent figures therein and all applicable quantities to determine if there are any conflicts, errors, discrepancies or any other reasons why the project can or should not be constructed as shown therein. If CONTRACTOR finds a conflict, error or discrepancy in the Contract Documents, or between the Contract

Documents and the physical conditions at the site of the Work or in any survey, or any other reason why the project can or should not be constructed as shown, CONTRACTOR shall report it to CITY REP in writing at once and before proceeding with the Work. The CITY REP on receipt of any such notice, will promptly investigate the circumstances and give appropriate instructions to the CONTRACTOR or make appropriate modifications to the Contract Documents. In the event such conflicts, errors, discrepancies or other reasons why the project can or should not be constructed as shown on such Contract Document, are later found to exist which the CONTRACTOR should reasonably have learned from such study and CONTRACTOR failed to inform CITY REP, then CONTRACTOR shall bear all cost arising therefrom.

2.5 Starting the Project

Work shall start on the date set forth in the "Notice to Proceed" as the date upon which Contract Times commence to run and shall be pursued diligently in accordance with the Construction Progress Schedule found acceptable by CITY REP or an acceptable revision/update. The work shall be completed within the time set forth in the Contract and as modified by subsequent Change Orders. No Work shall be done at the site prior to the date on which the Contract Times commence to run.

2.6 Construction Progress Schedule

A. Within ten (10) days of the date of execution of this Contract (unless otherwise specified in the Supplementary Conditions) CONTRACTOR shall submit to CITY REP for review for acceptability, a comprehensive Construction Progress Schedule in Critical Path Method (CPM) format, indicating the starting and completion dates of the various activities of the Work including any Milestones specified in the Contract Documents.

1) This Schedule shall contain a detailed representation of all activities for the project, both on-site construction and major procurement. All significant activities together with the resource loading requirements for each and all items appearing on the schedule of values or bid schedule for progress payments shall be shown on the Construction Progress Schedule or in attached reports to the Construction Progress Schedule.

2) Dependencies between activities shall be indicated so that it may establish as to the effect the progress of any one activity would have on other activities and on the schedule.

3) This schedule shall contain activities for submission, review and approval of all required submittals.

4) An amount of time shall be established prior to the final completion date for "punch list and cleanup." No other activities shall be scheduled during this period. Punch list and cleanup must be shown on the Construction Progress Schedule and must be entirely completed prior to the expiration of ;the Contract Time.

5) CITY has estimated an amount of time reasonably required to complete the Project and based the Contract Time on this estimation. In the event CONTRACTOR believes the Contract Time is too short, CONTRACTOR shall so advise CITY prior to submitting a bid on the project to allow CITY to reevaluate the Contract Time. CONTRACTOR'S Construction Progress Schedule shall not show a "CONTRACTOR contingency" or CONTRACTOR float" at the end of the construction contract time. Damage claims are prohibited and will not be paid to CONTRACTOR by CITY based on CONTRACTOR'S failure to meet an early completion date shown on CONTRACTOR'S submitted Construction Progress Schedule. (i.e., float within the Contract Time is owned by CITY and while it may be used by CONTRACTOR it may not be claimed to CITY'S detriment.)

6) For all items of materials and equipment that are critical or which may require long lead times to acquire, the Construction Progress Schedule shall show dates for submission, review and approval of submittals, ordering and delivery.

7) Computer generated reports detailing the early/late start dates, early/late finish dates and dependencies shall be submitted by CONTRACTOR together with the CPM schedule.

B. Within ten (10) days of receipt of CITY REP comments, CONTRACTOR shall make all required corrections, adjustments and additions to complete the Construction Progress Schedule and resubmit it to CITY REP for review.

C. The Comprehensive Construction Progress Schedule will be acceptable to CITY REP if it is in CPM format and if it complies with the requirements set forth herein and provides a realistic and orderly progression of the Work to completion within any specified Milestones and Contract Times. Such Acceptance by CITY REP or any revision or correction made at the request of CITY REP, does not impose on CITY responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve CONTRACTOR from CONTRACTOR'S full responsibility therefor. Acceptance of CONTRACTOR'S Work Progress Schedule by CITY, does not constitute approval of the times listed thereon nor constitute any extension of the Contract Time.

D. The Construction Progress Schedule shall be prepared by CONTRACTOR and the scheduling of Construction shall be the responsibility of the CONTRACTOR. The requirement for the Schedule is included to assure adequate planning and execution of the Work and to assist CITY REP in evaluating progress of the Work.

E. The Construction Progress Schedule submitted and signed by CONTRACTOR, when found acceptable by CITY REP, becomes a part of the Contract Documents and CONTRACTOR may not change, modify or deviate from such schedule without the consent of CITY REP.

F. If, at any time after CONTRACTOR'S Construction Progress Schedule has been found acceptable, CONTRACTOR desires to or it becomes necessary to make any changes to such schedule, CONTRACTOR shall submit such changes to CITY REP for review. CONTRACTOR shall revise and submit for review an updated schedule whenever it is demonstrated that the time for completion of the Project or for any of the Milestones shown on the Contract Documents, has changed by ten (10) or more days.

G. An updated Construction Progress Schedule must also be submitted by CONTRACTOR with each pay application. The updates shall include all past performance history and actual dates activities started and finished from the beginning of the project; and (2) the City reserves the right to accept or reject each update and, if rejected, the Contractor must revise and/or correct the update and resubmit within 7 days of Contractor's receipt of City comments. Failure to comply with this requirement may be cause for rejection of Contractor's next monthly progress payment application, as provided for in 15.2.

H. CONTRACTOR shall complete the Project in accordance with the Construction Progress Schedule as it may be adjusted from time to time as provided herein.

2.7 Other Submittals

A. Within ten (10) days of the date of execution of this Contract (unless otherwise specified in the General Requirements), CONTRACTOR shall submit to CITY REP for review and acceptance, a preliminary schedule of Shop Drawings submissions. Within ten (10) days after receipt of CITY REP'S comments, CONTRACTOR shall submit the corrected and completed schedule of Shop Drawings Submissions for approval. CONTRACTOR'S schedule of Shop Drawings and Sample submittals will be acceptable to CITY REP if it provides a workable arrangement for reviewing and processing the required submittals.

B. Within ten (10) days of the date of execution of this Contract (unless otherwise specified in the Supplementary Conditions), CONTRACTOR shall submit to CITY REP for review and acceptance, a preliminary schedule of values of the Work, and the anticipated amount of each monthly progress payment that will become due CONTRACTOR in accordance therewith. The Schedule of Values shall include quantities and unit prices aggregating the Contract Price, and for lump sum items shall subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction. Within ten days after receipt of CITY REP's comments, CONTRACTOR shall submit the corrected and completed Schedule of Values of the Work. CONTRACTOR'S schedule of values will be acceptable to CITY REP if it complies with the requirements herein and if it provides a reasonable allocation of the Contract Price to component parts of the Work.

C. No application for payment on the Project will be accepted and no payment will be made until CONTRACTOR has submitted an acceptable and complete Construction Progress Schedule, Schedule of Shop Drawing Submissions and Schedule of Values of the Work.

2.8 Pre-Construction Conference

Within sixty days after the Notice of Contract Award, and before CONTRACTOR starts the Work at the site, CITY will hold a Pre-Construction conference for discussion of the schedules referred to above, to establish lines of communication, procedures for handling Shop Drawings and other submittals and for processing Applications for Payment, to establish a working understanding and communication system among the parties as to the Work, and coordination of work among the various utilities. CONTRACTOR, CONTRACTOR'S Resident Superintendent and CONTRACTOR'S designated safety officer shall attend this Pre-Construction conference which will also be attended by the Project Designer, CITY REP and representatives from any company whose facilities may be affected by the Project.

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT AND REUSE

3.1 Contract Documents

A. The Contract Documents establish the rights and obligations of the parties and include the Contract, Addenda (which pertain to the Contract Documents), CONTRACTOR'S Bid or Proposal (including documentation accompanying the Bid and any post-Bid documentation submitted prior to the Notice of Award) when attached as an exhibit to the Contract, the accepted Construction Progress Schedule, the Notice to Proceed, the Performance Bond, the Payment Bond, Project Design, Engineering and Specifications, these General Conditions, the Supplementary Conditions, Special Provisions, Specifications, Contract Drawings, as the same may be more specifically identified in the Contract, Change Orders, Work Change Directives, Field Orders and the written interpretations and clarifications of the Project Designer or CITY REP and Modifications issued after execution of the Contract. Approved Shop Drawings and the reports and drawings of subsurface and physical conditions are not Contract Documents. Only printed or hard copies of the items listed in this paragraph are Contract Documents. Files in electronic media format of text data, graphics, and the like that may be furnished by CITY to CONTRACTOR are not Contract Documents.

B. The Contract Documents also include those parts of the Maricopa Association of Governments Uniform Standard Specifications and Details for Public Works Construction (MAG Standard Specifications and Details), which address matters not otherwise covered by or addressed in these General Conditions, the City Standard Specifications and Details, the Project Specifications or the Construction Contract and said MAG Standard Specifications and Details are incorporated herein only to the extent they do not conflict with or modify any of those documents named herein above in paragraph 3.1A.

3.2 Intent

A. The Contract Documents comprise the entire Contract between CITY and CONTRACTOR concerning the Work. They may be altered only by a written Modification.

B. The Contract Documents are complementary and intended to be interpreted as a whole; what is called for by one plan note, drawing detail, contract provision, etc., is as binding as if called for by all.

C. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result shall be provided by CONTRACTOR whether or not specifically called for at no additional cost to CITY.

D. Clarifications and interpretations of the Contract Documents shall be issued by the Project Designer through the CITY REP.

E. The Specifications may describe or the Drawings may show the general arrangement of an item of material or equipment when the actual details of said arrangement will vary with the source of the material or equipment. In such cases, CONTRACTOR shall bear all direct and indirect costs to accommodate the item of material or equipment furnished, whether the item of material or equipment is furnished by a manufacturer named in the Specifications or is furnished as an approved substitute "or equal" item of material or equipment.

F. When words in the Specifications or on the Drawings, which have a well-known technical or trade meaning, are used to describe Work, materials or equipment, such words shall be interpreted in accordance with such meaning.

3.3 Reference Standards

A. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

B. The provisions of any such standard, specification, manual or code, or any instruction of a Supplier shall not change the duties or responsibilities of CITY, CONTRACTOR, Project Designer or CITY REP, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents, nor shall any such provision or instruction assign to CITY, CONTRACTOR, Project Designer, or any of their agents, or employees any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.4 Reporting and Resolving Discrepancies

A. If during the performance of the Work, CONTRACTOR finds a conflict, error or discrepancy in the Contract Documents, or between the Contract Documents and any provision of any law or regulation applicable to the performance of the Work or of any standard, specification, manual or code, any survey, or of any instruction of any Supplier, CONTRACTOR shall report it to CITY REP in writing at once and before proceeding with the Work affected thereby (except in an emergency as required by paragraph 6.13). However, CONTRACTOR shall not be liable to CITY for failure to report any such conflict, error or discrepancy unless CONTRACTOR knew or should reasonably have known thereof. On receipt of any such

notice, CITY REP will promptly investigate the circumstances and give appropriate instructions to the CONTRACTOR. Until such instructions are given, any Work done by the CONTRACTOR after discovery of such conflict, error or discrepancy which is directly or indirectly affected by such conflict, error or discrepancy will be at CONTRACTOR'S own risk and CONTRACTOR shall bear all cost arising therefrom.

B. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

1) the provisions of any standard, specification, manual, code or instruction (whether or not specially incorporated by reference in the Contract Documents); or

2) the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation);

3) provided, however, when any of the Contracts Documents incorporate by reference standards, specifications or other documents, the printed provisions contained in the Contract Documents take precedence over any provisions incorporated by reference.

C. In a case of a discrepancy or conflict, the order in which the various contract documents shall govern is as follows from highest to lowest: Technical Specifications; Plans; Supplementary Conditions (sometimes referred to as Special Conditions); General Conditions; City of Chandler standard specifications and standard details.

D. Figured dimensions on Drawings shall govern, but work not dimensioned shall be as directed. Work not particularly shown or specified shall be the same as similar parts that are shown or specified. Large scale details shall take precedence over smaller scale drawings as to shape and details of construction. Specifications shall govern as to materials and workmanship. The specification calling for higher quality material or workmanship shall prevail.

3.5 Re-Use of Documents

Neither CONTRACTOR nor any Subcontractor, manufacturer, fabricator, supplier or distributor shall have or acquire any title to or ownership rights in any of the Drawings, Specifications or other documents (or copies of any thereof) prepared by or bearing the seal of the Project Designer; and they shall not re-use any of them on extensions of the Project or any other project without written consent of CITY and the Project Designer and specific written verification or adaptation by the Project Designer.

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

4.1 Availability of Lands

CITY shall furnish, as indicated in the Contract Documents the lands upon which the Work is to be performed, rights-of-way for access thereto, and such other lands which are designated for the use of CONTRACTOR. Easements for permanent structures or permanent changes in existing facilities will be obtained and paid for by CITY, unless otherwise provided in the Contract Documents. If CONTRACTOR believes that any delay in CITY'S furnishing these lands or easements entitles CONTRACTOR to an extension of the Contract Time, CONTRACTOR may make a claim therefore as provided in Article 13. CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment (marshalling yard).

4.2 Physical Conditions, Investigations and Reports

A. CONTRACTOR is to protect all existing facilities during construction. Utility poles that may be affected by the construction activities shall be protected by the CONTRACTOR. CONTRACTOR shall notify the appropriate Utility Company or agency of any construction that may affect their facilities.

B. The Supplementary Conditions identify any reports of investigations and tests of subsurface and latent physical conditions at the site, and any reports of conditions that otherwise may affect cost, progress or performance of the Work which have been utilized by Project Designer in preparation of the Drawings and Specifications. These reports are not intended to constitute any explicit or implicit representation as to the nature of the subsurface and latent physical conditions which may be encountered at the site or to constitute explicit or implicit representations as to any other matter contained in any report. Such reports are not guaranteed as to accuracy or completeness and are not part of the Contract Documents.

4.3 Differing Subsurface or Physical Conditions; Underground Facilities

4.3.1. Underground Facilities

A. The existence and number of facilities as shown on the plans are estimated from information furnished by the particular utility. CONTRACTOR is responsible for field verification and location of all utilities prior to the start of construction. No field work shall be allowed to start until CONTRACTOR has arranged for and Blue Stake has located all affected utilities. In addition CONTRACTOR shall expose and physically locate all potentially conflicting utilities prior to construction. The actual locations of the utilities shall be compared to locations shown on the plans and any required changes in alignment and grade shall be made at the time of construction in consultation with CITY REP. It is generally recognized and CONTRACTOR should anticipate that information from Blue Stake or information from utility companies during project design, frequently fails to disclose all underground facilities. The fact that more utility lines or other underground facilities are located in the Project Site than shown on the Project Plans does not constitute an "unforeseen Condition" and such undisclosed underground facilities do not differ materially from the conditions which CONTRACTOR should expect. The provisions of Sections 105.4, 105.6, 107.11 and 109.8.1 of the MAG Uniform Standard Specifications for Public Works Construction apply and are incorporated herein by reference.

. B. The project requires considerable coordination with utility companies such as Arizona Public Service, Quest, Cox, SW Gas and Salt River Project. The provisions of Sections 105.4, 105.6, 107.11 and 109.8.1 of the MAG Uniform Standard Specifications for Public Works Construction strictly apply and no claims for delays due to utility work on the project will be allowed.

C. Utilities damaged shall be repaired at the CONTRACTOR'S expense.

4.3.2 Unforeseen Conditions

The provisions of Section 104.2.2 of the MAG Uniform Standard Specifications for Public Works Construction strictly apply.

4.4 Reference Points

CITY shall provide engineering surveys to establish reference points for construction which in CITY'S judgment are necessary to enable CONTRACTOR to proceed with the Work. CONTRACTOR shall be responsible for laying out the Work, shall protect and preserve the established reference points and shall make no changes or relocations without the prior written approval of CITY. CONTRACTOR shall report to CITY REP whenever any reference point is lost

or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for replacement or relocation of such reference points by a licensed surveyor.

4.5 Hazardous Environmental Conditions

A. CONTRACTOR shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Document to be within the scope of the Work. CONTRACTOR shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by CONTRACTOR, Subcontractors, Suppliers, or anyone else for whom CONTRACTOR is responsible.

B. If CONTRACTOR encounters a Hazardous Environmental Condition or if CONTRACTOR or anyone for whom CONTRACTOR is responsible creates a Hazardous Environmental Condition. CONTRACTOR shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by paragraph 6.13); and (iii) notify CITY and CITY REP (and promptly thereafter confirm such notice in writing.) CITY shall promptly consult with CITY REP concerning the necessity for CITY to retain a qualified expert to evaluate such condition or take corrective action, if any.

C. CONTRACTOR shall be responsible for any and all civil or criminal penalties, fines, damages, or other charges imposed by any regulatory agency or court for sewage discharges that are in violation of applicable statutes and laws and that are a result, direct or indirect, of work performed under this Contract. CONTRACTOR shall also be responsible for reimbursement to CITY for administration, reporting, and tracking expenses required as a result of any spill event. In the event the regulatory agency or court imposes a probationary period, CONTRACTOR shall post bond for the probationary period to ensure that all such costs are reimbursed to CITY. This responsibility shall apply whether penalties are imposed directly on CONTRACTOR or any of its subcontractors, or the City of Chandler. CONTRACTOR shall defend and indemnify CITY against such penalties. Regulatory agencies may include, but are not limited to, the Arizona Department of Environmental Quality (ADEQ) and the United States Environmental Protection Agency (USEPA).

ARTICLE 5 – PERFORMANCE AND PAYMENT BONDS

A. CONTRACTOR shall furnish Performance and Payment Bonds, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of all CONTRACTOR'S obligations under the Contract Documents. With the performance and payment bonds CONTRACTOR shall provide a copy of the surety company's Certificate of Authority certified by the Arizona Department of Insurance. These Bonds shall remain in effect at least until one year after the date of final payment, except as otherwise provided by law. CONTRACTOR shall also furnish such other Bonds as are required by the Supplementary Conditions. All Bonds shall be in the forms prescribed by the Bidding Documents or Supplementary Conditions and be executed by such sureties as:

1) Are licensed to conduct business in the State of Arizona and have an agent for service of process in Arizona, and

2) Are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Audit Staff Bureau of Accounts, U.S. Treasury Department, and

3) Are acceptable to the City of Chandler.

All Bonds signed by an agent must be accompanied by a certified copy of the authority to act.

B. If the surety on any Bond furnished by CONTRACTOR is declared a bankrupt or becomes insolvent, or CONTRACTOR'S right to do business is terminated in any state where any part of the Project is located, or it ceases to meet the requirements of paragraph A above, CONTRACTOR shall within five (5) days thereafter substitute another Bond and surety, both of which shall be acceptable to CITY.

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

6.1 Supervision and Superintendence

A. CONTRACTOR shall supervise, inspect and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences and procedures of construction, but CONTRACTOR shall not be solely responsible for the negligence of others in the design or specification of a specific means, method, technique, sequence of procedure of construction which is shown or indicated in and expressly required by the Contract Documents. CONTRACTOR shall be responsible to see that the completed Work complies accurately with the Contract Documents.

B. At all times during the progress of the Work, CONTRACTOR shall assign a competent resident superintendent thereto, who shall not be replaced without written notice to CITY REP and the Project Designer except under extraordinary circumstances. The superintendent will be CONTRACTOR'S representative at the site and shall have authority to act on behalf of CONTRACTOR. All communications given to the superintendent shall be as binding as if given to CONTRACTOR. At the Pre-construction Conference CONTRACTOR shall provide to CITY REP the name of the person assigned as CONTRACTOR'S resident superintendent and said resident superintendent shall attend the Pre-Construction Conference with CONTRACTOR.

C. Whenever the resident superintendent is not present at a particular part of the Work where the CITY REP or Project Designer may desire to inform the CONTRACTOR relative to interpretation of the Drawings and Specifications or to disapproval or rejection of materials or Work performed, the CITY REP or Project Designer may provide such information in writing to the foreman or other worker in charge of the particular part of the Work in reference to which the information is given. Information so given shall be as binding as if given to the superintendent.

D. CONTRACTOR shall be solely responsible for coordination of all of the Work. CONTRACTOR shall supervise, direct and cooperate fully with all Subcontractors, manufacturers, fabricators, suppliers, distributors, installers, testing agencies and all others whose services, materials or equipment are required to ensure completion of the Work within the Contract Time.

E. CONTRACTOR shall also coordinate their Work with the work of others to assure compliance with schedules.

F. CONTRACTOR shall attend and participate in all project coordination or progress meetings and report on the progress of all Work and compliance with schedules.

6.2 Labor, Materials and Equipment

A. CONTRACTOR shall provide competent, suitably qualified personnel to survey, lay out and construct the Work as required by the Contract Documents. CONTRACTOR shall at all times maintain good discipline and order at the site.

B. Except in connection with the safety or protection of persons or the Work or property at the site or adjacent thereto, and except as otherwise indicated in the Supplementary Conditions, all Work at the site shall be performed during regular working hours, and CONTRACTOR will not permit overtime work or the performance of Work on Saturday, Sunday or any legal holiday without CITY'S written consent given after prior written notice to CITY REP. If it shall become absolutely necessary to perform Work at night or on Saturdays, Sundays or legal holidays, the CITY REP shall be informed at least 24 hours in advance of the beginning of performance of such Work. Only such Work shall be done at night as can be done satisfactorily as determined by the CITY REP and in a first-class manner. Good lighting and all other necessary facilities for carrying out and inspecting the Work shall be provided and maintained at all points where such Work is being done. Further, unless such non-normal work hours are performed at CITY'S request or required by the Contract Documents, CONTRACTOR shall pay to CITY all additional costs incurred by CITY by reason of such non normal working hours. Expenses incurred by CITY for overtime compensation for City Staff, CITY REP and/or Project Designer and staff will be charged to CONTRACTOR at the rate of $40.00 per hour for CITY on-site inspection staff and at actual cost plus ten percent administrative overhead for all others. Such costs may be deducted by CITY from any payments due to CONTRACTOR. Provided, however, if overtime work or work during other than normal hours is at the request of CITY and not due to CONTRACTOR delay, CITY will pay the cost of CITY overtime expenses.

C. CONTRACTOR shall provide and assume full responsibility for services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the execution, testing, start-up, and completion of the Work.

D. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All warranties and guarantees specifically called for by the Specifications shall expressly run to the benefit of CITY. If required by CITY REP, CONTRACTOR shall furnish satisfactory evidence (including reports of required tests) as to the kind and quality of materials and equipment. When the quality of material or equipment is not specifically set forth in the Contract Documents, the best available quality of material or equipment available within a reasonable distance of the project shall be provided.

E. All materials and equipment shall be stored, applied, installed, connected, erected, used, cleaned and conditioned in accordance with the instructions of the applicable manufacturer, fabricator, supplier or distributor, except as otherwise provided in the Contract Documents; but no provisions of any such instructions will be effective to impose on CITY or PROJECT DESIGNER responsibility for the means, methods, techniques, sequences or procedures of construction or for safety precautions incident thereto.

F. CONTRACTOR shall maintain sufficient competent personnel, drafting equipment and supplies at their disposal for the purpose of preparing layout and coordination drawings. These drawings shall supplement the Contract Documents, and the work and Shop Drawings as necessary to correlate the work of various trades. Where such drawings are to be prepared by the mechanical, electrical, plumbing, or heating and ventilating Subcontractors, CONTRACTOR will ensure that each Subcontractor has the required personnel and facilities.

6.3 Substitutes and "Or-Equals"

Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular manufacturer, fabricator, supplier, distributor or specific professional/building certifications or standards, the specification or description is intended to establish the type, function, appearance and quality required. Unless the specification contains or is followed by words reading that no like, equivalent, or "or-equal" item or indicating that no substitution is permitted, other items of material or equipment or material or equipment of other manufacturers, fabricators, suppliers, distributors or certifications may be submitted to CITY REP for review as specified below.

A. Requests for review of substitute items of material and equipment will not be accepted by CITY REP from anyone other than CONTRACTOR.

B. If CONTRACTOR wishes to furnish or use a substitute item of material or equipment, CONTRACTOR shall make written application to CITY REP for acceptance thereof, certifying that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar and of equal substance to that specified and be suited to the same use as that specified. The application will state that the evaluation and acceptance of the proposed substitute will not prejudice CONTRACTOR'S timely achievement of final completion, whether or not acceptance of the substitute for use in the Work will require a change in the Drawings or Specifications to adapt the design to the substitute and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty. All variations of the proposed substitute from that specified shall be identified in the application and available maintenance, repair and replacement service will be indicated. The application will also contain a statement that CONTRACTOR agrees to pay all costs that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other contractors affected by the resulting change.

C. CITY REP may require CONTRACTOR to furnish at CONTRACTOR'S expense additional data about the proposed substitute. CITY REP will be allowed a reasonable time within which to evaluate the proposed substitute and to obtain a recommendation from the Project Designer. CITY REP will be the sole judge of acceptability and no substitute will be ordered or installed without CITY REP'S prior written acceptance.

D. CITY REP may require CONTRACTOR to furnish at CONTRACTOR'S expense a special performance guarantee or other surety with respect to any substitute.

E. CITY REP will record time required by CITY REP, the Project Designer and CITY'S consultants in evaluating substitutions proposed by CONTRACTOR and in making changes in the Drawings or Specifications occasioned thereby. Whether or not CITY REP accepts a proposed substitute, CONTRACTOR shall reimburse CITY for the charges of CITY REP, the Project Designer and CITY'S consultants for evaluating any proposed substitute that does not meet the requirements of the Drawings and Specifications occasioned thereby. CITY may deduct any such charges from any payments due to CONTRACTOR.

6.4 Conformity with Contract Documents and Allowable Deviations

The Work shall conform to the lines, grades, dimensions, tolerances, and material and equipment requirements shown on the Drawings or set forth in the Specifications. Although measurement, sampling, and testing may be considered evidence as to such conformity, the CITY REP shall be the sole judge as to whether the Work or materials deviate from the Drawings and Specifications, and CITY REP's decision as to any allowable deviations therefrom shall be final.

6.5 Concerning Subcontractors

A. CONTRACTOR shall not employ any Subcontractor or other person or organization (including those who are to furnish the principal items of materials or equipment), whether initially or as a substitute, against whom CITY or the Project Designer may have reasonable objection. A Subcontractor or other person or organization identified in writing to CITY and the Project Designer by CONTRACTOR prior to the Notice of Award and not objected to in writing by CITY or the Project Designer prior to the Notice of Award will be deemed acceptable to CITY and the Project Designer. If CITY or the Project Designer after due investigation has reasonable objection to any Subcontractor, other person or organization proposed by CONTRACTOR after the Notice of Award, CONTRACTOR shall submit an acceptable substitute and the Contract Price shall be increased or decreased by the difference in cost occasioned by such substitution, and an appropriate Change Order shall be issued. CONTRACTOR shall not be required to employ any SUBCONTRACTOR, other person or organization against whom CONTRACTOR has reasonable objection. Acceptance of any Subcontractor, other person or organization by CITY or the Project Designer shall not constitute a waiver of any right of CITY or the Project Designer to reject defective work.

B. CONTRACTOR shall be fully responsible for all acts and omissions of their Subcontractors and of persons and organizations directly or indirectly employed by them and of persons and organizations for whose acts any of them may be liable to the same extent that CONTRACTOR is responsible for the acts and omissions of persons directly employed by CONTRACTOR. Nothing in the Contract Documents shall create any contractual relationship between CITY or the Project Designer and any Subcontractor or other person or organization having a direct contract with CONTRACTOR, nor shall it create any obligation on the part of CITY to pay or to see to the payment of any moneys due any Subcontractor or other person or organization, except as may otherwise be required by law. CITY may furnish to any Subcontractor or other person or organization, to the extent practicable, evidence of amounts paid to CONTRACTOR or amount of specific Work done.

C. The Divisions and Sections of the Specifications and the identifications of any Drawings shall not control CONTRACTOR in dividing the Work among Subcontractors or delineating the Work to be performed by any specific trade.

D. All Work performed for CONTRACTOR by a Subcontractor will be pursuant to an appropriate Contract between CONTRACTOR and the Subcontractor which specifically binds the Subcontractor to the applicable terms and conditions of the Contract Documents for the benefit of CITY.

6.6 Patent Fees And Royalties

CONTRACTOR shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of CITY or the Project Designer its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by CITY in the Contract Documents. CONTRACTOR shall indemnify and hold harmless CITY and the Project Designer and anyone directly or indirectly employed by either of them from and against all claims, damages, losses and expenses (including attorneys' fees) arising out of any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product or device not specified in the Contract Documents, and shall defend all such claims in connection with any alleged infringement of such rights.

6.7 Permits

A. Unless otherwise specified in the Contract Documents, CITY will, upon appropriate cooperation from CONTRACTOR, obtain and provide to CONTRACTOR those permits issued by the City of Chandler. CONTRACTOR shall obtain all other construction permits and licenses. CONTRACTOR shall pay all other governmental charges and inspection fees necessary for the prosecution of the Work, which are applicable at the time of bid opening. CONTRACTOR shall also pay all charges of utility service companies for connections to the Work, and CITY shall pay all charges of such companies for capital costs related thereto, such as plant investment fees and system development fees.

B. Work in any public easement or right-of-way shall be done in accordance with the requirements of a permit issued by the public agency in whose easement or right-of-way the Work is located in addition to conforming to the Drawings and Specifications. If a permit is not required, the Work shall conform to the standards of the public agency involved in addition to conforming to the Drawings and Specifications.

C. City of Chandler permits and permits from all applicable governing jurisdictions (i.e. Maricopa County and Arizona Department of Transportation) are required while performing work on City contracts. CONTRACTOR shall pay all permit fees as required by the other governing jurisdictions.

D. Construction water and landfill fees will not be waived and must be paid for by the CONTRACTOR. The system development fees for water and sewer shall be paid for by the CITY unless shown in the itemized Bid Schedule.

6.8 Laws and Regulations, and Government Policies

A. CONTRACTOR shall give all notices and comply with all laws, ordinances, standard details and specifications, rules and regulations applicable to the Work whether adopted by a City, State or Federal governmental agency.

B. If CONTRACTOR observes that the Specifications or Drawings are at variance with applicable laws or regulations, CONTRACTOR shall give CITY REP prompt written notice thereof, and any necessary changes shall be adjusted by an appropriate Modification. If CONTRACTOR performs any Work knowing or having reason to know that it is contrary to such laws, ordinances, rules and regulations, and without such notice to CITY REP, CONTRACTOR shall bear all costs arising therefrom; however, it shall not be CONTRACTOR'S primary responsibility to make certain that the Specifications and Drawings are in accordance with such laws, ordinances, rules and regulations.

C. The CONTRACTOR shall comply with the Immigration Reform and Control Act of 1986 (IRCA). The CONTRACTOR understands and acknowledges the applicability of the IRCA activities. The CONTRACTOR agrees to comply with the IRCA while performing their work and to permit City inspection of CONTRACTOR personnel records to verify such compliance.

D. The CONTRACTOR shall report immediately any discovery of archeological ruins or artifacts. Excavation must stop immediately so that the CITY can decide on the pertinent steps to follow such discovery.

E. If the project is Federally or State funded, additional requirements are generally associated with the project implementation. CONTRACTOR'S attention is directed to the fact that the Contract may include those additional requirements.

F. Spills of oil, gas, chemicals or any hazardous materials must be reported by the CONTRACTOR immediately. Approved mitigation measures shall be taken by the

CONTRACTOR as expediently as possible. Hazardous wastes shall not be discharged into the City's sanitary or storm sewer systems. See also § 4.5.

6.9 Taxes

A. CONTRACTOR shall pay all sales, consumer, use, and other similar taxes in effect at the time of bid submittal and required to be paid by CONTRACTOR, in accordance with the law of the state of Arizona. When equipment, materials or supplies generally taxable to CONTRACTOR are eligible for a tax exemption due to the nature of the Project, CONTRACTOR shall assist CITY in applying for and obtaining such tax credits and exemptions which shall be paid or credited to CITY.

B. CONTRACTOR shall obtain a current City of Chandler privilege tax license before Notice to Proceed is issued.

6.10 Use of Premises

A. CONTRACTOR shall confine construction equipment, the storage of materials and equipment and the operations of workmen to areas permitted by law, ordinances, permits, or the requirements of the Contract Documents, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment.

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

6.11 Record Documents

A. CONTRACTOR shall maintain one record copy of all Specifications, Drawings, Addenda, Written Amendments, Change Orders, Work Change Directives, Field Orders, written interpretations, and clarifications, in good order, in a safe place at the construction site and shall annotate them to show all changes made during the construction process. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings shall be available to CITY REP and the Project Designer for examination and/or reference. Upon completion of the Work, these record documents, Samples and Shop Drawings will be delivered to CITY REP for CITY.

B. CONTRACTOR shall also maintain, revise and provide accurate field data on a red-lined set of contract drawings, which are to be kept current and submitted as complete at the conclusion of the construction. These record drawings will be reviewed and used as documentation for periodic progress payments, and upon project completion, for the preparation of "as built" file drawings by the Project Designer. All record "as built" information shall be submitted on 4 mil photo mylar and shall be 24" x 36" in size. Final payment will not be issued until all record drawings and as built information are submitted by CONTRACTOR, and certified to be complete by the Project Designer and/or CITY REP.

6.12 Safety and Protection

A. CONTRACTOR shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1) All employees on the Work and other persons who may be affected thereby;

2) All the Work and all materials or equipment to be incorporated therein, whether in storage on or off the site; and

3) Other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

B. CONTRACTOR shall comply with all applicable laws, ordinances, rules, regulations and orders of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. CONTRACTOR shall notify owners of adjacent property, utilities and other underground facilities when prosecution of the Work may affect them. CONTRACTOR shall cooperate with the owner in the protection, removal, relocation or replacement of such property. All damage, injury or loss to any property referred to in Paragraph A above, caused, directly or indirectly, in whole or in part, by CONTRACTOR, any Subcontractor or anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, shall be remedied by CONTRACTOR (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of CITY or anyone employed by CITY or anyone for whose acts it may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of CONTRACTOR). CONTRACTOR'S duties and responsibilities for the safety and protection of the Work shall continue until such time as all the Work is completed and CITY REP has issued a notice to CITY and CONTRACTOR in accordance with Paragraph 14.9 that the Work is acceptable.

C. CONTRACTOR shall designate in writing and submit at the Pre-construction Conference the name of a responsible member of their organization, the designated Safety at the site whose duty shall be the prevention of accidents. This person shall be CONTRACTOR'S superintendent unless otherwise designated in writing by CONTRACTOR to CITY.

D. The right of CITY REP to conduct construction review or observation of the CONTRACTOR'S performance will not include review or observation of the adequacy of the CONTRACTOR'S safety measures in, on, or near the construction site.

6.13 Emergencies

In emergencies affecting the safety or protection of persons or the Work or property at the site or adjacent thereto, CONTRACTOR, without special instruction or authorization from CITY REP, is obligated to act to prevent threatened damage, injury or loss. CONTRACTOR shall give CITY REP prompt written notice of any significant changes in the Work or deviations from the Contract documents caused thereby.

6.14 Shop Drawings and Samples

A. CONTRACTOR shall submit Shop Drawings to CITY REP for review and approval in accordance with the acceptable schedule of Shop Drawing and Sample submittals (see Paragraphs 2.6 & 2.7) and the procedures specified in the Contract Documents. All Shop Drawings shall have been checked by and stamped with the approval of CONTRACTOR, after checking and verifying all field measurements, and marked with identification as CITY REP may require. The data shown on the Shop Drawings will be complete with respect to dimensions, design criteria, materials of construction and the like to enable Project Designer to review the information as required.

B. CONTRACTOR shall also submit Samples to CITY REP for review and approval in accordance with the acceptable schedule of Shop Drawings and Sample submittals. All Samples shall have been checked by and stamped with the approval of CONTRACTOR, identified clearly as to material, manufacturer, any pertinent catalog numbers and the use for which intended.

C. At the time of each submission, CONTRACTOR shall in writing call to the attention of CITY REP and Project Designer, all deviations that the Shop Drawings or Samples may have from the requirements of the Contract Documents.

D. CITY REP will review and approve or when applicable cause the Project Designer to review and approve, with reasonable promptness, but in no case more than twenty one (21) days, Shop Drawings and Samples. Provided, however, such review and approval shall be only for conformance with the design concept of the Project and for compliance with the information given in the Contract Documents, and shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions. CONTRACTOR shall make all corrections required by CITY REP and Project Designer and shall return the required number of corrected copies of Shop Drawings and resubmit new Samples for review and approval. CONTRACTOR shall direct specific attention in writing to revisions other than the corrections called for by Project Designer or CITY REP on previous submittals. CONTRACTOR'S stamp of approval on any Shop Drawing or Sample shall constitute a representation to CITY and the Project Designer that CONTRACTOR has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that CONTRACTOR has reviewed or coordinated each Shop Drawing or Sample with the requirements of the Work and the Contract Documents.

E. Where a Shop Drawing or Sample is required by the Specifications, no related Work shall be commenced until the submittal has been reviewed and approved by CITY REP and/or Project Designer.

F. Review and approval of Shop Drawings or Samples by CITY REP and/or the Project Designer shall not relieve CONTRACTOR from responsibility for any deviations from the Contract Documents unless CONTRACTOR has in writing called attention to such deviation at the time of submission and CITY REP or PROJECT DESIGNER has given written concurrence and approval to the specific deviation, nor shall any concurrence and approval by CITY REP or Project Designer relieve CONTRACTOR from responsibility for errors or omissions in the Shop Drawings or Samples.

6.15 Continuing the Work

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

6.16 Progress Schedule

A. CONTRACTOR shall adhere to the Construction Progress Schedule established in accordance with Paragraph 2.6, as it may be adjusted from time to time as provided below.

B. CONTRACTOR shall submit to CITY REP for acceptance (to the extent indicated in Paragraph 2.6) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times (or Milestones). Such adjustments will conform generally to the Progress Schedule then in effect and additionally will comply with any applicable provisions of the Contract Documents.

C. Proposed adjustments to the Progress Schedule that will change the Contract Times (or Milestones) shall be submitted in accordance with the requirements of Article 12. Such adjustments may only be made by a Change Order or Written Amendment.

6.17 Errors or Discrepancies Noted by Contractor

It is the duty of CONTRACTOR to promptly notify CITY REP in writing of any design, materials, or specified method that CONTRACTOR believes may prove defective or insufficient. If CONTRACTOR knows or should have known that a defect or insufficiency exists in design, materials, or specified method and fails to promptly notify CITY REP in writing of this belief, the CONTRACTOR waives any right to assert that defect or insufficiency in design, materials, or specified method at any later date in any legal or equitable proceeding against the CITY or in any subsequent arbitration or settlement conference between the CITY and the CONTRACTOR. CITY REP, on receipt of any such notice, will promptly investigate the circumstances and give appropriate instructions to the CONTRACTOR.

6.18 Contractor's General Warranty and Guarantee

A. CONTRACTOR warrants and guarantees to CITY that all Work will be in accordance with the Contact Documents and will not be defective.

   CONTRACTOR'S obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. Neither recommendation of any progress or final payment by CITY REP, nor the issuance of a letter of Substantial Completion, nor any payment or issuance of a certificate by CITY to CONTRACTOR under the Contract Documents, nor any use or occupancy of the Work or any part thereof by CITY, nor any act of acceptance by CITY nor any failure to do so, nor the issuance of a notice of acceptability by CITY REP pursuant to Section 15.9, nor any correction of defective Work by CITY shall constitute an acceptance of Work not in accordance with the Contract Documents or a release of CONTRACTOR'S obligation to perform the Work in accordance with the Contract Documents.

C. All representations, warranties and guarantees made in the contract documents shall survive final payment and termination or completion of this Contract.

6.19 Reimbursement For Additional Project Designer Services

A. The Work to be accomplished under these Contract Documents has been designed for CITY by a registered Professional Engineer and/or licensed Architect (Project Designer) retained by CITY for this purpose. It is understood that normal Construction Administration for the purpose of interpretation of the Contract Documents is provided by CITY. Should any services of the Project Designer be required to assist in the corrections of errors or omissions by CONTRACTOR, or services of the Project Designer be required because of changes in structure or equipment where CONTRACTOR has requested approval of substitute methods or material, or any other items detailed herein below, those services will be provided by the Project Designer at the standard hourly rates previously negotiated with CITY and shall be paid for by the CONTRACTOR.

B. The Project Designer shall be reimbursed by CONTRACTOR for the Project Designer's additional services to the Project through no fault of CITY or the Project Designer including, but not limited to, the following conditions:

   1) Additional site visits, investigations, inspections, design work and/or reports by the Project Designer which are required due to damages to existing facilities or completed work caused by the CONTRACTOR in his performance, CONTRACTOR'S negligence, or CONTRACTOR'S work which is rejected as defective or as failing to conform to the Contract Documents

3) Project Designer Construction Phase Services rendered on the project during the time the project remains incomplete after the Contract date of final completion will be charged to CONTRACTOR at a rate previously negotiated CITY.

4) All retesting required due to the failure of CONTRACTOR'S work to meet the requirements of the Contract Documents shall be at CONTRACTOR'S expense. All standby and travel time by the CITY'S testing lab, the Project Designer or CITY'S REP due to CONTRACTOR'S inability to be prepared for testing at the agreed upon time shall be at the CONTRACTOR'S expense.

C. City may withhold from any payment otherwise due to CONTRACTOR any amounts necessary to pay the Project Designer for such additional services as provided herein above.
D. CONTRACTOR shall not be required to bear additional costs incurred by CITY due to errors by the Project Designer.

ARTICLE 7 COOPERATION WITH OTHERS:

7.1 Contractor Responsible to Resolve Conflicts

A. The provisions of MAG Uniform Standard Specifications for Public Works Construction Sections 105.6, 105.6.1, 105.6.2, 107.11 and 109.8.1 strictly apply and shall be read together with Section 4.3.1 herein.

B. It shall be the responsibility of CONTRACTOR to ascertain the need for bracing or shoring of utility poles during the construction of the Project and no additional compensation will be allowed for such bracing or shoring.

C. In general, the contract will indicate various utility items, certain of which are to be relocated or adjusted by the utility owner and others, by the Contractor. Any work performed separate from this Contract by CONTRACTOR for any utility company, shall be paid for by the utility company and will not be a part of this Contract with CITY.

7.2 Notifications Requirement in the Event of Any Damage to or Dislocation of Underground Facilities

In the event of any damage to or dislocation of any underground facility, CONTRACTOR shall immediately notify the owner of such facility and shall not attempt to repair any facility, except those intended for the conveyance or storage of water and sewage. The excavation shall be left open until the arrival of representatives of the owner. The owner of the damaged facility will dispatch its representative promptly to examine the underground facility and, if necessary, make repairs.

7.3 Cooperation Between Contractors

CITY reserves the right at any time to contract for and perform other or additional work on or near the work covered by the contract. When separate contracts are let within the limits of any one project, each CONTRACTOR shall conduct his work so as not to interfere with or hinder the progress or completion of the work being performed by other Contractors. Contractors working on the same project shall cooperate with each other as directed by City. Each Contractor involved shall assume all liability, financial or otherwise, in connection with his contract and shall protect and save harmless the CITY from any and all damages or claims that may arise because of inconvenience, delay, or loss experienced by such Contractor because of the presence and operations of other Contractors working within the limits of the same project. Each Contractor shall arrange their work and shall place and dispose of the materials being used so as not to interfere with the operations of the other Contractors within the limits of the same project. Each Contractor shall join their work with that of others in an acceptable manner and shall perform it in proper sequence to that of the others. CITY will not honor any claim for extra compensation due

to delays, extra work, or extension of time caused by any other Contractors working within the limits of the same project.

ARTICLE 8 - STATUS OF CITY'S REP AND THE PROJECT DESIGNER DURING CONSTRUCTION

8.1 City's Representative

A. The term CITY'S REPRESENTATIVE (CITY REP) refers to the person or firm appointed by CITY to be on the project site daily to oversee the construction on the CITY'S behalf. CITY REP performs those functions of the person sometimes referred to as the "owner's representative," "resident engineer," "resident project representative," "onsite construction manager," or the "construction administrator." Sometimes the CITY REP will be a City employee, sometimes the CITY REP will be the same person or firm that designed the project, i.e., the Project Designer, and sometimes a different architect or engineer, but in any case, the CITY REP will represent the CITY and has only the authority granted by CITY, whether through an employment relationship or through a contract for professional services.

B. CITY may also appoint one person or firm to be CITY REP for certain phases or portions of the Project and another different person or firm to be CITY REP for other phases or portions of the Project. Frequently the CITY REP for that portion of a Project known as the "offsite improvements" will be a City Offsite Inspector.

C. The CITY REP may appoint persons to assist in observing the performance of the Work, and in the performance of the duties of CITY REP but in such case prior permission of CITY must be obtained and CITY shall provide written notice to CONTRACTOR. An assistant to the CITY REP may sometimes be referred to as the Owner's Field or Onsite Representative.

D. The duties and responsibilities and the limitations of authority of CITY REP during construction are set forth in the Contract Documents. Generally, unless otherwise specifically stated in the Contract Documents the CITY REP may perform the following functions:

1) Observe the performance of the Work, inform CITY of the progress of the Work and endeavor to guard CITY against defects and deficiencies in the Work.

2) Arrange, schedule and attend pre-construction conferences, progress meetings and other job conferences as may be required, and notify in advance those who are expected to attend. Prepare and circulate minutes of project meetings including coordination meetings.

3) Review the CONTRACTOR'S Progress Schedules, schedule of Shop Drawings, and other schedules prepared by the CONTRACTOR and determine their acceptability.

4) Review Contractor's initial cost breakdown with Schedule of Values and/or Bid Schedule Unit Price List and with concurrence from the Project Designer recommend approval.

5) Assist CITY in acquiring materials testing laboratory and inspection services.

6) Receive and record the date of receipt, and monitor transmission of Shop Drawings, samples, and test data submitted by the CONTRACTOR, forward the Shop Drawings and other submittals requiring such review to the Project Designer and/or other agencies or persons, receive from the Project Designer such submittals after review and record the date of such receipt, and transmit them back to CONTRACTOR as necessary. All such transmittal dates shall be recorded in the Submittal log.

7) Provide "on-site" observation regarding conformance of the work with the contract documents. Observe and document work and any delays and identify and reject defective or deficient work. Observe and approve or reject construction materials and equipment to determine their general compliance with the Contract Documents.

8) Advise the Project Designer when it is believed Work should be corrected, rejected, uncovered for observations, or requires special tests or inspections.

9) Arrange for CITY instigated inspections and tests (CONTRACTOR shall arrange for general inspections and materials testing.) Verify that tests, equipment and system start-up and operating and maintenance instructions are followed and conducted by the CONTRACTOR in the presence of the appropriate personnel, as required by the Contract Documents, and that the CONTRACTOR maintains adequate records thereof.

10) Observe, record, and report to CITY and the Project Designer, information concerning CITY instigated test procedures and start-ups.

11) Schedule, assist and accompany other City staff, the Project Designer and inspectors representing other agencies having jurisdiction over the Project, visiting the Work Site and record and report the outcome of these inspections.

12) Prepare progress reports.

13) Issue Field Orders.

14) Issue Work Change Directives.

15) Prepare all Change Orders and supplemental agreements in the form and manner approved by the CITY, for authorized alterations to the Work as provided for under the Contract Documents. Recommend to and obtain from CITY approval or denial of Changes to Contract Times or Price.

16) Verify and approve quantities of work put in place during the preceding month as requested in Contractor's application for payment.

17) Verify Contractor reimbursable field costs, if any, for authorized overtime and time and material work and amount of construction "work in place" completed each month for purpose of Contractor's application for payment.

18) Investigate and furnish to CITY and the Project Designer information relating to the CONTRACTOR'S claims and furnish CITY with documents, calculations and other information relevant to such claims together with recommendations with regard to payment of such claims.

19) Furnish CITY and the Project Designer with monthly reports as required, of the progress of the Work and of the CONTRACTOR'S compliance with the approved Progress Schedule, schedule of Shop Drawing submissions and other schedules.

20) Review the CONTRACTOR'S Application for Payment and certify that the Work has progressed to the point indicated by the CONTRACTOR, that to the best of the knowledge, information and belief of CITY REP, based on observations and review, the Work is in accordance with the Contract Documents, and that the CONTRACTOR is entitled to the payment of the amount certified.

21) Respond to general RFI's for general clarification and interpretation and consult, when appropriate with Project Designer or refer RFI to Project Designer for response.

22) Review the Project Designer's interpretation of the Contract Documents for subsequent presentation to Contractor and resolve unanticipated field problems by "on-site" inspections.

23) Maintain orderly files for correspondence, reports or job conferences, Shop Drawing and sample submissions, reproductions of original Contract Documents including Addenda, authorized alterations to the Contract Documents, Change Orders, Field Orders, additional Drawings issued subsequent to the execution of the Contract, clarification letters, and other alterations to the Contract Documents, interpretations of the Contract Documents, progress reports, and other Project related documents.

24) Review Contractor's completion documents.

25) Prepare, with assistance from the Project Designer, punch list items.

26) Recommend to CITY substantial completion.

27) Perform Final Inspection with assistance from the Project Designer.

28) Recommend, with concurrence of the Project Designer, to CITY Final Completion.

29) Issue certificates of completion.

8.2 The Project Designer

The duties and responsibilities and the limitations of authority of the Project Designer during construction are set forth in the Contract Documents and shall not be extended without written consent of CITY and the Project Designer. Generally, unless otherwise specifically provided in the Contract Documents, the Project Designer will perform the following functions:

A. Design the Project and prepare all Projects Plans and Specifications.

B. Assist in Bidding, respond to pre-bid questions and requests for clarifications.

C. Attend Pre-bid Conference.

D. Issue any necessary Addenda.

E. Respond to RFI's and as determined necessary by CITY REP, issue such written clarifications or interpretations of the Contract Documents (in the form of Drawings or otherwise) which shall be consistent with or reasonably inferable from the overall intent of the Contract Documents. If CONTRACTOR believes that a written clarification or interpretation justifies an increase in the Contract Price or Contract Time, CONTRACTOR may make a claim therefor as provided in Articles 11 and 12.

F. Correct Design defects.

G. Review and approve Shop Drawings

H. Review Contractor's initial schedule of values cost breakdown and with concurrence from CITY REP recommend approval.

I. Review Construction Progress Schedule and comment on acceptability.

J. Provide advice when requested regarding approval or denial of Changes to Contract Times or Price.

K. In the event of a claim or dispute by CONTRACTOR, interpret the requirements of the Contract Documents and judge the acceptability of the Work thereunder.

L. Assist CITY REP to prepare punch list items.

M. Assist CITY REP with Final inspection.

N. Recommend, with concurrence of CITY REP, to CITY Final Completion.

8.3 Contractor's Contact For All Communication

All communication to CITY or to the Project Designer from CONTRACTOR shall be through CITY REP.

8.4 Rejecting Defective Work

Both CITY REP and the Project Designer have authority to disapprove or reject Work which they determine to be defective, and also have authority to require special inspection or testing of the Work as provided in Article 13, whether or not the Work is fabricated, installed or completed. Final authority regarding acceptance of Work rests with CITY, who will act after receiving the recommendations of CITY REP and the Project Designer.

8.5 Limitations on Responsibilities of the Project Designer and/or CITY REP

A. Neither authority to act granted under this Article or elsewhere in the Contract Documents nor any decision made by CITY REP or the Project Designer in good faith, either to exercise or not exercise such authority, shall give rise to any duty or responsibility of CITY to CONTRACTOR, any Subcontractor, any manufacturer, fabricator, supplier or distributor or any of their agents or employees or any other person performing any of the Work.

B. Whenever in the Contract Documents the terms "as ordered", "as directed", "as required", "as allowed", "as approved" or terms of like effect or import are used, or the adjectives "reasonable", "suitable", "acceptable", "proper", or "satisfactory" or adjectives of like effect or import are used to describe a requirement, direction, review or judgment of CITY REP or the Project Designer as to the Work, it is intended that such requirement, direction, review or judgment will be solely to evaluate the Work for compliance with the Contract Documents (unless there is a specific statement indicating otherwise). The word "provide" shall be understood to mean furnish and install. The use of any such term or adjective never indicates that either the Project Designer or CITY REP shall have authority to supervise or direct performance of the Work or authority to undertake responsibility contrary to the provisions of Paragraphs C and D below.

C. Neither CITY REP nor the Project Designer will be responsible for CONTRACTOR'S means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, and they will not be responsible for CONTRACTOR'S failure to perform the Work in accordance with the Contract documents.

D. Neither CITY REP nor the Project Designer will be responsible for the acts or omissions of CONTRACTOR or of any Subcontractors, or of the agents or employees of any CONTRACTOR or Subcontractor, or of any other person at the site or otherwise performing any of the Work.

ARTICLE 9 – CONDITIONS OF THE SITE

9.1 Dust Control

A. CONTRACTOR shall keep suitable equipment on hand at the job site for maintaining dust control on the project and shall employ appropriate equipment for that purpose, in accordance with the requirements of the "Maricopa County Environmental Services Department Air Pollution Control Regulations".

B. CONTRACTOR, especially if earth-moving operations are involved, shall be responsible for obtaining an Air Quality Permit from Maricopa County prior to starting the work. County permit fees shall be paid for by the CONTRACTOR.

9.2 Clean Up

A. CONTRACTOR is responsible for keeping the sidewalks, streets, alleys, and adjacent areas around the Project site free from debris, obstacles, mud, dirt, etc. CONTRACTOR shall immediately and continuously clean up any and all mud or dirt tracked onto streets or sidewalks by construction traffic.

B. During progress of the Work, CONTRACTOR shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work. Failure of the CONTRACTOR to comply with the CITY REP cleanup orders may result in an order to suspend Work until the condition is corrected. No additional compensation or time will be allowed as a result of such suspension.

C. Excess or unsuitable material, broken asphaltic concrete, and broken portland cement concrete resulting from the construction shall be removed from the project and disposed of by the CONTRACTOR. Disposal of material within the Chandler City Limits or Planning Area must be approved by the CITY REP.

D. Construction silt, mud, and/or debris resulting from construction operation shall be prevented by the CONTRACTOR from being discharged into City storm drains, retention basins or street right-of-way.

E. Earthwork stockpiles are not to exceed 6 feet in height. Any earthwork stockpile, even less than 6 feet, must be removed within seven days of City notification if dust suppression efforts fail to maintain satisfactory airborne contaminant control.

F. At the completion of the Work, CONTRACTOR shall remove all waste materials, rubbish and debris from and about the premises, as well as all tools, appliances, construction equipment and machinery, temporary construction facilities and surplus materials, and shall leave the site clean and ready for occupancy by CITY. CONTRACTOR shall restore to their original condition those portions of the site not designated for alteration by the Contract Documents. CONTRACTOR shall also leave the public right-of-way, all streets, sidewalks, utility easements and any affected private property in a neat and clean condition with all damages including landscaping repaired and restored.

G. If CONTRACTOR is instructed by CITY REP to perform project clean up or street sweeping operations and fails to do so to CITY's satisfaction within two working days, CITY may procure project clean up services and/or commercial street sweeping services and charge such costs including City administrative time to CONTRACTOR.

9.3 Repair of landscaped areas and Re-Seeding of Seeded Areas

Any seeded area that has been damaged as a result of construction shall be leveled, raked and re-seeded or re-sodded by the CONTRACTOR at CONTRACTOR'S expense.

9.4 Traffic Control

Traffic Control shall be provided as required by the City of Chandler Traffic Barricade Design, Technical Design Manual #7. Any restriction to streets, sidewalks and alleys requires either a Street Closure Permit or permission to close or restrict from the City in accordance with said Technical Design Manual #7.

9.5 Property, Rights in Materials

A. Nothing in the Contract shall be construed as vesting in the CONTRACTOR any right of property in the materials used after they have been attached or affixed to the Work or the soil, or after payment has been made for materials delivered to the site of the Work, or stored subject to or under the control of the CITY. All such materials shall become the property of the CITY upon being so attached or affixed or upon payment for materials delivered to the site of the Work or stored subject to or under the control of the CITY.

B. Soil, stone, gravel, and other materials found at the site of the Work and which conform to the Drawings and Specifications for incorporation into the Work may be used in the Work. No other use shall be made of such materials except as may be otherwise described in the Drawings and Specifications.

9.6 Access

Access shall be maintained to adjacent properties at all times during construction. Where property has more than one point of access, no more than one access shall be restricted or closed at any one time. Access to adjacent private driveways shall be maintained during all non-working hours.

9.7 Notification of Property Owners

All property owners that may be affected by the proposed construction activities shall be notified of the scope, duration of the construction activities and possible interference with their day-to-day activities by CONTRACTOR prior to start of construction. In addition, individual residential or commercial interferences, such as driveway restrictions, water outages, and all other work adjacent to residence/business, require 48-hour notification in advance of specific adjoining work. Notification may be through door hangers or other procedures approved by the CITY.

9.8 Construction Signs

A. It shall be the responsibility of CONTRACTOR to furnish and erect construction signs in accordance with Project Specifications. The signs shall be professionally prepared and subject to approval by the CITY REP, shall be maintained by CONTRACTOR for the duration of the project and shall be removed by CONTRACTOR during the final project clean up.

B. The number of signs required, the size, shape, installation requirements and information to be included for construction signs is established on the detail sheet, provided, however, signs will be a minimum of 4 foot by 8 foot and will be installed so that the bottom of the sign is at least 4 foot above grade. No direct payment will be made for furnishing and erecting construction signs. The cost thereof shall be included in other items for which direct payment is made. Sign locations shall be determined by CITY REP.

C. All required construction signs shall be installed by CONTRACTOR within seven days of Notice to Proceed.

9.9 Water for Construction Purposes

A. If CONTRACTOR desires to use water from City mains, CONTRACTOR shall make application to the City Finance Department for a fire hydrant meter and pay the required deposit. CONTRACTOR may not take water from City mains until a meter is installed.

Contractor shall pay for such water as billed by the City Utility Department. City will not directly reimburse Contractor for such construction water costs as Contractor's cost should have been included in other unit or lump sum bid prices..

B. For conservation reasons, water flooding of trenches for backfilling purposes using potable water is discouraged.

9.10 Relocation of Existing Water Meters

When a service line has been extended and a line setter installed in a meter box, City forces will re-install meter. No compression fittings shall be utilized.

9.11 Water Turn-On or Turn-Off

A. CONTRACTOR shall coordinate all water line turn-ons and turn-offs through the CITY REP. Application shall be made to the Municipal Utility Department and CONTRACTOR shall pay the established charges. The City will close existing valves, but will not guarantee a bone-dry Shutdown.

B. CONTRACTOR shall notify all customers affected by the turn-off not less than forty-eight (48) hours in advance. Notification shall be in writing, shall give the reason for the turn-off and shall give the estimated time and duration that water service will be interrupted. CONTRACTOR is also notified that water turn-off will <u>not</u> be permitted on the day before and after Thanksgiving Day and Christmas Day.

C. No direct payment will be made to CONTRACTOR for turn-ons or turn-offs. Costs associated therewith shall be included in other items for which direct payment is made.

ARTICLE 10 – CONSTRUCTION PHOTOGRAPHS

10.1 Pre-construction Video

The CONTRACTOR shall furnish a pre-construction video recording of the entire project site showing the existing conditions of all pavement, concrete, piping, equipment, structures, landscaping, building, and other site features. The pre-construction video shall be in color VHS format. Two (2) copies of the VHS tape(s) shall be submitted to the CITY REP and approved prior to mobilization or initiating any construction activities. The CONTRACTOR shall notify the CITY REP at least 48 hours prior to making the recording so that the CITY REP may accompany the recorder.

10.2 Ground Level Construction Photographs

A. The CONTRACTOR shall furnish progress photographs of the project. The photographer selected by the CONTRACTOR shall be approved by the CITY REP and shall be either a commercial photographer or an individual experienced and equipped for such photography. The CONTRACTOR shall submit to the CITY REP three (3) representative prints of photos taken by the selected photographer for approval of the photographer's qualifications prior to taking the first photographs.

B. The CONTRACTOR shall deliver to the CITY REP all negatives and three 4" x 6" color glossy prints of each view of the photographs taking during that period with each application for payment. If the current photographs do not accompany the application, the application shall not be reviewed and shall be returned to the CONTRACTOR as incomplete. The number of photographs required to be taken per each application for payment shall be specified in the Supplementary Conditions for each Project but shall not be less than ten (10) photographs.

C. Processing and reproduction work shall be accomplished in accordance with standard practice to ensure that the negatives and subsequent prints are clear and sharp in detail, of

good tonal quality and uniform in range of density. Photos shall be taken by a 35 mm camera or a 2-1/4" x 2-1/4" format camera and shall be protected in appropriate professional enclosures. The photographs shall be taken at regular intervals which provide a step-by-step progress of each Project area.

D. The negatives and photographs shall be identified by use of typewritten labels affixed to the negative enclosure and to the back of the photograph. The label shall provide a description of the view, the direction from which the photograph was taken, the name of the project, CITY'S project number, the name of CONTRACTOR and the date of the photography. The stationing shall also be included for all pipeline installations.

E. CONTRACTOR shall furnish adjustable, hard-back photo album covers for each set for storage of the mounted photos. Photo albums shall be labeled as to Project title.

10.3 Aerial Construction Photographs

A. Unless otherwise specified in the Supplementary Conditions, CONTRACTOR shall engage a professional aerial photographer to photograph the site prior to construction mobilization, at three-month intervals during construction, and following final inspection. The photos shall be taken from two elevations, 1:6400 and 1:3600. The 1:6400 shall center the Project in one 9-inch image. The 1:3600 shall center the Project in two 9-inch images. The 9" square negatives and the following prints shall be provided:

Interval	**Prints**	**Total Prints**
3 month intervals	3 of 9"x9" @ 1:6400	9 – 9" x 9"
	3 of each 9"x8" overlapping image @ 1:3600	Every 3 months

B. The pilot must be well qualified, possessing a minimum of 250 hours of photographic map flying experience. The photographer shall possess a minimum of 250 hours of experience representing actual time spent in executing vertical aerial photography on photographic assignments. Oblique photography is also considered as qualifying experience.

C. The airplane to be used shall be entirely capable of stable performance at the necessary altitude and air speeds, and shall be equipped with all essential navigational and photographic instruments and accessories, and all maintained in operational condition during the period of the contract. No windows shall be interposed between the camera lens system and the terrain. The camera lens system shall not be in the direct path of any gases or oil from the aircraft engines.

D. All photography shall be made with a single lens precision aerial mapping camera equipped with a "high-resolution, distortion-free type lens," calibrated by the National Bureau of Standards. The calibrated focal length of the lens (the focal length at which the values of lens distortion, irrespective of sign, are held to the minimum within 45 degrees of the optical axis) shall be 153 millimeters, plus or minus 3 millimeters. The camera shall function properly at the necessary altitude and under the expected climatic conditions, and shall expose a 9-inch square negative. The lens-cone shall be so constructed that the lens, focal plane at calibrated focal length, fiducial markers and marginal data markers comprise an integral unit or are otherwise fixed in rigid orientation with one another. Dimensional changes brought about by variations of temperature or other conditions shall not be of such magnitude as would cause deviation from the calibrated focal length in excess of plus or minus 0.05 millimeter or would preclude determination of the principal point location to which plus or minus 0.003 millimeter.

E. All prints shall be made on double weight, semi-matte paper stock. They shall be sharp and clear, shall contain all highlight and shadow detail, and shall be evenly tone. They shall be permanently fixed, thoroughly washed, processed through flattening solution and dried without pressing, rolling, or excessive heating and trimmed to image area.

F. Aerial film will be of a quality that is equal or superior to 4 mil Kodak Aerocolor Negative film 2445 (Ester Base). Only fresh, fine-grained aerial film shall be used. The negatives shall be exposed and developed in such a manner that they shall be sharp and clear, and contain all highlights and shadow detail. They shall be free of any defects which, in the opinion of the CITY REP, render them unsuitable for their intended purpose.

G. Negatives and 9"x9" prints shall be enclosed in plastic enclosures and labeled by use of typewritten labels affixed to the negative enclosure and to the back of the print. The label shall include the name of the Project, CITY'S Project number, the name of CONTRACTOR and the date of the photography. Labels shall also be affixed to the larger prints.

H. CONTRACTOR shall furnish adjustable, hard-back photo album covers for each set of 9"x9" prints for storage. Photo albums shall be labeled as to Project title, CITY'S index number, and of CONTRACTOR.

10.4 Procedures

A. Photographic exposures shall be taken during the construction period. CITY REP may vary the specified frequency so that significant progress or changes can be recorded on the photographs.

B. The ground level construction photographs shall be of aesthetic composition and shall depict the progress of the work from the beginning of construction through and including the finished product.

C. All buried piping of greater than four (4) inches in diameter shall be photographed prior to backfill. CITY REP will establish when increased photograph frequency is required, but in no case shall photographs represent sections of new piping installations greater in length than 200 linear feet.

ARTICLE 11 - CHANGES IN THE WORK

11.1 Field Orders

CITY REP may authorize minor changes in the Work not involving an adjustment in the Contract Price or the Contract Times, which are consistent with the overall intent of the Contract Documents. These may be accomplished by a written Field Order on the standard form approved by CITY and executed by CITY REP. Such Field Orders shall be binding on CITY, and also on CONTRACTOR who shall perform the change promptly. If CONTRACTOR believes that a Field Order justifies an increase in the Contract Price or Contract Time, CONTRACTOR may make a claim therefor as provided in Article 12 or Article 13.

11.2 Change Order at City's Request

Without invalidating the Contract, CITY may, at any time or from time to time, order additions, deletions or revisions in the Work. If such addition, deletion or revision will cause a change in the Contract Price or Contract Times, (including to any Milestones), CITY REP using a standard form approved by CITY, will submit a Request for Proposal to CONTRACTOR requesting CONTRACTOR to respond within five (5) days by providing, in writing on the standard form approved by CITY to CITY REP, CONTRACTOR'S proposed time and price changes. Such Proposal shall contain a detailed cost breakdown substantiating all proposed charges and an

explanation for any requested extension to the Contract Times and will also contain the number of days for which the proposal will remain valid.

A. If CITY agrees to the proposal submitted by CONTRACTOR, CITY REP shall, within the time specified in the proposal, obtain the authorized signature of CITY on a Change Order using the standard form approved by CITY and return the executed Change Order to CONTRACTOR for signature by CONTRACTOR.

B. If CITY and CONTRACTOR cannot agree on the changes to the Contract Price and/or Contract Times warranted by the proposed Change Order, CITY may perform any additional work itself, may contract with others to perform any additional work, may order CONTRACTOR to comply with the change to the work and determine the Change in Contract Price in accordance with Article 12 herein, or may determine not to proceed with the proposed Change Order. In such case, where the parties are unable to agree, and CITY desires CONTRACTOR to perform the Change, CITY will issue a Work Change Directive (Change Order executed only by CITY), but noting the appropriate method to determine Contract Price changes, i.e., unit prices, and cost of work based on time and materials as set forth in Article 12, or through alternate dispute resolution pursuant to Article 17 herein. If CONTRACTOR disputes or disagrees with the method noted by CITY and/or if the method selected is through dispute resolution, CONTRACTOR should submit written notice of such dispute to CITY REP within two (2) days of receipt of the Change Order executed by CITY.

C. Upon receipt of the executed Change Order or Work Change Directive, CONTRACTOR shall proceed with the change to the Work involved. All such Work shall be performed under the applicable conditions of the Contract Documents.

11.3 No Payment Without Written Authorization

Additional Work performed without authorization of a written executed Change Order or a written executed Field Order will not entitle CONTRACTOR to an increase in the Contract Price or an extension of the Contract Time, except as otherwise specifically provided herein.

11.4 No Change Order for Adjusted Quantities

CONTRACTOR is responsible for performing its own independent quantity takeoffs during the bid process. Actual field measured quantities and/or quantities verified by registered land surveyor stamped calculations upon request from the City will be paid to the contractor at the unit rates established in the bid schedule. No adjustment in unit prices will be made for quantities actually used that differs from that shown in the bid proposal. Sections 109.4.1, 109.4.2, and 109.4.3 of "MAG Uniform Standard specifications for Public Works Construction," as revised in the version adopted in the Chandler City Code, do not apply to this contract.

11.5 Notice on Bond

If notice of any changes affecting the general scope of the Work or change in the Contract Price is required by the provisions of any Bond to be given to the surety, it will be CONTRACTOR'S responsibility to notify the surety, and the amount of each applicable Bond shall be adjusted accordingly. CONTRACTOR shall furnish proof of such adjustment to CITY.

ARTICLE 12 - CHANGE OF CONTRACT PRICE

The Contract Price constitutes the total compensation (subject to authorized adjustments) payable to CONTRACTOR for performing the Work.

12.1 Written Document Required to Change

The Contract Price may only be changed by a written Change Order. Any claim for an increase in the Contract Price shall be based on written notice delivered to CITY REP within two (2) days of

the occurrence of the event giving rise to the claim. Notice of the amount of the claim with supporting data shall be delivered as soon as CONTRACTOR can determine the cost but no later than within fifteen (15) days of completion of any additional work required due to such occurrence unless CITY REP allows an additional period of time to ascertain accurate cost data. However, MAG Standard Specifications Section 104.2.2 C) shall be strictly applied.

12.2 Value of Work

The value of any Work covered by a Change Order or of any claim for an increase or decrease in the Contract Price shall be determined in one of the ways listed herein:

A. Where the Work involved is covered by unit prices contained in the Contract Documents, by application of unit prices to the quantities of the units involved.

B. By mutual written agreement to a lump sum amount, CONTRACTOR shall furnish an itemized cost breakdown together with supporting data including the quantities used in computing the lump sum.

C. On the basis of the Cost of the Work (determined as provided in Paragraph 12.4) plus a Contractor's Fee for overhead and profit (determined as provided in Paragraph 12.5).

D. Through the use of the alternate dispute resolution process set forth in Article 17 herein.

12.3 Work Verification

A. Whenever the cost of any Work is to be determined pursuant to Paragraph 12.4.A and 12.4.B, CONTRACTOR will submit in a form acceptable to CITY REP, daily work sheets showing an itemized labor, material and equipment cost breakdown together with supporting data. No payment will be made for Work not verified by CITY REP.

B. Whenever it is necessary to determine the Cost of the Work because CITY and CONTRACTOR do not agree on an appropriate price for a change in the Work, CITY will incur additional costs to document the time, materials and equipment performed or used at the Site for such Work. CONTRACTOR shall reimburse CITY for all such additional costs to CITY in the event such documenting of time, materials and equipment charges result in a price equal to or less than the amount offered by CITY to CONTRACTOR for such work. CITY'S additional costs will include but not be limited to the cost to CITY for additional time of CITY REP and/or assistants to document CONTRACTOR'S time and materials.

12.4 Cost of the Work

A. The term Cost of the Work means the sum of all costs necessarily incurred and paid by CONTRACTOR in the proper performance of the Work. Except as otherwise may be agreed to in writing by CITY, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items and shall not include any of the costs itemized in Paragraph 12.4.B.

   1) Payroll costs for employees in the direct employ of CONTRACTOR in the performance of the Work under schedules of job classifications agreed upon by CITY and CONTRACTOR. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise and payroll taxes, workers' compensation, health and retirement benefits, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work after regular working hours, on Saturday, Sunday or legal holidays shall be included in the above only to the extent authorized in writing by CITY.

2) Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and manufacturers' field services required in connection therewith. All cash discounts shall accrue to CONTRACTOR unless CITY deposits funds with CONTRACTOR with which to make payments, in which case the cash discounts shall accrue to CITY. All trade discounts, rebates and refunds, and all returns from sale of surplus materials and equipment shall accrue to CITY, and CONTRACTOR shall make provisions so that they may be obtained.

3) Payment made by CONTRACTOR to the Subcontractors for Work performed by Subcontractors. If required by CITY, CONTRACTOR shall obtain competitive bids from Subcontractors acceptable to CONTRACTOR and shall deliver such bids to CITY who will then determine which bids will be accepted. If a Subcontractor provides that the Subcontractor is to be paid on the basis of Cost of the Work Plus a Fee, the Subcontractor's Cost of the Work shall be determined in the same manner as CONTRACTOR'S Cost of the Work except as modified herein. All subcontracts shall be subject to the other provisions of the Contract Documents insofar as applicable.

4) Costs of special consultants (including, but not limited to, engineers, architects, testing laboratories, surveyors, lawyers and accountants) employed for services specifically related to the Work.

5) Supplemental costs including the following:

   a. The proportion of necessary transportation, travel and subsistence expenses of CONTRACTOR'S employees incurred in discharge of duties connected with the Work.

   b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office and temporary facilities at the site and hand tools not owned by the workmen, and which are consumed in the performance of the Work, and cost less market value of each item used, but not consumed, which remain the property of CONTRACTOR.

   c. Rentals of all construction equipment and machinery and the parts thereof whether rented from CONTRACTOR or others in accordance with rental agreements approved by CITY, and the costs of transportation, loading, unloading, installation, dismantling and removal thereof -- all in accordance with terms of said rental agreements. The rental of any such equipment, machinery or parts shall cease when the use thereof is no longer necessary for the Work. The "Rental Rate Blue Book for Construction Equipment" published by Primedia Information, Inc., (Dataquest Blue Book) shall be used to determine hourly equipment rates (without operators) for Actual Cost Work (MAG 109.5.1 modification) in accordance with the following formula:

   HERR = f X [(Monthly Rate)/ 176] + HOC,

   Where:

   Monthly rate = Blue Book Monthly Rate, Adjusted with Factor for Blue Book Equipment Year of Manufacture

   HERR = The Hourly Equipment Rental Rate

   F = Regional Climate Adjustment Factor = 0.9 (for all Equipment)

   HOC = Blue Book Hourly Operating Cost

Overhead and profit are included in the above established equipment hourly rate that CITY will be compensating CONTRACTOR for actual cost work. Equipment hours will be recorded to the nearest one-half hour.

Standby equipment time for equipment not operating to perform change order work and when equipment cannot be used elsewhere for other contract work shall be calculated as follows:

SBR = F x (MERR/176) x ½,

Where

SBR = Standby Equipment Rate

F = Regional Climate Adjustment Factor = 0.9 (For All Equipment)

MERR = Blue Book Monthly Equipment Rental Rate, Adjusted With Factor for Blue Book Equipment Year of Manufacture

Overhead and profit are included in the above established equipment hourly rate that the City will be compensating the contractor for actual cost work. Equipment hours will be recorded to the nearest one-half hour.

When double or triple shifting is required, the following equipment rates shall apply:

Double Shift (16 Hours/Day): The first 8-Hour shift shall be at the rates established above. The second 8-Hour shift shall be at 50% of the hourly rate established for one 8-Hour shift.

Triple Shift (24 Hours/Day): The first two 8-Hour shifts shall be at the rates established above. The third 8-Hour shift shall be at 50% of the hourly rate established for the second 8-Hour shift.

For all actual cost work, payment for "stand-by" will be limited to not more than eight hours in a 24-hour day or 40 hours in a normal week. No compensation shall be allowed for equipment that is inoperable due to breakdown or with equipment utilization on work other than the actual cost work for which compensation is being tracked. In addition, no payment shall be allowed for equipment that is not operating because work has been suspended by the contractor for the contractor's reasons. Leased equipment expenses will be compensated as specified in ADOT Specifications, Section 109.04(D)(3)(c). Transportation, freight time and/or other costs including overhead and profit on leased equipment will not be included as part of the actual cost change order work compensation.

d. Sales, user or similar taxes related to the Work, and for which CONTRACTOR is liable, imposed by any governmental authority.

e. Deposits lost for causes other than CONTRACTOR'S negligence, royalty payments and fees for permits and licenses.

f. Losses and damages (and related expenses), not compensated by insurance or otherwise, to the Work or otherwise sustained by CONTRACTOR in connection with the execution of the Work, provided they have resulted from causes other than the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of CITY. No such losses, damages and expenses shall be included in the Cost of the Work for the purpose of determining CONTRACTOR'S Fee. If, however, any such loss or damage requires reconstruction and CONTRACTOR is placed in charge thereof,

CONTRACTOR shall be paid for services a fee proportionate to that stated in Paragraph 12.5.

g. The cost of utilities, fuel and sanitary facilities at the site associated with the additional work.

h. Cost of premiums for additional Bonds and insurance required because of changes in the Work.

B. The term **Cost of the Work** shall not include any of the following:

1) Payroll costs and other compensation of CONTRACTOR'S officers, executives, principals (of partnership and sole proprietorships), general managers, engineers, architects, estimators, lawyers, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks and other personnel employed by CONTRACTOR, whether at the site or in CONTRACTOR'S principal or a branch office for general administration of the Work, and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 12.4.A.1 -- all of which are to be considered administrative costs covered by the CONTRACTOR'S Fee.

2) Expenses of CONTRACTOR'S principal and branch offices other than CONTRACTOR'S office at the site.

3) Any part of CONTRACTOR'S capital expenses, including interest on CONTRACTOR'S capital employed for the Work and charges against CONTRACTOR for delinquent payments.

4) Cost of premiums for all Bonds and for all insurance whether or not CONTRACTOR is required by the Contract Documents to purchase and maintain the same (except for additional Bonds and insurance required because of changes in the Work).

5) Costs due to the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied and making good any damage to property.

6) Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 12.4.A.

12.5 Contractor's Fee

The CONTRACTOR'S Fee allowed to CONTRACTOR for overhead and profit shall be determined in accordance with MAG Specifications Section 109.5 except as modified herein for "actual cost work" and as follows:

A. A mutually acceptable fixed fee.

B. If a mutually acceptable fixed fee cannot be agreed upon, the fee will be based on the following portions of the cost of work:

1) For costs incurred under Paragraphs 12.4.A.1 and 12.4.A.2, the CONTRACTOR'S Fee shall not exceed a total of fifteen percent (ten percent for overhead and five percent for profit). CITY reserves the right to furnish materials and equipment as CITY deems advisable, and the CONTRACTOR will not be paid the CONTRACTOR'S Fee for such materials and equipment.

2) For costs incurred under Paragraph 12.4.A.3, the CONTRACTOR'S Fee shall not exceed a total of five percent; and if a subcontract is on the basis of Cost of the Work Plus a Fee, the maximum allowable to the Subcontractor as a fee for overhead and profit shall not exceed a total of fifteen percent.

3) No fee shall be payable on the basis of costs itemized under Paragraph 12.4.A.4, 12.4.A.5 and 12.4.B.

4) The amount of credit to be allowed by CONTRACTOR to CITY for any such change which results in a net decrease in cost, will be the amount of the net decrease plus a deduction in CONTRACTOR'S Fee by an amount equal to ten percent of the net decrease.

5) When both additions and credits are involved in any one change, the adjustment in CONTRACTOR'S Fee shall be computed on the basis of the net change in the Contract Price.

12.6 Cash Allowances

It is understood that CONTRACTOR has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be done by such Subcontractors, manufacturers, fabricators, suppliers or distributors and for such sums within the limit of the allowances as may be acceptable to CITY. Upon final payment, the Contract Price shall be adjusted as required and an appropriate Change Order issued. CONTRACTOR agrees that the original Contract Price includes such sums as CONTRACTOR deems proper for costs and profit on account of cash allowances. No demand for additional cost or profit in connection therewith will be allowed.

12.7 Hindrances and Delays

A. Except as provided in Paragraph B, below, no increase in the contract price nor additional payment shall be paid nor due to CONTRACTOR for hindrances or delays from any cause during the progress of any portion of the work included in this Contract; but such delays may entitle CONTRACTOR to an extension of the Contract Time in accordance with the provisions of Article 13 hereof.

B. The parties agree to negotiate for the recovery of damages related to expenses actually incurred by the Contractor for a delay under the following circumstances:
   1) If the CITY is solely responsible for the delay which is unreasonable under the circumstances, and
   2) Which delay was not within the contemplation of the parties and was not foreseeable at the time the Contract was entered into, and
   3) The CONTRACTOR can show the impact of the delay on the critical path as indicated on the approved Construction Progress Schedule.

   The maximum compensation for any delay meeting the above requirements shall not exceed the daily amount specified for liquidated damages by the then current version of "MAG Uniform Standard specifications for Public Works Construction."

ARTICLE 13 - CHANGE OF THE CONTRACT TIMES

13.1 Written Document Required

The Contract Times, including any Milestones, may only be changed by a written Change Order. Any claim for any extension in the Contract Time shall be based on written notice delivered to CITY within two (2) days of the occurrence or the event giving rise to the claim. Notice of the extent of the claim with supporting data shall be delivered within fifteen (15) days of the

conclusion of such occurrence unless CITY REP allows, in writing, an additional period of time to ascertain more accurate data.

A. Notice of the extent of the claim must state the amount of additional time requested, the cause of the delay and its impact on critical path work items, the date of the occurrence causing the delay, and must include all other evidence reasonably available or known to the CONTRACTOR which would support the extension of time requested. Minimum required supporting data/criteria will include CPM computer software print outs at acceptable time periods as required by City staff to show the true schedule impact during the delay period.

B. Requests for extensions of time failing to include the information specified in this Article and requests for extensions of time which are not received within the time specified above, shall result in the forfeiture of the CONTRACTOR'S right to receive any extension of time requested.

C. Acceptance of the daily reports by CITY REP shall not be deemed an admission of the CONTRACTOR'S right to receive an extension of time or a waiver of the CITY'S right to strictly enforce the time provisions contained in the Contract Documents.

D. If CONTRACTOR and CITY REP are unable to agree on CONTRACTOR'S request for an extension of time, the dispute shall be resolved through the alternate dispute resolution process provided herein.

13.2 Delays Beyond Contractor's Control

Where CONTRACTOR is prevented from completing any critical path work items within the Contract Times (or Milestones) due to delay beyond the control of CONTRACTOR, the Contract Times (or Milestones) will be extended if a claim is made therefor, as provided herein. Delays beyond the control of CONTRACTOR shall include, but not be limited to, acts or neglect by CITY, fires, floods, labor strikes, epidemics, abnormal weather conditions, or acts of God.

13.3 Delays Within Contractor's Control

The Contract Times (or Milestones) will not be extended due to delays within the control of CONTRACTOR. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of CONTRACTOR.

13.4 Delays Beyond City's and Contractor's Control

Where CONTRACTOR is prevented from completing any part of the Work within the Contract Times (or Milestones) due to delay beyond the control of both CITY and CONTRACTOR, an extension of the Contract Times (or Milestones) in an amount equal to the time lost due to such delay shall be CONTRACTOR'S sole and exclusive remedy for such delay. No change to the Contract Price for extended overhead nor any other costs will be granted for delays beyond CITY'S control.

13.5 Rain

Time extensions for rain may be granted only for conditions in excess of normal rainfall, which impacts ongoing activities at the site that have successive following activities that must be accomplished in a required sequence for completion of the project within the specified period. These would be generally labeled as Critical Path Activities. For the purposes of this contract, normal weather conditions, such as average days of rain per month, will be determined by meteorological data obtained from the National Weather Service for station 021514, CHANDLER HEIGHTS, ARIZONA. When it is established that rain in excess of normal rainfall justifies a time extension, a no cost time extension will be granted by the City. The contractor is expected and may be directed to perform other work on the project not effected by heavy rains.

ARTICLE 14 - WARRANTY AND GUARANTEE; TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

14.1 Notice of Defects

Prompt written notice of all defective Work of which CITY, CITY REP or the Project Designer have actual knowledge will be given to CONTRACTOR. All defective Work may be rejected, corrected, or accepted as provided herein.

14.2 Access to Work

CITY, CITY REP and the Project Designer and agents of each of them, testing agencies and governmental agencies with jurisdictional interests shall be provided access to the Work at reasonable times for their observation, inspection and testing. CONTRACTOR shall provide proper and safe conditions for such access.

14.3 Tests and Inspections

A. CONTRACTOR shall give CITY REP timely (at a minimum, twenty-four hours) notice of readiness of the Work for all required inspections, tests or approvals. CONTRACTOR shall give timely notice to CITY REP in advance of backfilling or otherwise covering any part of the Work so that CITY REP may, if desired, observe such part of the Work before it is concealed. Whenever CONTRACTOR varies the normal period during which Work or any portion of it is carried on each day, CONTRACTOR shall give timely notice to CITY REP so that CITY REP may, if desired, be present to observe the Work in progress. If CONTRACTOR fails to give such timely notice, any Work done in the absence of CITY REP will be subject to rejection. If CONTRACTOR gives such notice to CITY REP, but then is not ready for such inspections, tests, approvals or observations at the time so noticed, CONTRACTOR shall reimburse CITY for all costs incurred by the attendance of CITY REP or other CITY representatives.

B. If any law, ordinance, rule, regulation, code, or orders of any public body having jurisdiction requires any Work (or part thereof) to be inspected, tested or approved, CONTRACTOR (unless another party is specified in the Contract Documents) shall assume full responsibility therefor, pay all costs in connection therewith and furnish CITY REP the required certificates of inspection, testing, or approval. CONTRACTOR shall also be responsible for and shall pay all costs in connection with any inspection or testing required by the Specifications in connection with CITY'S acceptance of a manufacturer, fabricator, supplier or distributor of materials or equipment proposed to be incorporated in the Work, or of materials or equipment submitted for approval prior to CONTRACTOR'S purchase thereof for incorporation in the Work. The cost of all other inspections, tests and approvals required by the Contract Documents shall be paid by CITY (unless otherwise specified).

C. All inspections, tests or approvals other than those required by law, ordinance, rule, regulation, code or order of any public body having jurisdiction shall be performed by organizations acceptable to CITY and by the Project Designer if so specified.

D. Neither observations by CITY REP, the Project Designer nor inspections, tests or approvals by others shall relieve CONTRACTOR from their obligations to perform the Work in accordance with the Contract Documents.

14.4 Uncovering Work

A. If any Work that is to be observed, inspected, tested or approved is covered without written concurrence of CITY REP, it must, if requested by CITY REP be uncovered for observation. Unless CONTRACTOR has given CITY REP timely notice of CONTRACTOR'S intention to cover such Work and CITY REP has not acted with reasonable promptness in response to such notice, CONTRACTOR shall furnish all necessary labor, material and bear all the expenses of such uncovering, exposure, observation, inspection and testing and of

satisfactory reconstruction, including compensation for additional professional services, and an appropriate deductive Change Order shall be issued.

B. If CITY REP considers it necessary or advisable that Work covered with the concurrence of CITY REP or Work covered after CITY REP failed to act with reasonable promptness in response to a written notice from CONTRACTOR, be observed, inspected or tested by CITY REP or others, CONTRACTOR, at CITY REP'S request, shall uncover, expose or otherwise make available for observation, inspection or testing as CITY REP may require, that portion of the Work in question and CONTRACTOR shall bear all costs. If, however, such Work is not found to be defective, CONTRACTOR shall 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 if CONTRACTOR makes a claim therefor as provided in Articles 11 and 12.

14.5 City May Stop the Work

If the Work is defective, or CONTRACTOR fails to supply sufficient skilled workmen or suitable materials or equipment, CITY may order CONTRACTOR to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of CITY to stop the Work shall not give rise to any duty on the part of CITY to exercise this right for the benefit of CONTRACTOR or any other party.

14.6 Correction or Removal of Defective Work

A. If required by CITY REP, CONTRACTOR shall promptly, without cost to CITY and as specified by CITY REP, either correct any defective Work, whether or not fabricated, installed or completed, or, if the Work has been rejected by CITY, remove it from the site and replace it with non-defective Work. CONTRACTOR shall correct any Work which may be displaced in correcting, removing or replacing defective Work. No compensation will be allowed CONTRACTOR for such removal, replacement or remedial Work. CONTRACTOR shall reimburse CITY for costs incurred by CITY due to such correction or removal including but not limited to additional expenses for inspection, testing or observation and/or for repeated reviews by the CITY REP or Project Designer.

B. Upon failure on the part of the CONTRACTOR to comply within a reasonably prompt time with any written order of CITY REP to correct or remove defective Work, CITY REP shall have authority to cause nonconforming materials or rejected Work to be remedied, removed, or replaced at the CONTRACTOR'S expense and to deduct the costs from any moneys due or to become due the CONTRACTOR.

14.7 Correction Period - One Year Guarantee

A. If, within one year after the date of the Certificate of Final Acceptance, or 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, or by any specific provision of the Contract Documents, any Work is found to be defective, CONTRACTOR shall promptly, without cost to CITY and in accordance with CITY'S written instructions, either correct such defective Work, or, if it has been rejected by CITY, remove it from the site and replace it with non-defective Work. If CONTRACTOR does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, CITY may have the defective Work corrected or the rejected Work removed and replaced, and all direct and indirect costs of such removal and replacement, including compensation for additional professional services, shall be paid by CONTRACTOR. Such action by the CITY will not relieve the CONTRACTOR of the guarantees required by this Article or elsewhere in the Contract Documents.

B. If, in the opinion of the CITY, defective Work creates a dangerous condition or requires immediate correction or attention to prevent further loss to the CITY or to prevent interruption of operation of the CITY, the CITY will attempt to give the notice required by this Article. If the CONTRACTOR cannot be contacted or does not comply with the CITY'S request for correction within a reasonable time as determined by the CITY, the CITY may, notwithstanding the provisions of this Article, proceed to make such correction or provide such attention; and the costs of such correction or attention shall be charged against the CONTRACTOR. Such action by the CITY will not relieve the CONTRACTOR of the guarantees required by this Article or elsewhere in the Contract Documents.

C. This Article does not in any way limit the guarantee on any items for which a longer guarantee is specified or on any items for which a manufacturer or supplier gives a guarantee for a longer period. The CONTRACTOR agrees to act as co-guarantor with such manufacturer or supplier and shall furnish the CITY all appropriate guarantee or warranty certificates upon completion of the Project. No guarantee period, whether provided for in this Article or elsewhere, shall in any way limit the liability of CONTRACTOR or their sureties or insurers under the indemnity or insurance provisions of these General Conditions and the Supplementary Conditions.

14.8 Acceptance of Defective Work

A. If, instead of requiring correction or removal and replacement of defective Work, CITY prefers to accept it, CITY may do so. If any such acceptance occurs prior to final payment, a Change Order shall be issued incorporating the necessary revisions in the Contract Documents, including appropriate reduction in the Contract Price; or, if the acceptance occurs after final payment, an appropriate amount shall be paid by CONTRACTOR to CITY.

B. CITY may require CONTRACTOR to furnish at CONTRACTOR'S expense, a special performance guarantee or other surety prior to acceptance of defective work.

14.9 City May Correct Defective Work

If CONTRACTOR fails within a reasonable time after written notice of CITY REP to proceed to correct defective Work or to remove and replace rejected Work as required by CITY in accordance with Paragraph 14.6, or if CONTRACTOR fails to perform the Work in accordance with the Contract Documents (including any requirements of the progress schedule), CITY may, after seven days' written notice to CONTRACTOR, correct and remedy any such deficiency. In exercising CITY'S rights under this Paragraph, CITY shall proceed expeditiously. To the extent necessary to complete corrective and remedial action, CITY may exclude CONTRACTOR from all or part of the Work, and suspend CONTRACTOR'S services related thereto, take possession of CONTRACTOR'S tools, appliances, construction equipment and machinery at the site and incorporate in the Work all materials and equipment stored at the site or for which CITY has paid CONTRACTOR, but which are stored elsewhere. CONTRACTOR shall allow CITY, CITY REP, agents and employees such access to the site as may be necessary to enable CITY to exercise CITY'S rights under this Paragraph. All direct and indirect costs of CITY in exercising such rights shall be charged against CONTRACTOR in an amount verified by CITY REP, and a Change Order shall be issued incorporating the necessary revisions in the Contract Documents and a reduction in the Contract Price. Such direct and indirect costs shall include, in particular but without limitation, compensation for additional professional services required and all costs of repair and replacement of work or others destroyed or damaged by correction, removal or replacement of CONTRACTOR'S defective work. CONTRACTOR shall not be allowed an extension of the Contract Time because of any delay in CONTRACTOR'S performance of the Work attributable to the exercise by CITY or CITY'S rights hereunder.

14.10 Correction or Removal of Unauthorized Work

A. Any Work done beyond the lines and grades shown on the Drawings or established by the Project Designer or any changes in, additions to, or deductions from the Work done without written authority will be considered as unauthorized and will not be paid for. Work so done may be ordered remedied, removed, or replaced at the CONTRACTOR'S expense.

B. Upon failure on the part of the CONTRACTOR to comply promptly with any order of the CITY REP, CITY shall have authority to cause unauthorized Work to be remedied, removed, or replaced at the CONTRACTOR'S expense and to deduct the costs from any moneys due or to become due the CONTRACTOR.

ARTICLE 15 - PAYMENTS TO CONTRACTOR AND COMPLETION

15.1 Schedule of Values

The Schedule of Values established as provided in Paragraph 2.7 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to CITY REP. Progress payments on account of Unit Price Work will be based on the number of units completed.

15.2 Application for Progress Payment

A. On or before the first day of each calendar month after actual construction is started (but not more often than once a month), CONTRACTOR shall submit to CITY REP for review a completed Application for Payment signed by CONTRACTOR, covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents and also as CITY REP may reasonably require. An Application for Payment will not be considered complete unless it is accompanied by an updated Construction Progress Schedule and a certification that the on-site, red lined, as built drawings are up to date. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably, securely stored at the site or at another location (such as a bonded warehouse) agreed to in writing, the Application for Payment shall also be accompanied by such data, satisfactory to CITY, as will establish CITY'S title to the material and equipment and protect CITY'S interest therein, including applicable insurance. Each subsequent Application for Payment shall include an affidavit of CONTRACTOR stating that all previous progress payments received on account of the Work have been applied to discharge in full all of CONTRACTOR'S obligations reflected in prior Applications for Payment.

B. Applications for Payment may only be submitted to that specific person named in the Contract as the CITY REP, and not to any other agent or representative of CITY, nor to the Project Designer.

C. The amount of retainage with respect to progress payments will be as stipulated in the Contract and will be in accordance with state law.

15.3 Contractor's Warranty of Title

A. CONTRACTOR warrants and guarantees that title to all Work, materials and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to CITY at the time of payment, free and clear of all liens, claims, security interests and encumbrances (hereafter in these General Conditions referred to as "Liens"), provided that this shall not preclude the CONTRACTOR from installing metering devices or other equipment of utility companies or municipalities, the title of which is commonly retained by the utility company or municipality.

B. No materials, supplies, or equipment for the Work under this Contract shall be purchased subject to any chattel mortgage or under a conditional sale contract or other agreement by which an interest therein, or any part thereof, is retained by the seller or supplier.

C. Nothing contained in this Article shall defeat or impair the right of such persons furnishing materials or labor under any bond given by the CONTRACTOR for their protection, or any right under any law permitting such persons to look to funds due the CONTRACTOR in the hands of the CITY. The provisions of this Article shall be inserted in all subcontracts and material contracts, and notices of its provision shall be given to all persons furnishing materials for the Work when no formal contract is entered into for such materials.

15.4 Review of Applications for Progress Payments

A. An Application for Payment will be deemed approved and certified for payment after seven (7) days from the date of submission by CONTRACTOR unless CITY REP, on or before the expiration of such seven days, prepares and issues to CONTRACTOR a specific written finding setting forth those items in detail in the Application for Payment that are not approved for payment under the Contract. CITY may withhold an amount from the progress payment sufficient to pay the expenses CITY reasonably expects to incur in correcting any deficiencies set forth in the written finding.

B. Progress Payments shall be paid on or before fourteen (14) days after the Application for Payment is certified and approved.

C. Within five (5) work days after receipt of each Application for Payment, CITY REP with advice and assistance from the Project Designer, shall either provide to CITY a written recommendation for payment, or return the Application to CONTRACTOR indicating in writing CITY REP'S reasons for refusing to recommend payment. In the latter case, CONTRACTOR may make the necessary corrections and resubmit the Application.

D. The recommendation of Project Designer and CITY REP for payment of any amounts requested in an Application for Payment will constitute a representation by them and each of them to CITY, based on on-site observations of the Work in progress as experienced and qualified design and construction professionals, and based on their review of the Application for Payment and the accompanying data and schedules, that the Work has progressed to the point indicated; that, to the best of their knowledge, information and belief, the quality of the Work is in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning Project upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents and any qualifications stated in the recommendation); and that CONTRACTOR is entitled to payment of the amount recommended. However, by recommending any such payment, neither CITY REP nor the Project Designer will thereby be deemed to have represented that exhaustive or continuous on-site inspections have been made to check the quality or the quantity of the Work, or that the means, methods, techniques, sequences, and procedures of construction have been reviewed, or that any examination has been made to ascertain how or for what purpose CONTRACTOR has used the money's paid or to be paid to CONTRACTOR on account of the Contract Price, or that title to any Work, materials or equipment has passed to CITY free and clear of any Liens.

E. The recommendation by the Project Designer and CITY REP for final payment will constitute an additional representation by them and each of them to CITY that the conditions precedent to CONTRACTOR'S being entitled to final payment as set forth in Paragraph 15.9 have been fulfilled.

F. The Project Designer and CITY REP may refuse to recommend the whole or any part of any payment if, in either of their opinions, it would be incorrect to make such representations to CITY. They may also refuse to recommend any such payment, or because of subsequently

discovered evidence or the results of subsequent inspections or tests, nullify any such payment previously recommended, to such extent as may be necessary in their opinion to protect CITY from loss because:

1) The Work is defective, or completed Work has been damaged requiring correction or replacement.

2) Written claims have been made against CITY or Liens have been filed in connection with the Work.

3) The Contract Price has been reduced because of Modifications.

4) CITY has been required to correct defective Work or complete the Work in accordance with Paragraph 14.9.

5) CONTRACTOR'S unsatisfactory prosecution of the Work in accordance with the Contract Documents.

6) CONTRACTOR'S failure to make payment to Subcontractors for labor, materials or equipment.

15.5 Substantial Completion

A. When CONTRACTOR considers the entire Work ready for its intended use, CONTRACTOR shall notify CITY REP, in writing, that the entire Work is substantially complete (except for items specifically listed by CONTRACTOR as incomplete) and request that CITY REP issue a certificate of Substantial Completion. Promptly thereafter, CITY REP and the Project Designer shall make an inspection of the Work to determine the status of completion. If CITY does not consider the Work substantially complete, CITY REP will notify CONTRACTOR in writing giving reasons therefor. If CITY considers the Work substantially complete, CITY REP, with the concurrence of CITY and assistance from the Project Designer, will prepare a list (punch list) of items to be completed or corrected before final acceptance and a certificate of Substantial Completion and shall fix the date of Substantial Completion. The list of items to be completed or corrected shall be attached to the certificate of Substantial Completion when it is issued to CONTRACTOR. At the time of delivery of the certificate and list, CITY REP will also deliver to CONTRACTOR a written recommendation as to a division of responsibilities pending final payment between CITY and CONTRACTOR with respect to security, operation, safety, maintenance, heat, utilities and insurance. Unless and until CONTRACTOR and CITY agree otherwise in writing, this recommendation shall be binding on CITY and CONTRACTOR.

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

15.6 Partial Utilization

A. CITY at CITY'S option may use and occupy any substantially completed parts of the Work which has specifically been identified in the Contract Documents, or which CITY, the Project Designer and CONTRACTOR agree constitutes a separately functioning and usable part of the Work that can be used by CITY for its intended purpose, without significant interference with CONTRACTOR'S performance of the remainder of the Work, provided, however, if the portion of the Work to be used or occupied has not been found to be substantially complete, CITY must do so in accordance with Paragraph 15.5 prior to such occupancy.

B. In lieu of the issuance of a Certificate of Substantial Completion as to part of the Work, CITY may take over operation of a facility constituting part of the Work whether or not it is

substantially complete if such facility is functionally and separately usable; provided that prior to any such takeover, CITY and CONTRACTOR agree in writing as to the division of responsibilities between CITY and CONTRACTOR for security, operation, safety, maintenance, correction period, heat, utilities and insurance with respect to such facility.

C. Substantial completion of or CITY'S beneficial occupancy of a part of the project will not alter the fact that the one year warranty for the whole project starts at the date of Final Completion of the whole project.

15.7 Final Inspection

A. Upon written notice from CONTRACTOR that the Work is complete, CITY REP and the Project Designer will make a final inspection with CONTRACTOR and will provide written notice to CONTRACTOR of all items of Work which are incomplete or defective. CONTRACTOR shall immediately take such measures as are necessary to remedy such deficiencies.

B. The release of the retention monies will be no earlier than the completion of all such deficiencies.

15.8 Final Application for Payment

A. After CONTRACTOR has corrected all such deficiencies and completed all such corrections to the satisfaction of CITY and delivered all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, marked up record documents, and other documents, all as required by the Contract Documents, and after the Project Designer has indicated that the Work is acceptable (subject to the provisions of Paragraph 15.9) CONTRACTOR may make application for final payment following the procedure for progress payments. The final Application for Payment shall be accompanied by all documentation called for in the Contract Documents and such other data and schedules as CITY REP may reasonably require, together with complete and legally effective releases or waivers (satisfactory to CITY) of all Liens arising out of or filed in connection with the Work.

B. The final Application for Payment must be accompanied by a completed Contractor's Affidavit Regarding Settlement of Claims, the form for which is included in the Contract Documents. The affidavit serves to indemnify and save harmless the CITY against any and all liens for labor, services, material and equipment for which a Lien could be filed, and that all payrolls, material and equipment bills, and other indebtedness connected with the Work for which CITY or CITY'S property might in any way be responsible, have been paid or otherwise satisfied. If any Subcontractor, manufacturer, fabricator, supplier or distributor fails to furnish a release or receipt in full, CONTRACTOR may furnish a Bond or other collateral satisfactory to CITY to indemnify CITY against any Lien.

C. The final Application for Payment must also be accompanied by the completed on-site, red line, as-built drawings showing all construction as it was in actual fact constructed and installed.

D. The final Application for Payment must also be accompanied by a completed Certificate of Completion, the form for which is included in the Contract Documents. This document certifies that all goods and/or services required by the Contract have been delivered in accordance with the Contract, and all activities required by the Contractor under the Contract have been completed.

15.9 Final Payment and Acceptance

A. If, on the basis of observation of the Work by CITY REP during construction and final inspection and review of the final Application for Payment and accompanying documentation

by CITY REP and the Project Designer, all as required by the Contract Documents, CITY is satisfied that the Work has been completed and CONTRACTOR has fulfilled all of its obligations under the Contract Documents, CITY REP, with the concurrence and assistance of the Project Designer, shall within ten days after receipt of the final Application for Payment, indicate in writing a recommendation for payment and present the Application to CITY for payment. Thereupon, the Project Designer will give written notice to CITY and CONTRACTOR that the Work is acceptable subject to the provisions of Paragraph 15.8. Otherwise, CITY REP will return the Application to CONTRACTOR indicating in writing the reasons for refusing to recommend final payment, in which case CONTRACTOR shall make the necessary corrections and resubmit the Application. If the Application and accompanying documentation are appropriate as to form and substance, and the CITY finds the Work has been completed according to the Contract, the CITY shall accept the Work, shall file a notice of completion, and shall pay the entire sum so found to be due as recommended by the CITY REP, after deducting therefrom all previous payments and all amounts to be retained under the provisions of the Contract. All prior progress estimates and payments shall be subject to correction in the final estimate and payment. The final payment shall be due and payable within sixty (60) days from the date of filing a notice of completion of the Work by the CITY.

B. If, through no fault of CONTRACTOR, final completion is materially delayed and if CITY REP so confirms, CITY shall, upon receipt of CONTRACTOR'S final Application for Payment and recommendation of the Project Designer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by CITY for Work not fully completed or corrected is less than the retainage stipulated in the Contract, and if bonds have been furnished as required in Paragraph 5 the written consent of the Surety to the payment of the balance due for the portion of the Work fully completed and accepted shall be submitted by CONTRACTOR to CITY REP with CONTRACTOR'S Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

15.10 Contractor's Continuing Obligation

CONTRACTOR'S obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. Neither recommendation of any progress or final payment by the Project Designer, nor the issuance of a letter of Substantial Completion, nor any payment or issuance of a certificate by CITY to CONTRACTOR under the Contract Documents, nor any use or occupancy of the Work or any part thereof by CITY, nor any act of acceptance by CITY nor any failure to do so, nor the issuance of a notice of acceptability by the Project Designer pursuant to Paragraph 15.9, nor any correction of defective Work by CITY shall constitute an acceptance of Work not in accordance with the Contract Documents or a release of CONTRACTOR'S obligation to perform the Work in accordance with the Contract Documents.

15.11 Waiver of Claims

The making and acceptance of final payment shall constitute a waiver of all claims by CONTRACTOR against CITY, CITY REP and the Project Designer, and their consultants, directors, officers, employees and agents other than those previously made in writing and still unsettled.

15.12 City's Right to Withhold Certain Amounts and Make Application Thereof

A. In addition to the amount of retainage as stipulated in the Contract, the CITY may withhold a sufficient amount or amounts from any payment otherwise due to the CONTRACTOR as in CITY'S judgment may be necessary to cover:

1) Payments which may be past due and payable for properly filed claims against the CONTRACTOR or any Subcontractors for labor or materials furnished in or about the performance of the Work on the Project under this Contract.

2) Estimated or actual costs for correcting defective Work not remedied.

3) Amounts claimed by the CITY as liquidated damages, special damages, or other offsets, such as testing costs chargeable to the CONTRACTOR, reimbursement to CITY for costs incurred by reason of defective work and or repeated review of CONTRACTOR'S submittals.

4) Estimated costs for an independent consultant to properly complete as-built drawings when not acceptably completed in accordance with all the requirements herein.

B. CITY may apply such withheld amount or amounts to the payment of such claims at CITY'S discretion. In so doing, CITY shall be deemed the agent of CONTRACTOR and any payments so made by CITY shall be considered as a payment made under the Contract by the CITY to the CONTRACTOR, and CITY shall not be liable to the CONTRACTOR for such payment made in good faith. Such payments may be made without prior judicial determination of the claim or claims. CITY will render to CONTRACTOR a proper account of such funds disbursed on behalf of CONTRACTOR.

ARTICLE 16- SUSPENSION OF WORK AND TERMINATION

16.1 City May Suspend Work

CITY may, at any time and without cause, suspend the Work or any portion thereof for a period of not more than ninety (90) days by notice in writing to CONTRACTOR and the Project Designer which shall fix the date on which Work shall be resumed. CONTRACTOR shall resume the Work on the date so fixed. CONTRACTOR will be allowed an increase in the Contract Price or an extension of the Contract Time, or both for costs, directly attributable to any suspension but not lost profits if CONTRACTOR makes a claim therefore as provided in Articles 12 and 13.

16.2 City May Terminate

A. Upon the occurrence of any one or more of the following events:

1) If CONTRACTOR is adjudged a bankrupt or insolvent;

2) If CONTRACTOR makes a general assignment for the benefit of creditors;

3) If a trustee or receiver is appointed for CONTRACTOR or for any of CONTRACTOR'S property;

4) If CONTRACTOR files a petition to take advantage of any debtor's act, or to reorganize under the bankruptcy or similar laws;

5) If CONTRACTOR repeatedly fails to perform the Work in accordance with the Contact Documents, including but not limited to, failure to supply sufficient skilled workmen or suitable materials or equipment or failure to adhere to the progress schedule established under Paragraph 2.6 as adjusted from time to time pursuant to Paragraph 6.16.

6) If CONTRACTOR repeatedly fails to comply with written directives from CITY REP.

7) If CONTRACTOR repeatedly fails to make prompt payments to Subcontractors or for labor, materials or equipment;

8) If CONTRACTOR disregards laws, ordinances, rules, regulations or orders of any public body having jurisdiction;

9) If CONTRACTOR otherwise violates in any substantial way any provisions of the Contract Documents.

CITY may without prejudice to any other right or remedy, serve written notice upon the CONTRACTOR and CONTRACTOR'S surety of CITY'S intention to terminate the Contract. Said notice to contain the reasons for such intention to terminate the Contract, and provide that unless within ten days after the service of such notice all such violations have been corrected and remedied, the Contract shall cease and terminate, and CONTRACTOR shall be excluded from the site. In such case, CONTRACTOR shall not be entitled to receive any further payment until the Work is finished by others.

B. In the event of any such termination, CITY shall immediately serve written notice thereof upon the surety and CONTRACTOR, and the surety shall have the right to take over and perform the Contract, provided however, that if the surety, within fifteen (15) days after the serving upon it of a notice of termination, does not give the CITY written notice of their intention to take over and perform the Contract, or does not commence performance thereof within thirty (30) days from the date of serving said notice, CITY may take possession of the Work and of all CONTRACTOR'S tools, appliances, construction equipment and machinery at the site and use the same to the full extent they could be used by CONTRACTOR (without liability to CONTRACTOR for trespass or conversion), incorporate in the Work all materials and equipment stored at the site or for which CITY has paid CONTRACTOR but which are stored elsewhere, and finish the Work as CITY may deem expedient for the account and at the expense of the CONTRACTOR. CONTRACTOR'S surety shall be liable to the CITY for any excess costs or other damage occasioned the CITY thereby. If the unpaid Balance of the Contract Price exceeds the direct and indirect costs of completing the Work, including but not limited to, compensation for additional professional services and all costs generated to insure or bond the Work of substituted contractors or subcontractors utilized to complete the Work, such excess shall be paid to CONTRACTOR. If such costs exceed the unpaid balance, CONTRACTOR shall pay the difference to the CITY promptly upon demand; on failure of CONTRACTOR to pay, the surety shall pay on demand by CITY. Any portion of such difference not paid by CONTRACTOR or surety within thirty (30) days following the mailing of a demand for such costs by CITY shall earn interest at the rate of fifteen (15%) percent per annum or the maximum rate authorized by Arizona law, whichever is lower. Such costs incurred by CITY shall be verified by CITY REP and incorporated in a Change Order, but in finishing the Work, CITY shall not be required to obtain the lowest figure for the Work performed.

C. Where CONTRACTOR'S services have been so terminated by CITY, the termination shall not affect any rights of CITY against CONTRACTOR then existing or which may thereafter accrue. Any retention or payment of moneys due CONTRACTOR by CITY will not release CONTRACTOR from liability.

D. If funds are not appropriated to continue this Contract and for the payment of charges hereunder, CITY may terminate this Contract at the end of the fiscal period. CITY agrees to give written notice of termination to the CONTRACTOR at least thirty (30) days prior to the end of CITY'S current fiscal period and will pay to the CONTRACTOR all charges incurred through the end of such period.

E. Upon seven (7) days written notice to CONTRACTOR and the Project Designer, CITY may, without cause and without prejudice to any other right or remedy, elect to abandon the Work and terminate the Contract. In such case, CONTRACTOR shall be paid for all Work executed and any expense sustained plus reasonable termination expenses.

16.3 Contractor May Stop Work or Terminate

If, through no act or fault of CONTRACTOR, the Work is suspended for a period of more than ninety (90) days by CITY or under an order of court or other public authority, or CITY fails to pay within (14) fourteen days to CONTRACTOR, any sum finally determined to be due, then CONTRACTOR may, upon seven (7) days written notice to CITY, terminate the Contract and recover from CITY payment for all Work executed and any expense sustained plus reasonable termination expenses. In addition and in lieu of terminating the Contract, if CITY has failed to make any payment as aforesaid, CONTRACTOR may, upon seven (7) days written notice to CITY, stop the Work until payment of all amounts then due. The provision of this paragraph shall not relieve CONTRACTOR of their obligations under Paragraph 6.15 to carry on the Work in accordance with the progress schedule and without delay during disputes and disagreements with CITY.

ARTICLE 17– ALTERNATE DISPUTE RESOLUTION

17.1 Notice Required

A. Notwithstanding anything to the contrary provided elsewhere in the Contract documents, the alternative dispute resolution (ADR) process provided herein shall be the exclusive means for resolution of claims or disputes arising under, relating to or touching upon this Contract, the interpretation thereof or the performance or breach by any party thereto, including, but not limited to, original claims or disputes asserted as cross claims, counterclaims, third party claims or claims for indemnity or subrogation, in any threatened or ongoing litigation or arbitration with third parties, if such disputes involve parties to contracts containing this ADR provision.

B. CONTRACTOR shall submit written notice of any claim or dispute to CITY REP within seven (7) days of the occurrence, event or disputed response from CITY for immediate resolution pursuant to these provisions. Each claim or dispute shall be submitted and resolved as they occur and not postponed until the Project is complete nor lumped together with other pending claims.

C. Failure to submit a notice of any claim, dispute, request or other issue within the times set forth in Articles 11, 12, 13 or 17 shall constitute CONTRACTOR'S forfeiture of its right to dispute the issue, raise the claim or make the request and shall also constitute CONTRACTOR'S agreement and acceptance of the CITY'S position.

17.2 Decision of Project Designer on Disagreements

A. CITY REP will provide to CONTRACTOR a written response to any claim, request or proposal for a Change Order on or before fifteen (15) days from receipt of CONTRACTOR'S written claim, request or proposal.

B. The Project Designer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder.

C. Written notice of any request for which an interpretation by the Project Designer is sought, together with written supporting data, shall be delivered by CONTRACTOR to CITY REP for presentation to the Project Designer within seven (7) days of the occurrence or the event giving rise thereto, within seven (7) days of CONTRACTOR becoming aware of the need for clarification or further information, or if the claim or dispute was first submitted for a response from CITY REP and CONTRACTOR disputes or disagrees with the response of CITY REP, within three (3) days of CONTRACTOR'S receipt of such response.

D. CITY REP will immediately transmit any such CONTRACTOR requests, claims or disputes and other matters relating to the acceptability of the Work or the interpretation of the requirements of the Contract Documents pertaining to the execution and progress of the

Work to the Project Designer in writing with a request for written response within seven (7) days.

E. The Project Designer will render a decision within seven (7) days of receipt of such transmittal.

17.3 Neutral Evaluator, Arbitrators

CITY will select a Neutral Evaluator to serve as set forth in this ADR process. CITY and CONTRACTOR shall each select an arbitrator of their choice within fifteen (15) days of the date of execution of this Contract to serve as set forth in this ADR process. Each arbitrator selected shall be a member of the State Bar of the State of Arizona, and shall be experienced in the field of construction law. Neither the arbitrator nor the arbitrator's firm shall have presently, or in the past, represented any party to the arbitration.

17.4 Neutral Evaluation Process

In the event either party disagrees with the response of the Project Designer or for disputes not appropriate for submittal to the Project Designer, if CONTRACTOR disagrees with the response of the CITY REP, the following neutral evaluation process shall be used to obtain resolution.

A. Notification of Dispute: Within three (3) days of receipt of the disputed response, the disputing party shall notify the City Engineer of the unresolved dispute. The City Engineer shall promptly notify the Neutral Evaluator in writing of the existence of a dispute.

B. Nonbinding Information Hearing: The Neutral Evaluator shall schedule a nonbinding informal hearing of the matter to be held within seven (7) days from receipt of notification of the existence of a dispute. The Neutral Evaluator may conduct the hearing in such manner as deems appropriate and shall notify each party to attend the hearing and present evidence they believe will resolve the dispute. The Neutral Evaluator is not bound by the rules of evidence in admitting evidence in the hearing and may limit the length of the hearing, witnesses or evidence introduced to the extent that he deems same to be relevant and efficient. Each party to the dispute shall be notified by the Neutral Evaluator that they shall submit a written outline of the issues and evidence intended to be introduced at the hearing and proposed resolution of the dispute to the Neutral Evaluator before the hearing commences. Arbitrators shall not participate in such informal hearing or proceeding process.

C. Nonbinding Decision: The Neutral Evaluator shall render a nonbinding written decision as soon as possible, but not later than five (5) days after the hearing.

17.5 Binding Arbitration Procedure

If the neutral evaluation procedure is unsuccessful, the following binding arbitration procedure shall serve as the exclusive method to resolve all unresolved disputes. If any party chooses not to accept the decision of the Neutral Evaluator, such party shall notify the Neutral Evaluator in writing within three (3) business days of receipt of the Neutral Evaluator's decision of a request for arbitration. The party requesting arbitration shall post a cash bond with the Neutral Evaluator in the amount of $5,000, or a greater amount as determined by the Neutral Evaluator, that will defray the cost of the arbitration as set forth in paragraph M, Fees and Costs, and proceeds from said bond shall be allocated in accordance with said paragraph by the Arbitration Panel.

A. Arbitration Panel: The Arbitration Panel shall consist of the arbitrators previously selected by the parties involved in the dispute, (i.e., CITY'S arbitrator, CONTRACTOR'S arbitrator, or any other CONTRACTOR'S arbitrator who has a contract with the CITY which contains this ADR provision and is a party to the dispute), and the foregoing arbitrators shall select a neutral arbitrator as set forth herein. The Neutral Evaluator shall participate in the proceedings and in the deliberations, but shall not be entitled to vote.

B. Selection of Neutral Arbitrator: The selected arbitrators shall choose additional arbitrator(s) (one additional arbitrator or two additional arbitrators as needed to ensure that the arbitration panel will consist of an odd number of arbitrators), within five (5) days of receipt of notification of a dispute from the Neutral Evaluator. The Neutral Arbitrator(s) shall have the same qualifications as those of the arbitrators set forth in the Neutral Evaluator, Arbitrators paragraph. In the event that the selected arbitrators cannot agree on additional Neutral Arbitrators as set forth above, the Neutral Evaluator shall select the additional arbitrator(s).

C. Expedited Hearing: The parties have structured this procedure with the goal of providing for the prompt and efficient resolution of all disputes falling within the purview of this ADR process. To that end, any party can petition the Neutral Evaluator to set an expedited hearing if circumstances justify it. The Neutral Evaluator shall contact the selected Arbitration Panel and arrange for scheduling of the arbitration at the earliest possible date. In any event, the hearing of any dispute not expedited will commence as soon as practical, but in no event later than twenty (20) days after notification of request for arbitration having been submitted. This deadline can be extended only with the consent of all the parties to the dispute, or by decision of the Arbitration Panel upon a showing of emergency circumstances.

D. Procedure: The Neutral Evaluator shall act as Chairman of the Arbitration Panel and will conduct the hearing that will resolve disputes in a prompt, cost efficient manner giving due regard to the rights of all parties. Each party shall supply to the Arbitration Panel a written pre-hearing statement, which shall contain a brief statement of the nature of the claim or defense, a list of witnesses and exhibits, a brief description of the subject matter of the testimony of each witness who will be called to testify, and an estimate as to the length of time that will be required for the arbitration hearing. The Arbitration Panel may review and consider the Neutral Evaluator's decision. The Chairman shall determine the nature and scope of discovery, if any, and the manner of presentation of relevant evidence consistent with the deadlines provided herein, and the parties' objective that disputes be resolved in a prompt and efficient manner. No discovery may be had of privileged materials or information. The Chairman, upon proper application, shall issue such orders as may be necessary and permissible under law to protect confidential, proprietary, or sensitive materials or information from public disclosure or other misuse. Any party may make application to the Maricopa County Superior Court to have a protective order entered as may be appropriate to conform to such orders of the Chairman.

E. Hearing Days: To effectuate the parties' goals, the hearing once commenced, will proceed from business day to business day until concluded, absent a showing of emergency circumstances.

F. Award: The Arbitrator Panel shall within ten (10) days from the conclusion of any hearing issue its award. The award shall include an allocation of fees and costs pursuant to the Binding Arbitration Procedure paragraph herein. Any award providing for deferred payment shall include interest at the rate of ten (10%) percent per annum. The award is to be rendered in accordance with the Contract and the laws of the State of Arizona.

G. Scope of Award: The Arbitration Panel shall be without authority to award punitive damages, and any such punitive damage award shall be void. The Arbitration Panel shall also be without authority to issue an award against any individual party in excess of $500,000, exclusive of interest, arbitration fees, costs, and attorney's fees. If an award is made against any individual party in excess of $50,000, exclusive of interest, arbitration fees, costs. and attorneys' fees, it must be supported by written findings of fact, conclusions of law and statement as to how damages were calculated.

H. Jurisdiction: The Arbitration Panel shall not be bound for jurisdictional purposes by the amount asserted in any party's claim, but shall conduct a preliminary hearing into the

question of jurisdiction upon application of any party at the earliest convenient time, but not later than the commencement of the arbitration hearing.

I. Entry of Judgment: Any party can make application to the Maricopa County Superior Court for confirmation of any award and for entry of judgment on it.

J. Severance and Joinder: To reduce the possibility of inconsistent adjudications, the Neutral Evaluator or the Arbitration Panel, may at the request of any party, join and/or sever parties, and/or claims arising under other contracts containing this ADR provision, and the Neutral Evaluator, (Chairman) may, on his own authority, join or sever parties and/or claims subject to this ADR process as they deem necessary for a just resolution of the dispute, consistent with the parties' goal of the prompt and efficient resolution of disputes. Nothing herein shall create the right by any party to assert claims against another party not recognized under the substantive law applicable to the dispute. Neither the Neutral Evaluator nor the Arbitration Panel is authorized to join to the proceeding parties not in privity with the CITY.

K. Appeal: Any party may appeal errors of law by the Arbitration Panel if, but only if, the errors arise in an award in excess of $100,000; the exercise by the Chairman or Arbitration Panel of any powers contrary to or inconsistent with the Contract; or any of the grounds provided in A.R.S. 12-1512. Appeals shall be to the Maricopa County Superior Court within fifteen (15) days of entry of the award. The standard of review in such cases shall be that applicable to the consideration of a motion for judgment notwithstanding the verdict, and the Maricopa County Superior Court shall have the authority to confirm, vacate, modify or remand an award appealed under this section.

L. Uniform Arbitration Act. Except as otherwise provided herein, binding arbitration pursued under this provision shall be governed by the Uniform Arbitration Act as enacted in Arizona in A.R.S. I2-1501, et. seq.

M. Fees and Costs. Each party shall bear its own fees and costs in connection with any informal hearing before the Neutral Evaluator. All fees and costs associated with any arbitration before the Arbitration Panel, including without limitation, the Arbitration Panelists' fees, the prevailing party's attorneys' fees, expert witness fees and costs, will be paid by the nonprevailing party, except as provided for herein. The determination of prevailing and nonprevailing parties, and the appropriate allocation of fees and costs, will be included in the award by the Arbitration Panel. Fees for the Neutral Evaluator shall be a project cost.

N. Equitable Litigation: Notwithstanding any other provision of ADR to the contrary, any party can petition the Maricopa County Superior Court for interim equitable relief as necessary to preserve the status quo and prevent immediate and irreparable harm to a party or to the Project pending resolution of a dispute pursuant to ADR provided for herein. No court may order any permanent injunctive relief except as may be necessary to enforce an order or award entered by the Arbitration Panel. The fees and costs incurred in connection with any such equitable proceeding shall be determined and assessed in ADR.

O. Change Order: Any award in favor of the CONTRACTOR against the CITY or in favor of the CITY against the CONTRACTOR shall be reduced to a Change Order and executed by the parties in accordance with the award and the provisions of General and Supplementary Conditions to this Construction Contract.

P. Merger and Bar: Any claim asserted pursuant to this ADR process shall be deemed to include all claims, demands, and requests for compensation for costs and losses or other relief, including the extension of Contract Time which reasonably should or could have been brought against any party that was or could have been brought into this ADR process. The Arbitration Panel shall apply legal principles commonly known as merger and bar to deny any claim or claims against any party regarding which claim or claims recovery has been sought

or should have been sought in a previously adjudicated claim for an alleged cost, loss, breach. error. or omission.

Q. Disputes of amounts greater than $500,000: Disputes for which the Arbitration Panel has determined to warrant an award in an amount greater than Five Hundred Thousand Dollars ($500,000) to any one party, may be brought in the appropriate Court. A party must obtain such a determination from the Arbitration Panel prior to filing any legal action.

ARTICLE 18 - VALUE ENGINEERING

18.1 General

A. The CONTRACTOR may submit to CITY REP proposals for modifying the Plans, Specifications, or other requirements of the Contract for the sole purpose of reducing the total cost of the project without impairing in any manner the essential functions or characteristics of the project, including, but not limited to, service life, economy of operations, ease of maintenance, desired appearance, or design and safety standards.

B. It shall not be inferred from this subsection that the CITY is required to consider any proposal submitted.

C. Cost reductions contained in the proposal resulting from changes to contingency items, such as traffic control, dust palliative, etc., will not be considered.

18.2 Proposal Requirements

Proposals submitted pursuant to this subsection shall be identified as Value Engineering Proposals. They shall be submitted in writing and, at a minimum, contain the following:

A. A description of both the existing Contract requirements for performing the work and the proposed changes.

B. All engineering drawings and computations necessary for a thorough and expeditious evaluations.

C. An itemization of the existing Contract requirements that must be changed if the proposal is adopted and a recommendation as to the manner in which the change should be made.

D. A detailed estimate of the cost of performing the work under the existing Contract and under the proposed changes, including the cost of developing and implementing the changes.

E. The contract items affected by the proposed changes and any variations in quantities resulting from the changes.

F. An objective estimate of any effects the proposal will have on collateral costs to the CITY, cost of related items, and costs of maintenance and operation.

G. A statement as to the effect that the proposal will have on the time for the completion of the project.

H. A statement as to the time by which a change order adopting the proposal must be executed or when the CITY must have given oral or written approval.

I. A statement as to any time extension of time related to costs which will be required by the CONTRACTOR as a condition for implementing the proposed changes.

18.3 Review and Response

Proposals will not be considered until all of the above requirements have been met. Once all of the required submittals have been received, CITY REP will respond within ten (10) working days in writing as to whether or not the proposal will be considered for detailed evaluation. If no such notice is issued within the time allotted, the proposal shall be deemed rejected.

A. CITY will not be liable for any delay in acting upon any proposal nor for any failure to accept any proposal pursuant to this subsection.

B. CITY will be the sole judge of the acceptability of a proposal and of the estimated net savings in construction costs from the adoption of all or any part of the proposal. CONTRACTOR will be notified in writing by the CITY REP as to whether the CONTRACTOR'S proposal has been accepted. The decision by the CITY is final.

C. When CITY deems such action to be appropriate, it reserves the right to require the CONTRACTOR to share in the cost to the CITY of investigating, evaluating, and processing the proposal as a condition for the consideration of such proposal. Such cost shall be shared whether the proposal is accepted or rejected. When such a condition is imposed, the CONTRACTOR shall indicate their acceptance thereof in writing and such acceptance shall authorize the CITY to deduct the CONTRACTOR'S share of the CITY'S costs from any monies due or that may become due to the CONTRACTOR under the Contract.

18.4 Acceptance

A. If CONTRACTOR'S proposal is accepted in whole or in part, the necessary Contract modifications and Contract Price adjustments will be effected by the execution of a Change Order which will specifically state that it is executed pursuant to the provisions of this subsection.

B. CONTRACTOR shall continue to perform the work in accordance with the requirements of the Contract until a Change Order incorporating the proposal has been executed or until the CONTRACTOR has been given oral or written approval by the CITY that the CONTRACTOR'S proposal has been accepted. If the Change Order has not been executed, or the CONTRACTOR has not been given oral or written approval on or before the mutually agreed upon date, or on or before such other date as the CONTRACTOR may have subsequently specified in writing, the proposal shall be deemed to be rejected.

C. The executed Change Order shall incorporate the changes in the Plans, Specifications, or other requirements of the Contract Documents which are necessary to permit the proposal, or such part of it which has been accepted, to be put into effect, and shall include any conditions upon which the CITY'S approval thereof is based if such approval is conditional. The executed Change Order Contract shall also extend the time for the completion of the Contract if, and only if, the extension was required by the CONTRACTOR as a condition for implementing the proposal and such an extension has been deemed to be warranted by the CITY as a result of the CITY'S evaluation of the proposal.

D. The executed Change Order shall also establish the estimated net savings in the cost of performing the Work attributable to the proposal effectuated by the Change Order. In determining the net savings, the right is reserved to the CITY to disregard the Contract bid prices if, in the CITY'S judgment, such prices do not represent a fair measure of the value of the Work to be performed or to be deleted. The net savings will be established by determining the CONTRACTOR'S cost of performing the Work, taking into account the CONTRACTOR'S cost of developing the proposal and implementing the change, and reducing this amount by any ascertainable collateral cost to the CITY. The executed Change Order shall provide the Contractor be paid forty (40%) percent of the estimated net savings amount.

E. The executed Change Order shall also provide for the adjustment in Contract Prices. Contract Prices shall be adjusted by subtracting the CITY'S share of the accrued net savings.

F. The amount specified to be paid to the CONTRACTOR in the executed Change Order which effectuates a value engineering proposal shall constitute full compensation to the CONTRACTOR for the value engineering proposal and the performance of the Work thereof pursuant to the said Change Order.

ARTICLE 19 -- GENERAL PROVISIONS

19.1 Partial Invalidity

If any provision of the Contract is held by a court of competent jurisdiction to be invalid, void or unenforceable, the remaining provisions shall nevertheless continue in full force without being impaired or invalidated in any way.

19.2 Attorneys' Fees

Should either party to the Contract bring an action to enforce any provision of the Contract, the prevailing party shall be entitled to recover reasonable attorneys' fees and costs in connection therewith.

19.3 Waiver of Rights

Except as otherwise specifically provided in the Contract Documents, no action or failure to act by the CITY, the Project Designer or CONTRACTOR shall constitute a waiver of any right or duty afforded any of them under the Contract Documents, nor shall any such action or failure to act constitute an approval of or acquiescence in any breach thereunder.

19.4 Giving Notice

A. When any provisions of the Contract Documents requires CONTRACTOR or the Project Designer to give written notice to CITY, it shall be deemed to have been validly given if delivered in person to the person designated in the Contract Documents as CITY REP, or if delivered at or sent by registered or certified mail, postage prepaid, to the City Engineer addressed as follows:

City of Chandler
Public Works Department
Attn: City Engineer
P.O. Box 4008, Mail Stop 405
Chandler, AZ 85244-4008

B. When any provisions of the Contract Documents requires CITY, CITY REP, or the Project Designer to give written notice to CONTRACTOR, it shall be deemed to have been validly given if delivered in person to the person designated in the Contract Documents as CONTRACTOR'S Resident Superintendent, or if delivered at or sent by registered or certified mail, postage prepaid, to CONTRACTOR at the last address in the Contract Documents or such substitute address which CONTRACTOR designates in writing, or to the business address known to the giver of notice.

19.5 Computation of Time

When any period of time is referred to in the Contract Documents by days, it shall be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day shall be omitted from the computation. Unless otherwise specified any action required shall be accomplished within a reasonable time.

19.6 Conflict of Interest

Pursuant to A.R.S. Sec. 38-511, a municipality may, within three (3) years after its execution, cancel any contract, without penalty or further obligation, if any person significantly involved in initiating, negotiating, securing, drafting or creating the contract on behalf of the municipality is, at any time while the contract or any extension of the contract is in effect, an employee or agent of any 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.

19.7 Assignment

A. The performance of the Contract may not be assigned, except upon the written consent of the CITY. Consent will not be given to any proposed assignment which would relieve the original CONTRACTOR or their surety of their responsibilities under the Contract, nor will the CITY consent to any assignment of a part of the Work under the Contract.

B. Upon obtaining a prior written consent of the CITY, the CONTRACTOR may assign moneys due or to become due them under the Contract, to the extent permitted by law, but any assignment of moneys shall be subject to all proper setoffs in favor of the CITY and to all deductions provided for in the Contract, and particularly all money withheld, whether assigned or not, shall be subject to being used by the CITY for the completion of the Work in the event that the CONTRACTOR should be in default therein.

C. No assignment of the Contract will be approved unless it shall contain a provision that the funds to be paid to the assignee under the assignment are subject to a prior lien for services rendered or materials supplied for performance of the Work called for under the Contract in favor of all persons, firms, or corporations rendering such services or supplying such materials and that the CITY may withhold funds due until all Work required by the Contract Documents is completed to the CITY'S satisfaction.

19.8 Notice of Injury

Should CITY or CONTRACTOR suffer injury or damage to their person or property because of any error, omission or act of the other party or of any of the other party's employees or agents or others for whose acts the other party is legally liable, claim shall be made in writing to the other party within seven (7) days of the first observance of such injury or damage.

END OF GENERAL CONDITIONS
ARTICLES 1 THROUGH 19