



City of  
**Evans, Colorado**

**Contract Documents and Specification for**

**COMBINED NON-POTABLE /  
IRRIGATION IMPROVEMENTS  
PROJECT**

**DECEMBER, 2012**

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ARTICLE 1.0

**CONTRACTING PROCEDURES**

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**1.1 ADVERTISEMENT FOR BIDS**

The City of Evans, Colorado will receive sealed bids for the following project:

**Combined Non-Potable / Irrigation Improvements Project**

Bids will be received by the City Clerk at 1100 37th Street, Evans, Colorado, until **2:00 p.m.** on **January 3, 2013** at which time said bids will be publicly opened in the City Clerk's Office.

A pre-bid meeting will be held in the Cottonwood Room of the Evans Community Complex at **11:00 a.m.** on **December 20, 2012**.

Copies of the contract documents may be obtained at the Public Works Department.

The Evans City Manager reserves the right to reject any or all bids, to waive any informalities in bids, and to accept the bid that is in the best interests of the City of Evans, Colorado.

CITY OF EVANS, COLORADO

By: \_\_\_\_\_  
Earl Smith  
Director of Public Works

Published in the Greeley Tribune on **December 14, 2012**.

**Dated: December 11, 2012**

## **1.2 INFORMATION FOR BIDDERS**

### **1.2.1 OWNER**

The OWNER of this project is the City of Evans, 1100 37th Street, Evans, Colorado 80620; phone number (970) 475-1113 and fax number (970) 330-3472.

### **1.2.2 ENGINEER**

The ENGINEER is City of Evans, 1100 37th Street, Evans, Colorado 80620. The City Engineer is Cameron Parrott P.E., phone number (970) 475-1113. The City of Evans Project Manager is **Dawn R. Anderson**, phone number **(970) 475-1160**. For this project, the ENGINEER has contracted with **HDR Engineering, Inc. and Aqua Engineering, Inc.**, to do the design of the improvements.

### **1.2.3 BID SUBMITTAL**

Bids will be received by the City Clerk of Evans, Colorado (herein called the "CITY"), at Evans Community Complex, 1100 37th Street, Evans, CO 80620 until **2:00 p.m.** on **January 3, 2013**, and then at said place publicly opened and read aloud.

Each Bid must be submitted in a sealed envelope, addressed to:

City Clerk  
City of Evans  
1100 37th Street  
Evans, CO 80620

Each sealed envelope containing a bid must be plainly marked on the outside as bid for

### **Combined Non-Potable / Irrigation Improvements Project**

and the envelope should bear on the outside the name of the bidder, his address, and the name of the project for which the bid is submitted. If forwarded by mail, the sealed envelope containing the Bid must be enclosed in another envelope addressed to: City Clerk, City of Evans, 1100 37<sup>th</sup> Street, Evans, CO 80620.

All bids must be made on the required bid sheet. All blank spaces for bid prices must be filled in, in ink or typewritten, and the bid sheet must be fully completed and executed when submitted. Only one copy of the bid sheet is required.

### **1.2.4 INFORMALITIES**

The CITY may waive any informalities, minor defects, or reject any and all bids. Any bid may be withdrawn prior to the above scheduled time for the opening of bids or authorized postponement thereof. In the event of strikes, wars, acts of God or other good cause as determined by the City Manager, bid openings may be extended for a reasonable time not to exceed thirty calendar days. No bidder may withdraw a bid within 60 days after the actual date of the opening thereof. Should there be reasons why the contract cannot be awarded within the specified period; the time may be extended by mutual agreement between the CITY and the bidder.

### **1.2.5 CONDITIONS OF WORK**

Bidders must satisfy themselves of the accuracy of the estimated quantities in the Bid Schedule(s) by examination of the site. After bids have been submitted, the bidder shall not assert that there was a misunderstanding concerning the quantities of work or of the nature of the work to be done.

The CITY shall provide to any and all bidders, prior to bidding, all information that is pertinent to and delineates and describes the land owned and rights-of-way acquired upon request.

The Contract Documents contain the provisions required for the construction of the project. Information otherwise obtained from an officer, agent or employee of the CITY or any other person shall not affect the risks or obligations assumed by the CONTRACTOR or relieve him from fulfilling any of the conditions of the contract.

### **1.2.6 BID SECURITY**

Each bid must be accompanied by a Bid Bond payable to the City for five percent of the total amount of the bid. As soon as the bid prices have been compared, the CITY will return the bonds of all except the three lowest responsible bidders within three days after the date of the bid opening. When the Agreement is executed, the Bid Bonds of the two remaining unsuccessful bidders will be returned. The Bid Bond of the successful bidder will be retained until the Agreement, Payment Bond and Performance Bond have been executed and approved, after which it will be returned.

A Performance Bond and Payment Bond, each in the amount of 100 percent of the Contract Price, with a corporate surety approved by the CITY, will be required for the faithful performance of the contract.

### **1.2.7 POWER OF ATTORNEY**

Attorneys-in-fact who sign the Bid Bonds or Payment Bonds and Performance Bonds must file with each bond a certificate and effective dated copy of their Power of Attorney.

## **1.3 AWARD OF CONTRACT**

The party to whom the contract is awarded will be required to execute the Agreement and obtain the Performance Bond, Payment Bond, and Certificates of Insurance within ten (10) calendar days from the date when Notice of Award is delivered to the bidder. The Notice of Award shall be accompanied by the necessary Agreement. In case of failure of the bidder to execute the Agreement and to furnish said Bonds and Certificates, the CITY may at its option, consider the bidder in default, in which case the Bid Bond accompanying the proposal shall become the property of the CITY. The CITY will be entitled to such other rights as may be granted by law.

The CITY within ten (10) days of receipt of acceptable Performance Bond, Payment Bond Certificates of Insurance and Agreement signed by the party to whom the Agreement was awarded, shall sign the Agreement and return to such party an executed duplicate of the Agreement. Should the CITY not execute the Agreement within such period, the bidder may, by written notice, withdraw his signed Agreement. Such notice of withdrawal shall be effective upon receipt of the notice by the CITY.

The Notice to Proceed shall be issued within ten (10) days of the execution of the Agreement by the CITY or as otherwise stated in the Special Conditions. Should there be reasons why the Notice to

Proceed cannot be issued within such period; the time may be extended by mutual agreement between the CITY and the CONTRACTOR. If the Notice to Proceed has not been issued within the ten (10) day period or within the period mutually agreed upon, the CONTRACTOR may terminate the Agreement without further liability on the part of either party.

The CITY may make such investigations as deemed necessary to determine the ability of the bidder to perform the work, and the bidder shall furnish to the CITY all such information and data for this purpose as the CITY may request. The CITY reserves the right to reject any bid if the evidence submitted by, or investigation of, such bidder fails to satisfy the CITY that such bidder is qualified to carry out the obligations of the Agreement and to complete the work contemplated therein. The CITY reserves the right to reject any conditional or qualified bid.

The CONTRACTOR shall commence work not later than fifteen (15) calendar days after date of the Notice to Proceed issued by the CITY to the CONTRACTOR and shall complete the work as specified, within the time specified in the contract. In the event no written Notice to Proceed is issued by the CITY, the contract time as specified in the contract shall be counted from the first day of actual work on the project. All work shall be prosecuted in an orderly and diligent manner. The CONTRACTOR shall cooperate with, and conform to, the request of the CITY to expedite particular portions of the work or to suspend or transfer his operations on any portion of the work where such alteration of the CONTRACTOR's operations is deemed advisable by the CITY.

All applicable laws, ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the contract throughout.

Each bidder is responsible for inspecting the site and informing himself of the conditions under which the work is to be performed and for reading and being thoroughly familiar with the contract documents. The bidder's inspection shall cover the ground structure, obstacles which may be encountered, location of water tables, and other matters relevant to the work both above and below ground. Where test boring logs, indicating underground conditions, are shown on the drawings, this data is for the bidder's information and to reflect the conditions observed at the time and place of drilling. Neither the CITY nor the ENGINEER shall be held responsible for any variance or deviation from the data shown on the drawings, as encountered during actual construction. The failure or omission of any bidder to do any of the foregoing shall in no way relieve any bidder from any obligation in respect to his bid. The successful bidder will not be allowed any extra compensation in the form of contract price or time by any matter or thing on which he could have fully informed the CITY of prior to the bidding.

The low bidder shall supply the names and addresses of major material suppliers and subcontractors when requested to do so by the CITY.

The successful bidder will provide the CITY of Evans with a current list of references of previous work performed in this field.

The OWNER reserves the right to reject any or all bids and to pass upon the regularity or waive any irregularities of the bidders and to determine the acceptability of the surety offered.

If Bid Schedules are set forth in the Proposals, the CONTRACTORS must bid on all the Schedules. The CONTRACTOR'S bid considered for award shall be for the combined low bid for the Base Bid

and Force Account.

Portions of any project may have been termed "Alternates or Contingent" and the OWNER reserves the right to include or remove any or all of these Alternates from the Contract at his sole option or discretion.

**1.3.1 CONSIDERATION OF PROPOSALS:**

After the proposals are opened and read, they will be compared on the basis of the summation of the products of the approximate quantities shown in the bid schedule by the unit bid prices. The results of such comparisons will be immediately available to the public. In the event of a discrepancy between unit bid prices and extensions, the unit bid price shall govern.

The right is reserved to reject any or all proposals, to waive technicalities or to advertise for new proposals, if in the judgment of the awarding authority the best interests of the CITY will be promoted thereby.

**1.3.2 AWARD OF CONTRACT:**

The award of contract, if it is awarded, will be made within 60 calendar days after the opening of proposals to the lowest responsible and qualified bidder whose proposal complies with all the requirements prescribed. The successful bidder will be notified, by letter mailed to the address shown on his proposal, that his bid has been accepted and that he has been awarded the contract.

**1.3.3 CANCELLATION OF AWARD:**

The CITY reserves the right to cancel the award of any contract at any time before the execution of said contract by all parties without any liability against the CITY.

**1.3.4 EXECUTION AND APPROVAL OF CONTRACT:**

The Contract shall be signed by the successful bidder and returned, together with requisite attachments outlined in Section 1.5.7. All documents will be executed in triplicate and shall be submitted to the CITY within 10 calendar days after the date of award. If the signed Contract and Bond is returned by the successful bidder within 10 calendar days after award and if the Contract is not executed by the CITY within 60 days from date of award, the bidder shall have the right to withdraw his bid without penalty. No Contract shall be considered effective until it has been fully executed by all of the parties thereto.

**1.3.5 FAILURE TO EXECUTE CONTRACT:**

Failure to execute the Contract and file acceptable bonds within 10 calendar days after the date of award shall be just cause for the cancellation of the award and the forfeiture of the proposal guaranty which shall become the property of the CITY. The CITY may elect to waive forfeiture of the proposal guaranty only if it is determined that the bidder has made a good faith remedial error and that no damages were sustained by the CITY as a result of the failure by the successful bidder to execute the contract and file acceptable bonds within the time prescribed. Award may then be made to the next lowest responsible bidder, or the work may be re-advertised and constructed under contract or otherwise, as the CITY may decide.

## **1.4 THE CONTRACT: FOLLOWING EXECUTION**

### **1.4.1 MATERIALS:**

Unless otherwise stipulated, the CONTRACTOR shall provide and pay for all materials, labor, water, tools, equipment, light power, transportation, and other facilities necessary for the execution and completion of the work. The CONTRACTOR shall furnish satisfactory evidence as to the kind and quality of materials.

### **1.4.2 PROGRESS SCHEDULE:**

The CONTRACTOR shall submit, at such times as may reasonably be requested by the ENGINEER, schedules which shall show the order in which he proposes to carry on the work, with dates at which the CONTRACTOR will start the several parts of the work, and estimated dates of completion of the several parts. The Special Conditions or Drawings may require that certain phases or parts of the work be completed first or in a certain order. If the CONTRACTOR elects to use PERT or CPM charts, he shall furnish copies of them and all revisions thereto or amendments thereto as the work progresses to the ENGINEER upon request.

### **1.4.3 ASSIGNMENT OF CONTRACT:**

No assignment by the CONTRACTOR of this contract or any part thereof or of the funds to be received thereunder by the CONTRACTOR will be recognized unless such assignment has had the written approval of the CITY and the surety has been given due notice of such assignment and has furnished written consent thereto. Such written approval by the CITY shall not relieve the CONTRACTOR of the obligations incurred by him under the terms of this contract. In addition to the usual recitals in assignment contracts, the following language must be set forth:

It is agreed that the funds to be paid to the assignee under this assignment are subject to a prior lien for services rendered or materials supplied for the performance of the work called for in said contract in favor of all persons, firms, or corporations rendering such services or supplying such materials."

### **1.4.4 SUBLETTING OF CONTRACT:**

The CONTRACTOR shall as soon as practical after signing the contract, notify the ENGINEER in writing, giving the names and qualifications of all subcontractors proposed for work and shall not employ any that the ENGINEER may within a reasonable time object to. The CONTRACTOR will not be allowed to subcontract more than fifty percent (50%) of the total monetary value of the contract without prior approval of the OWNER. The CONTRACTOR shall notify the ENGINEER of each subcontract he awards, giving:

- A. Name, address, and telephone number of the subcontractor
- B. Branch of work covered
- C. Total price of subcontract
- D. Date of subcontract

Subcontractors, before commencing work, must file with the ENGINEER satisfactory certificates in duplicate showing insurance coverage. Failure of the subcontractor to provide such certificates shall

not relieve the CONTRACTOR of his obligation to insure and to hold the CITY harmless. Subcontractors shall also file with the ENGINEER copies of applicable permits and licenses required to do the subcontracted work.

**1.4.5 OTHER CONTRACTS:**

The CITY may award other contracts for additional work, and the CONTRACTOR shall fully cooperate with such other contractors and carefully fit his own work to that provided under the other contracts as may be directed by the ENGINEER. The CONTRACTOR shall not commit or permit any act that will interfere with the performance of work by any other contractor.

**1.5 CONTRACT DOCUMENTS**

**1.5.1 NON-COLLUSION STATEMENT**

\_\_\_\_\_, being first duly sworn, deposes and says that:

- (1) He is the \_\_\_\_\_ of  
(owner, partner, officer, representative or agent)  
\_\_\_\_\_, the  
(Company's Name)  
bidder that has submitted the attached bid;
- (2) He is fully informed respecting the preparation and contents of the attached bid and of all pertinent circumstances respecting such bid;
- (3) Such bid is genuine and is not a collusive or sham Bid;
- (4) Neither the said bidder nor any of its officers, partners, owners, agents, representatives, employees or parties in interest, including this affiant, has in any way colluded, conspired, connived or agreed, directly or indirectly with any other bidder, firm or person to submit a collusive or sham bid in connection with the contract for which the attached bid has been submitted or to refrain from bidding in connection with such contract, or has in any manner, directly or indirectly, sought by agreement or collusion or communication or conference with any other bidder, firm or person to fix the price or prices in the attached bid or of any other bidder, or to fix any overhead, profit or cost element of the bid price or the bid price of any unlawful agreement any advantage against the City of Evans or any person interested in the proposed contract; and
- (5) The price or prices quoted in the attached bid are fair and proper and are not tainted by a collusion, conspiracy, connivance, or unlawful agreement on the part of the bidder or any of its agents, representatives, owners, employees, or parties in interest, including this affiant.

Signed: \_\_\_\_\_

Title: \_\_\_\_\_

Subscribed and sworn to before me this \_\_\_ day of \_\_\_\_\_, A.D., **2013**.

Notary Public \_\_\_\_\_

My Commission expires: \_\_\_\_\_

**1.5.2 BID PROPOSAL**

**Combined Non-Potable / Irrigation Improvements Project**

Proposal of \_\_\_\_\_ (hereinafter called bidder, doing business as \* \_\_\_\_\_ organized and existing under the laws of the State of \_\_\_\_\_, to the City of Evans (hereinafter called CITY).

In compliance with your Advertisement for Bids, bidder hereby proposes to perform all work for the **Combined Non-Potable / Irrigation Improvements Project** in strict accordance with contract documents, within the time set forth therein, and at prices stated below.

By submission of this bid, each bidder certifies, and in cases of a joint bid, each party hereto certifies as to his own organization, that this bid has been arrived at independently, without consultation, communication, or agreement as to any matter relating to this bid with any other bidder or with any competitor.

Bidder hereby agrees to commence work under this contract on or before a date specified in the Special Conditions. Bidder further agrees to pay liquidated damages as provided in the Special Conditions.

Bidder acknowledges receipt of the following Addendum:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Bid shall include all applicable taxes and fees.

Bidder agrees to perform all work described in the contract documents in accordance with the attached Bid Schedule.

\* Insert "a Corporation", "a Partnership", or "an Individual" as applicable.

**1.5.3 BID SCHEDULE**

**City of Evans Combined Non-Potable / Irrigation Improvements Project**

Item	Description	Quantity	Units	Unit Cost	Total Cost
<b>Miscellaneous</b>					
1	MOBILIZATION & DEMOBILIZATION	1	LS		
2	GENERAL CONTRACT REQUIREMENTS, BONDS AND INSURANCE	1	LS		
3	TRAFFIC AND PEDESTRIAN CONTROL	1	LS		
4	MATERIALS TESTING	1	LS		
5	CONSTRUCTION SURVEYING & ELECTRONIC AS BUILTS	1	LS		
<b>Subtotal - Miscellaneous</b>					

<b>17th Avenue Drop Structure Replacement</b>					
<b>Demolition &amp; Erosion Control</b>					
6	SALVAGE HEADGATE	1	EA		
7	REMOVE AND DISPOSE DEBRIS PILE	1	LS		
8	REMOVE AND DISPOSE CONCRETE WALLS	140	SF		
9	REMOVE 48-INCH RCP	5	LF		
10	CHECK DAM (RipRap D50 = 6")	2.2	CY		
11	CONCRETE WASHOUT	1	EA		
12	VEHICLE TRACKING CONTROL (D50 = 1.5" to 3")	1	EA		
13	SILT FENCE	390	LF		
14	RE-SEED ALL DISTURBED AREAS	1	LS		
<b>Subtotal - Demolition &amp; Erosion Control</b>					

<b>Civil</b>					
15	RIPRAP (D50 = 6")	15	CY		
16	NON-WOVEN GEOTEXTILE	400	SF		
17	STRUCTURE EXCAVATION	127	CY		
18	SUBGRADE PREP	35	SY		
19	STRUCTURAL BACKFILL (Compacted On-Site Material)	70	CY		
20	GUARDRAIL	27	LF		
<b>Subtotal - Civil</b>					

<b>Structure &amp; Gate</b>					
21	CONCRETE STRUCTURE (Class D) (Complete In Place)	41	CY		
22	HANDRAIL	1	LS		
23	OVERSHOT DROP STRUCTURE GATE (Complete In Place)	1	LS		
24	LOPAC CHECK STRUCTURE GATE (Complete In Place)	1	LS		
<b>Subtotal - Structure &amp; Gate</b>					

**17th Avenue Drop Structure Subtotal**

<b>Prairie View Drive Landscaping</b>					
25	TEMPORARY EROSION CONTROL	1	LS		
26	IRRIGATION SYSTEM - MAINLINE (Incl. control wires and laterals to medians)	1	LS		
27	IRRIGATION WATER CONNECTION ASSEMBLY	1	LS		
28	IRRIGATION CONTROLLER UNIT / ENCLOSURE	1	LS		
29	INSTALL IRRIGATION CONTROLLER	1	LS		
30	INSTALL 3-INCH NON-POTABLE WATER METER	1	LS		
31	INSTALL 3-INCH POTABLE WATER METER	1	LS		
32	PRIMARY ELECTRICAL SERVICE INSTALLATION	1	LS		
<b>Prairie View Landscaping Subtotal</b>					

**Parker Meadows Non-Potable Irrigation**

**Pump System**

33	PRE-FABRICATED PUMP SYSTEM SKID w/ BACK-UP PUMP, PM PUMP & FILTER	1	LS		
34	6-FOOT DIAMETER PRECAST CONCRETE WET WELL	1	LS		
35	PUMP SYSTEM CONCRETE FLOOR SLAB (17 FT x 15.5 FT x 0.5 FT)	16	CY		
36	PUMP SYSTEM ENCLOSURE (15 FT x 13.5 FT)	225	SF		
37	ELECTRICAL COMPONENTS IN PUMP SYSTEM ENCLOSURE	1	LS		
38	18-INCH FLAT BACK GALVANIZED CANAL GATE (9 ft Frame)	1	LS		
39	CONCRETE DIVERSION STRUCTURE (Including trash rack)	1	LS		
40	18-INCH SDR 32.5 PIPE FROM DIVERSION STRUCTURE TO WET WELL	30	LF		
41	2-INCH CL 200 PVC FLUSH PIPELINE	45	LF		
42	PRIMARY ELECTRICAL SERVICE INSTALLATION	1	LS		

Subtotal - Pump System

**Distribution System**

43	6-INCH C900 PVC (Including all fittings)	1605	LF		
44	ISOLATION GATE VALVE ASSEMBLIES	1	LS		
45	BLOW-OFF ASSEMBLIES	1	LS		
46	AIR VACUUM RELIEF VALVES	1	LS		
47	OPEN CUT AND SLEEVING UNDER EVANS DITCH	20	LF		
48	POTABLE METER W/ VAULT (3-INCH)	1	EA		
49	SPOOL ASSEMBLY W/ VAULT	1	LS		

Subtotal - Distribution System

**Parker Meadows Non-Potable Subtotal**

**Combined Non-Pot / Irrigation Improvements Base Bid Total:**

NOTES:

- X Safety is of the utmost importance in construction work and it will be the responsibility of the contractor to insure safety at all times.
- X All costs associated with safety will not be paid for separately and shall be subsidiary to other contract line items.
- X Line Item #15, RipRap: Shall include all costs associated with the UDFCD Type II Granular Bedding. (6" Thick)
- X Line Item #23, Overshot Drop Structure Gate: Shall include all costs associated with the gate control cabinet and motor & gear box assembly.
- X Line Item #26, Irrigation - Mainline: All PVC sleeves are existing. Mainline lump sum shall include all pipe, valves, connections, sensors, etc., unless otherwise listed as an individual line item.
- X Line Item #27, Irrigation Water Connection Assembly: Lump sum cost shall include all items included in detail 1 on sheet IR-11 of the plans.
- X Line Item #29, Install Irrigation Controller: Controller shall be a Signature Constellation Controller with premium surge. It must also include the optional Signature Spread Spectrum Radio with 3DB Dome antenna.
- X Line Item #33, Pre-fabricated Pump System: Vertical Turbine Pump manufacturer shall be Watertronics.
- X Line Item #49, Spool Assembly w/ Vault: Contractor to verify location with the City.
- \* Please refer to Articles 4.0 through 6.0 of the Contract Documents for detailed technical specifications.

The undersigned, if awarded the Contract, at the prices shown in the bid, agrees to complete the work within Sixty (60) working days after the Notice to Proceed is issued.

Date

Company

Official Address:

Signature

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

\_\_\_\_\_  
 Title

**1.5.4 BID BOND**

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned, \_\_\_\_\_ as Principal, and \_\_\_\_\_ surety, are hereby held and firmly bound unto the City of Evans in the penal sum of (\$\_\_\_\_\_) for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, successors and assigns.

Signed this \_\_\_\_ day of \_\_\_\_\_, **2013**.

The condition of the above obligations is such that whereas the Principal has submitted to the City of Evans a certain bid, attached hereto and hereby made a part hereof, to enter into a contract in writing, for the

**Combined Non-Potable / Irrigation Improvements Project**

NOW THEREFORE,

- (A) If said bid shall be rejected, or in the alternate,
- (B) If said bid shall be accepted and the Principal shall execute and deliver a contract in the form of contract attached hereto (properly) completed in accordance with said bid and shall furnish a bond for his faithful performance of said contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said bid,

then this obligation shall be void, otherwise, the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received, hereby stipulates and agrees that the obligations by any extension of the time within which the CITY may accept such bid; and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the Principal and the Surety have hereunder set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

\_\_\_\_\_  
Principal

\_\_\_\_\_  
Surety

By: \_\_\_\_\_

**1.5.5 NOTICE OF AWARD**

TO: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PROJECT DESCRIPTION: **Combined Non-Potable / Irrigation Improvements Project**

The CITY, represented by the undersigned, has considered the bid submitted by you for the above described work in response to its Advertisement for Bids dated **December 14, 2012**.

You are hereby notified that your bid has been accepted for **Combined Non-Potable / Irrigation Improvements Project** in the amount of **{Bid Amount}**.

You are required by the Information for Bidders to execute the Agreement and furnish the required Contractor's Performance Bond, Payment Bond, and Certificates of Insurance within ten (10) calendar days from the date of this Notice to you. If you fail to execute said Agreement and to furnish said bonds and certificates within ten (10) days from the date of this Notice, said CITY will be entitled to consider all your rights arising out of the CITY's acceptance of your bid as abandoned and as a forfeiture of your Bid Bond. The CITY will be entitled to such other rights as may be granted by law.

You are required to return an acknowledged copy of this Notice of Award to the CITY.

Dated this \_\_\_ day of \_\_\_\_\_**2013**.

The City of Evans  
(CITY)

By: \_\_\_\_\_  
Title: City Engineer

**1.5.6 ACCEPTANCE OF NOTICE**

Receipt of the above Notice of Award is hereby acknowledged on this, the \_\_\_ day of \_\_\_\_\_  
\_\_\_\_\_ **2013**.

By: \_\_\_\_\_  
Title: \_\_\_\_\_

IMPORTANT: Surety companies executing bonds must appear on the Treasury Department's most current list (circular 570 as amended) and be authorized to transact business in the State of Colorado.

### 1.5.7 AGREEMENT

THIS AGREEMENT, made this \_\_\_\_\_ day of \_\_\_\_\_, **2013**, by and between the City of Evans, hereinafter called "CITY", and \_\_\_\_\_ doing business as hereinafter called "CONTRACTOR".

WITNESSETH: That for and in consideration of the payments and agreements hereinafter mentioned:

1. The CONTRACTOR will commence and complete the phased construction of **Combined Non-Potable / Irrigation Improvements Project**.
2. The CONTRACTOR shall furnish all material, supplies, tools, equipment, labor and other services necessary for the construction and completion of the project described herein.
3. The CONTRACTOR shall commence the work required by the Contract Documents in accordance with the date stated in the Special Conditions and shall complete the work within the time stated in the Special Conditions unless the period for completion is extended otherwise by the Contract Documents.
4. The CONTRACTOR agrees to perform all the work described in the Contract Documents and comply with the terms therein for the sum of **{Project Amount}** for the **Combined Non-Potable / Irrigation Improvements Project**.
5. The term "Contract Documents" means and includes the following:
  - (A) Advertisement for bids
  - (B) Information for Bidders
  - (C) Non-Collusion Statement
  - (D) Bid Proposal
  - (E) Bid Schedule
  - (F) Bid Bond
  - (G) Notice of Award
  - (H) Acceptance of Notice
  - (I) Agreement
  - (J) Payment Bond
  - (K) Performance Bond
  - (L) Certificate of Incorporation
  - (M) Certificates of Insurance
  - (N) Notice to Proceed
  - (O) Special Conditions
  - (P) General Conditions
  - (Q) Technical Provisions
  - (R) Change Order
  - (S) Addendum

No. \_\_\_\_\_, dated \_\_\_\_\_, **2013**  
No. \_\_\_\_\_, dated \_\_\_\_\_, **2013**  
No. \_\_\_\_\_, dated \_\_\_\_\_, **2013**

- (T) Notice of Contractor's Settlement
- (U) Final Receipt and Guarantee
- (V) Other

6. The CITY will pay the CONTRACTOR in the manner and at such time as set forth in the General Conditions, such amounts required by the Contract Documents.
7. This Agreement shall be binding upon all parties hereto and their respective heirs, executors, administrators, successors, and assigns.

IN WITNESS WHEREOF, the parties hereto have executed, or caused to be executed by their duly authorized officials, this Agreement, each of which shall be deemed an original on the date first written above.

THE CITY OF EVANS

CONTRACTOR

BY \_\_\_\_\_  
 NAME Lyle Achziger  
 TITLE Mayor

BY \_\_\_\_\_  
 NAME \_\_\_\_\_  
 TITLE \_\_\_\_\_  
 ADDRESS \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

(SEAL)

ATTEST:

ATTEST:

NAME \_\_\_\_\_  
 TITLE \_\_\_\_\_

NAME \_\_\_\_\_  
 TITLE \_\_\_\_\_

APPROVED AS TO FORM:

\_\_\_\_\_  
 Evans City Attorney

APPROVED AS TO SUBSTANCE

\_\_\_\_\_  
 Evans City Manager

**1.5.8 PERFORMANCE BOND**

KNOW ALL MEN BY THESE PRESENTS: that

\_\_\_\_\_  
(Name of Contractor)

\_\_\_\_\_  
(Address of Contractor)

a \_\_\_\_\_, hereinafter called Principal, Corporation, Partnership or Individual

\_\_\_\_\_  
(Name of Surety)

\_\_\_\_\_  
(Address of Surety)

hereinafter called Surety, are held and firmly bound unto the City of Evans, 1100 37th Street, Evans, Colorado 80620, hereinafter called CITY, in the penal sum of \$\_\_\_\_\_ in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, successors, and assigns, jointly, severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas the Principal entered into a certain Contract with the CITY, dated the \_\_\_\_\_ day of \_\_\_\_\_, 2013, a copy of which is hereto attached and made a part hereof for the construction of:

**Combined Non-Potable / Irrigation Improvements Project**

NOW, THEREFORE, if the Principal shall well, truly, and faithfully perform its duties, all the undertakings, covenants, terms, conditions, and agreements of said contract during the original term thereof, and any extensions thereof which may be granted by the CITY, with or without notice to the Surety and during the two-year guarantee period, and if he shall satisfy all claims and demands incurred under such contract, and shall fully indemnify and save harmless the CITY from all costs and damages which it may suffer by reason of failure to do so, and shall reimburse and repay the CITY all outlay and expense which the CITY may incur in making good any default, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the said Surety, for value received hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract or to work to be performed thereunder or the specifications accompanying the same shall in any ways affect its obligation on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract or to the work or to the specifications.

PROVIDED, FURTHER, that no final settlement between the CITY and the CONTRACTOR shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed this \_\_\_\_\_ day of \_\_\_\_\_, **2013**.

ATTEST:

\_\_\_\_\_  
Principal

\_\_\_\_\_  
Principal Secretary

By \_\_\_\_\_(S)

(SEAL)

\_\_\_\_\_  
Witness as to Principal

\_\_\_\_\_  
Address

ATTEST:

\_\_\_\_\_  
Surety Secretary

(SEAL)

\_\_\_\_\_  
Witness as to Surety

By \_\_\_\_\_  
Attorney-in-Fact

\_\_\_\_\_  
Address

\_\_\_\_\_  
Address

NOTE: Date of bond must not be prior to date of contract. If CONTRACTOR is a partnership, all partners should execute bond.

IMPORTANT: Surety companies executing bonds must appear on the Treasury Department's most current list (circular 570, as amended) and be authorized to transact business in the state where the project is located.

**1.5.9 PAYMENT BOND**

KNOW ALL MEN BY THESE PRESENTS: that

\_\_\_\_\_  
Name of Contractor

\_\_\_\_\_  
Address of Contractor

a \_\_\_\_\_ hereinafter called Principal, and Corporation,  
Partnership or Individual

\_\_\_\_\_  
Name of Surety

\_\_\_\_\_  
Address of Surety

hereinafter called Surety, are held and firmly bound unto the City of Evans, 1100 37th Street, Evans, Colorado 80620 hereinafter called "CITY", in the penal sum of \$ \_\_\_\_\_ in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the Principal entered into a certain contract with the CITY, dated the \_\_\_\_\_ day of \_\_\_\_\_ 2013, a copy of which is hereto attached and made a part hereof for the construction of:

**Combined Non-Potable / Irrigation Improvements Project**

NOW, THEREFORE, if the Principal shall, during the entire length of said contract and any extension thereof, promptly make payment to all persons, firms, subcontractors, and corporations furnishing materials for or performing labor in the prosecution of the work provided for in such contract, and any authorized extension or modification thereof, including all amounts due for materials, lubricants, oil, gasoline, coal and coke, repairs on machinery, equipment and tools, consumed or used in connection with the construction of such work, and all insurance premiums on said work, and for all labor performed in such work whether by subcontractor or otherwise, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the said Surety, for value received hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the contract or to the work or to be performed thereunder or the specifications accompanying the same shall in any way affect its obligation on time, alteration or addition to the terms of the contract or to the work or to the specifications.

PROVIDED, FURTHER, that no final settlement between the CITY and the CONTRACTOR shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed in \_\_\_\_\_ (number) counterparts, each one of which shall be deemed an original, this the \_\_\_\_\_ day of \_\_\_\_\_ 2013.

ATTEST:

\_\_\_\_\_  
Principal

\_\_\_\_\_  
Principal Secretary

By \_\_\_\_\_ (S)

(SEAL)

\_\_\_\_\_  
Witness as to Principal

\_\_\_\_\_  
Address

ATTEST:

\_\_\_\_\_  
Surety Secretary

(SEAL)

\_\_\_\_\_  
Witness as to Surety

By \_\_\_\_\_  
Attorney-in-Fact

\_\_\_\_\_  
Address

\_\_\_\_\_  
Address

NOTE: Date of bond must not be prior to date of contract. If CONTRACTOR is a partnership, all partners should execute bond.

IMPORTANT: Surety companies executing bonds for must appear on the Treasury Department's most current list (circular 570, as amended) and be authorized to transact business in the state where the project is located.

**1.5.10 NOTICE TO PROCEED**

TO: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

DATE: \_\_\_\_\_

Project: **Combined Non-Potable / Irrigation Improvements Project**

You are hereby notified to commence work in accordance with the Agreement dated **{Agreement Date}**, on or before **{Start Date}**, and you are to complete the work within **Sixty (60)** consecutive working days thereafter. The date of completion of all work is therefore **{Finish Date}**.

THE CITY OF EVANS

By \_\_\_\_\_

Title Civil Engineer II \_\_\_\_\_

**1.5.11 ACCEPTANCE OF NOTICE**

Receipt of the above Notice to Proceed is hereby acknowledged by

\_\_\_\_\_  
\_\_\_\_\_

this the \_\_ day of \_\_\_\_\_, 2013.

By \_\_\_\_\_

Title \_\_\_\_\_

**1.5.12 CHANGE ORDER**

CHANGE ORDER NO. \_\_\_\_\_  
 DATE: \_\_\_\_\_

PROJECT: **Combined Non-Potable / Irrigation Improvements Project**

TO (CONTRACTOR): \_\_\_\_\_

JUSTIFICATION: \_\_\_\_\_

You are directed to make the following changes in the work. All other terms and conditions of the contract not expressly modified hereby shall remain in full force and effect.

ITEM NO.	DESCRIPTION	EST. QTY.	UNIT	UNIT COST	AMOUNT
----------	-------------	-----------	------	-----------	--------

	The original contract sum was			\$	_____
	Net change by previous change orders			\$	_____
	The contract sum prior to this Change Order was			\$	_____
	The contract sum will be (increased) (decreased) or (unchanged) by this Change Order			\$	_____
	The contract sum including this Change Order will be			\$	_____
	The new contract time will be (increased) (decreased) or (unchanged) by (___) days.				

The date of completion as of the date of this Change Order is therefore \_\_\_\_\_, **2013**.

ACCEPTED BY:

ORDERED BY:

\_\_\_\_\_  
 Contractor

The City of Evans  
 1100 37th Street  
 Evans, CO 80620

Address

By \_\_\_\_\_

By \_\_\_\_\_

Date \_\_\_\_\_

Date \_\_\_\_\_

**1.5.13 NOTICE OF CONTRACTOR'S SETTLEMENT**

This is to notify all persons interested that the City of Evans, Colorado will make final payment to **{Contractor's Name}** for work completed on **Combined Non-Potable / Irrigation Improvements Project**.

Said final payment will be made on **{Final Payment Date}**.

Anyone having claims in conjunction with this project may file same with the undersigned no later than **{Wednesday Before Final Payment Date}**.

CITY OF EVANS

By \_\_\_\_\_  
Earl Smith, Director of Public Works

Dated: \_\_\_\_\_

The Greeley Tribune

**1.5.14 FINAL RECEIPT AND GUARANTEE**

CITY OF EVANS  
Date: \_\_\_\_\_

Received this date of **{Final Payment Date}**, as full and final payment of the cost of improvements provided for in the Contract executed by **{Contractor's Name}** and Payee on or about **{Agreement Date}**, together with all amendments, change orders, and additions thereto, the sum of Dollars (**#{Final Payment Amount}**), by checking, being the remainder of the full amount accruing to the undersigned by virtue of said contract and extra work performed thereunder, said payment covering and including full payment for the cost of all extra work and material furnished by the undersigned in the construction of said improvements, and all incidentals thereto, for the additional consideration of One Dollar (\$1.00) for the execution hereto, and the undersigned hereof releases the City of Evans from any claims whatsoever resulting from said contract and all work performed thereunder.

The undersigned by these present certifies that all persons doing work upon or furnishing materials for said improvements under the foregoing contract and all additions thereto have been paid in full. The undersigned further certifies that all work has been completed in a workmanlike manner in conformity with the plans and specifications. That should any portion of said work or material prove defective within **two (2) years** from the date of initial acceptance of the entire project by the CITY, the undersigned shall replace any such defective material and remedy any such defective work to the satisfaction of the City of Evans and shall defend, indemnify, expenses, and charge of every kind which may arise as a result of any such defective material and workmanship during said period. **The Performance and Payment Bonds for this contract shall remain in effect for the period of the guarantee.**

**Combined Non-Potable / Irrigation Improvements Project**

Signature: \_\_\_\_\_

Name: \_\_\_\_\_

Title: \_\_\_\_\_

## **1.6 INSURANCE REQUIREMENTS**

The CONTRACTOR shall secure and maintain such insurance policies as will protect himself, his subcontractors, and the City of Evans, from claims for bodily injuries, death or property damage, which may arise from operations under this contract whether such operations be by himself or by any subcontractor or anyone employed by them directly or indirectly. The following insurance policies are required:

- (a) Statutory Worker's Compensation
- (b) Commercial General Liability
  - General Aggregate \$1,200,000
  - Products/ (Completed Operations Aggregate) \$1,200,000
  - Each Occurrence \$ 600,000
  - Personal & Advertising Injury \$ 600,000
  - Fire Damage \$ 50,000
  - Medical Expense \$ 5,000
- (c) Automobile Liability
  - Bodily Injury and Property Damage/ (Combined Single Limit) \$ 600,000

*The Certificate of Insurance must show the City of Evans, as Additional Insureds.*

All policies shall be for not less than the amounts set forth above or as stated in the Special Conditions. Other forms of insurance shall also be provided if called for by the Special Conditions.

Certificates or copies of policy of such insurance shall be filed with the CITY and shall be subject to its approval as to adequacy of protection, within the requirements of the specifications. Said Certificates of Insurance shall contain a 30-day written notice of cancellation in favor of the CITY.

## ARTICLE 2.0

### GENERAL CONDITIONS

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## **2.1 DEFINITIONS**

- (a) The Contract Documents shall consist of the Advertisement for Bids, Information for Bidders, Non-Collusion Statement, Bid Proposal, Bid Bond, Notice of Award, Agreement, Performance Bond, Payment Bond, Insurance Requirements, Notice to Proceed, Change Order, Notice of Contractor's Settlement, Final Receipt and Guarantee, Drawings, Specifications, and Special and General Conditions, including all modifications thereof incorporated in any of the documents before and after the execution of the Contract.
- (b) The CITY and the CONTRACTOR are those named as such in the Agreement. They are treated through the Contract Document as if each were of singular number and masculine gender.
- (c) Wherever in this Contract the word "ENGINEER" is used, it shall be understood as referring to the City Engineer, acting personally or through any assistants or assigns.
- (d) Any written notice served pursuant to the terms of the Agreement shall be deemed to have been duly served as if delivered in person or by registered mail to the individual, or to a partner, or to an officer of the corporation for whom it is intended, or any authorized representative thereof.
- (e) The term "subcontractor" shall mean anyone, other than the contractor, who furnished at the site, under an agreement with the CONTRACTOR, labor, or labor and materials, or labor and equipment, but shall not include any person who furnished services of a personal nature.
- (f) Work shall mean the furnishing of all labor, materials, equipment, and other incidentals necessary to the successful completion of the Contract and the carrying out of all duties and obligations imposed by the Contract.
- (g) Extra work shall mean such additional labor, materials, equipment, and other incidentals as are required to complete the Contract for the purpose for which it was intended, but was shown on the Drawings or called for in the Specifications, or is authorized by the CITY in addition to that work called for in the Drawings and Specifications.
- (h) Dispute shall mean lack of agreement between any parties that have any obligations, duties, or responsibilities under the terms of the Contract Drawings or Specifications.
- (i) Mobilization shall consist of preparatory work and operations, including, but not limited to, those necessary for the movement of personnel, equipment, supplies and incidentals to the project site; for the establishment of all offices, buildings and other facilities necessary for work on the project; and for all other work land operations which must be performed in order to begin work on the various items on the project site.

## 2.1.1 ABBREVIATIONS

Wherever the following abbreviations are used in these general conditions, supplemental condition, specifications, standard details or on the drawings, they are to be construed the same as the respective expressions represented.

AASHTO	American Association of State Highway and Transportation Officials
AAN	American Association of Nurserymen
AB	Aggregate Base
Aban	Abandon
ABC	Aggregate base course
AC	Asphalt cement or concrete
ACB	Asphalt concrete base
ACI	American Concrete Institute
ACP	Asbestos cement pipe
ACPA	American Concrete Pipe Association
ACWS	Asphalt concrete wearing surface
AGC	Associated General Contractors of America, Inc.
Agg	Aggregate
Ahd	Ahead
AIA	American Institute of Architects
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
APA	American Plywood Association
Approx	Approximate
APWA	American Public Works Association
AR	Aged residue
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
Asph	Asphalt
ASTM	American Society for Testing Materials
Ave	Avenue
AWPA	American Wood Preservers Association
AWSC	American Welding Society Code
AWWA	American Water Works Association
Bbl	Barrel
BC	Beginning of curve
BCR	Beginning of curb return
Beg	Beginning
Bk	Book or Back
Blvd	Boulevard
BM	Bench Mark or Board Measure
Brg	Bearing
BST	Bituminous Surface Treatment

BTB	Bituminous Treated Base
BTU	British Thermal Units
BVC	Beginning of vertical curve
BVCE	Beginning of vertical curve elevation
BVCS	Beginning of vertical curve station
C	Centigrade or Curb
CB	Catch Basin
CBF&C	Catch basin frame & cover
CC or C/C	Center to Center
CCA	Colorado Contractor's Association, Inc.
CDOT	Colorado Department of Transportation
CE	City or County Engineer
Cem	Cement
CF	Curb face
cfs	Cubic Feet per second
CIP	Cast Iron pipe
CIPP	Cast-in-place concrete pipe
CL or C	Centerline
Cm	Centimeter
CMP	Corrugated metal pipe
CO	Clean out
Col	Column
Conc	Concrete
Const	Construct
CP	Concrete pipe(non-reinforced)
CRS	Colorado Revised Statutes
CTB	Cement Treated Base
Cu	Cubic
CY	Cubic Yards
Deg	Degree
DF	Douglas Fir
DG	Decomposed granite
Dia	Diameter
Dim	Dimension
DIP	Ductile Iron Pipe
Div	Division
Dr	Drive
DRCOG	Denver Regional Council of Governments
Drwg	Drawing
Dwy	Driveway
Ea	Each
Ease	Easement
E	East
EC	End of curve

ECR	End of curb return
El or Elv	Elevation
Equa or Eq	Equation
EVC	End of vertical curve
EVCE	End of vertical curve elevation
EVCS	End of vertical curve station
Ex or Exist	Existing
F	Fahrenheit
FB	Field Book
F & C	Frame & cover
FH	Fire hydrant
FL or F	Floor line or flow line
FIEI	Floor Elevation
Fnd	Found
fps	Feet per second
FS	Finished surface
FSS	Federal Specifications and Standards
Ft	Foot or feet
G	Gutter
Ga	Gage
Galv	Galvanized
GL	Ground line
gpm	Gallons per minute
Gr	Grade
H	High or height
HC	House connection
Hdwl	Headwall
Horiz	Horizontal
Hwy	Highway
ID	Improvement District or inside diameter
IE	Invert Elevation
IEEE	Institute of Electrical and Electronic Engineers
In	Inch
Inv	Invert
IP	Iron Pipe
IPS	Iron Pipe Size
Irrig	Irrigation
Jt	Joint
JC	Junction Chamber
Jct	Junction
JS	Junction Structure

L	Length
Lb	Pound
L&T	Lead and tack
LD	Local depression
LF	Linear Feet
LH	Lamp hole
Lin	Linear
Long	Longitudinal
Lt	Left
M	Map or maps
Max	Maximum
Meas	Measured
MH	Manhole
MHF&C	Manhole frame and cover
Min	Minutes or minimum
Misc	Miscellaneous
MLorM	Monument line
Mm	Millimeter
Mon	Monolithic or monument
MTD	Multiple tile duct
MUTCD	Manual of Uniform Traffic Control Devices
N	North
NBS	National Bureau of Standards
NCPI	National Clay Pipe Institute
NE	Northeast
NEC	National Electric Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NP	Non-plastic
NPI	Non pay item
NSC	National Safety Council
NSF	National Sanitation Foundation
NW	Northwest
No	Number
OC	On center
OD	Outside diameter
Oz	Ounces
PC	Point of curvature
PCR	Point of curb return
PCC	Point of compound curve or Portland Cement Concrete
PI	Point of intersection or plastic index
PL	Property line
POC	Point of Curve

POS	Point of Spiral
PP	Power pole
ppm	Parts per million
PRC	Point of reverse curve
Prod	Proposed or property
psi	Pounds per square inch
psf	Pounds per square foot
PTorPOT	Point of Tangent
P&TP	Power and telephone pole
Pvmt	Pavement
Q	Rate of flow
R	Radius
RC	Reinforced concrete
RCP	Reinforced concrete pipe
Rd	Road
Rdwy	Roadway
Reinf	Reinforced, Reinforcing
Ret Wall	Retaining Wall
RGRCP	Rubber Gasket Reinforced Concrete Pipe
rpm	Revolutions Per Minute
Rt	Right
R/W or Row	Right-of-way
S	South or slope
SAE	Society of Automotive Engineers
San	Sanitary
SC	Spiral to Curve
SCCP	Steel cylinder concrete pipe
SD	Storm drain or Sewer District
SDDTC	Storm Drainage Design and Technical Criteria
Sdl	Saddle
Sec	Seconds
Sect	Section
SE	Southeast
SF	Square feet
Sht	Sheet
Spec	Specifications
SPR	Simplified Practice Recommendation
SpMH	Special manhole
Sq Ft Yd	Square Foot, Yard
SS	Sanitary sewer
St	Street
Sta	Station
Std	Standard
Str gr	Structural grade

Struct	Structure or structural
SW	Southwest
SY	Square Yard
T	Tangent Distance
Tel	Telephone
Temp	Temporary
TH	Test hole
TP	Telephone pole
Tr	Tract
Trans	Transition
TS	Traffic signal or Tangent to spiral
TSC	Traffic signal conduit
Typ	Typical
UD & FCD	Urban Drainage and Floor Control District
USDCM	Urban Storm Drainage Criteria Manual
UL	Underwriters Laboratories
USC&GS	United States Coast and Geodetic Survey
USGS	United States Geological Survey
V	Velocity of flow
VC	Vertical curve
VCP	Vitrified clay pipe
Vert	Vertical
W	West or width
WI	Wrought iron
WS	Wearing surface
Wt	Weight
Yd	Yard
'	feet or minutes
"	inches or seconds
o	degrees
%	percent
#	number or pound
@	at
/	per
=	equals

## 2.1.2 GENERAL DEFINITIONS AND TERMS:

Whenever in these specifications or in other contract documents the following terms or pronouns in place of them are used, the intent and meaning shall be interpreted as follows:

**Addendum:** A Supplement to any of the Contract Documents issued, in writing, after advertisement of but prior to the opening of bids for a contract.

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

**Agency:** The government agency for which the construction is being done, either by permit or contract.

**Agreement:** The written agreement between OWNER and CONTRACTOR covering the Work to be performed; other Contract Documents are made a part thereof as provided therein.

**Application for Payment:** The form accepted by the ENGINEER which is to be used by CONTRACTOR in requesting progress or final payment and which is to include such supporting documentation as required by the Contract Documents.

**Award:** The formal action of the governing body in accepting a proposal.

**Backfill:** Material placed in an excavated space to fill such space. For trenches this space will be the area from 1 foot above the top of the pipe or conduit to the existing or proposed finished grade of pavement.

**Base Course:** The upper course of the granular base of a pavement or the lower course of an asphalt concrete pavement structure.

**Bedding:** Is the material placed in the area from the bottom of the trench to 1 foot above the top of the pipe or conduit.

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

**Bidder:** Any qualified individual, firm, partnership, corporation or combination thereof, acting directly or through a duly authorized representative who legally submits a proposal for the advertised work.

**Bond Issue Project:** A project financed from bonds issued by the CITY pledging credit or a revenue resource.

**Bridge:** A structure, including supports, erected over a depression or an

obstruction, as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads and having a length measured along the center of roadway of more than 20 feet between undercopings of abutments or extreme ends of openings for multiple boxes.

(Length) The length of a bridge structure is the over-all length measured along the line of survey stationing back to back of backwalls of abutments, if present, otherwise end to end of the bridge floor; but in no case less than the total clear opening of the structure.

(Roadway Width) The clear width measured at right angles to the longitudinal centerline of the bridge between the bottom of curbs or guard timbers or in the case of multiple height of curbs, between the bottom of the lower risers.

**Budget Project:** A project financed by funds from General Tax levies and shared revenue funds set aside in the annual budget adopted by the Evans City Council.

**Building:** Any structure built for the support, shelter, or enclosure of persons, animals, chattel or movable property.

**Building Code:** A regulation adopted by the governing body establishing minimum standards of construction for the protection of the public health, safety, and welfare in terms of measured performance rather than in terms of rigid specifications of materials and methods.

**Calendar Day:** Every day shown on the calendar.

**Change Order:** A written order issued by the ENGINEER to the CONTRACTOR to make changes in the work or to perform extra work, and setting forth conditions for payment and/or adjustment in time of completion.

**City:** A municipal corporation, organized and existing under and by virtue of the laws of the State of Colorado.

**City Clerk:** The duly authorized person who performs the duties of clerk for the Contracting Agency.

**Completion Time:** The number of calendar days for completion of an act, including authorized time extensions. In case a calendar date of completion is shown in the proposal in lieu of the number of calendar days, the contract shall be completed by that date. The time within which an act is to be done shall be computed by excluding the first and including the last day; and if the last day be Sunday or a legal holiday, that shall be excluded.

**Conflicting Utility Line:** An existing utility line, shown or not shown on the drawings, is a conflicting line when any part falls within the trench pay widths as listed or within the dimensions, as shown on the drawings, for appurtenant

structures.

**Construction Project:** The erection, installation, remodeling, alteration, of durable facilities upon, under, or over the ground. This shall include, but is not limited to buildings, roadways and utility pipes, lines, poles or other structures.

**Contingent Bid Item:** This is a minor bid item which is likely, but not certain, to occur during the course of work. If the ENGINEER determines that this work is required, the CONTRACTOR will accomplish the work and payment will be made based on the contingent unit bid price included in the proposal. Since the quantity listed in the proposal is primarily for bid comparison, the amount of work required by the ENGINEER may vary materially from this.

**Contract:** The written instrument executed by the CONTRACTOR and the Contracting Agency by which the CONTRACTOR is bound to furnish all labor, equipment, and materials and to perform the work specified, and by which the Contracting Agency is obligated to compensate the CONTRACTOR therefore at the prices set forth therein. The Contract Documents are herewith by reference made a part of the contract as if fully set forth therein.

**Contract Documents:** The Agreement, Addenda (which pertain to the Contract Documents), CONTRACTOR's Bid (including documentation accompanying the Bid and any post Bid documentation submitted prior to the Notice of Award) when attached as an exhibit to the Agreement, the Bonds, these General Conditions, the Supplementary Conditions, the Specifications and the Drawings as the same are more specifically identified in the Agreement, together with all amendments, modifications and supplements issued on or after the Effective Date of the Agreement.

**Contracting Agency:** The legal entity that has contracted for the performance of the work or for whom the work is being performed.

**Contractor:** The individual, firm, partnership, corporation or combination thereof entering into a contract with the Contracting Agency to perform the advertised work.

**Council:** The City Council that by law constitutes the Legislative Department of the City organized and existing under and by virtue of the laws of the State of Colorado.

**Culvert:** Any structure not classified as a bridge, which provides an opening under or adjacent to the roadway.

**Days:** Unless otherwise designated, days will be understood to mean calendar days.

**Emergency:** Unforeseen occurrences and combinations of circumstances involving the public welfare or the protection of work already done under the Contract Documents, or which endanger life or property and call for immediate action or

remedy.

**Engineer:** The person, appointed as ENGINEER by the CITY acting directly or through his duly authorized representative.

**Equipment:** (Construction)-All machinery and equipment, together with the necessary supplies for upkeep and maintenance, and also tools and apparatus necessary for the proper construction and acceptable completion of work.

(Installed)-All material or articles used in equipping a facility as furnishings or apparatus to fulfill a functional design.

**Extra Work:** An item of work not provided for in the contract as awarded but found essential to the satisfactory completion of the contract within its intended scope.

**Field Order:** A written set of emergency instructions to the CONTRACTOR issued only where the time required for preparation and execution of a formal Change Order would result in a delay or a stoppage of work, or would allow a hazardous condition to exist.

**Flooding:** Flooding will consist of the inundation of the entire lift with water, puddled with poles or bars to insure saturation of the entire lift.

**Foundation:** For buildings or structures, this will be the substructure. For pipe this will be the native material or prepared material on which the pipe rests; normally, this is the bottom grade line of the trench.

**Full Depth Pavement:** An asphalt concrete pavement structure in which the granular base and subbase are replaced by equivalent structural thickness of asphalt concrete.

**General Conditions:** Uniform general specifications adopted as standard specifications by the ENGINEER.

**Holiday:** Holidays recognized by collective bargaining agreements in the State of Colorado are:

- New Year's Day
- Memorial Day
- Independence Day
- Labor Day
- Thanksgiving Day
- Christmas Day

Additional holidays recognizable by the State of Colorado Cities and Counties are:

- Martin Luther King's Birthday
- Presidents Day
- Columbus Day

Veteran's Day  
General Election Day in even-numbered years

When New Year's Day, Independence Day or Christmas Day fall on Sunday, the following Monday shall be considered a holiday.

Additional legal holidays, when designated by the State Governor or President of the United States, will also be recognized by the State, City and/or County.

**Improvement District Project:** A project financed by assessments against the property included in a special assessment district authorized under, or implemented by an act of the legislature of the State and/or a procedural ordinance of the City or County.

**Inspector:** The ENGINEER's authorized representative assigned to make detailed inspections of contract performance.

**Jetting:** Jetting is the densification of material, using a continuous supply of water, under pressure, transmitted to the material through a rigid pipe of sufficient length to reach the bottom of the lift being densified. In all cases, the entire lift will be completely saturated working from the top to the bottom.

**Laboratory:** The established materials testing laboratory of the Contracting Agency's Engineering Department, or other laboratories acceptable to and/or authorized by the ENGINEER to test materials and work involved in the Contract.

**Liquidated Damages:** A daily charge made against the CONTRACTOR for each working day, including free time, that any work shall remain uncompleted after elapse of Contract time.

**Major Item:** Any item of work and/or materials having an original contract value that exceeds ten percent of the amount of the original contract.

**Materials:** Any substance specified in the project, equipment and other material used or consumed in the performance of the work.

**Median:** The portion of a divided highway separating the roadways used by traffic going in opposite directions.

**Method of Measurement:** The manner in which a "Pay Item" is measured to conform to the "Pay Unit."

**Non Pay Item:** An item of work for which no separate payment will be made under the proposal, but which must be included as an incidental cost for payment on an associated pay item included in the proposal.

**Notice of Award:** A letter from the CITY advising the CONTRACTOR that he is the

successful Bidder and the Evans City Council has accepted his proposal.

**Notice to Bidders:** The standard forms inviting proposals or bids.

**Notice to Proceed:** A directive issued by the Engineer, authorizing the CONTRACTOR to start the work or improvements required in the Contract.

**Obligee:** One to whom another is obligated. For bonding purposes, the OWNER is the obligee.

**Open Trench:** The excavated area shall be considered as open trench until all the aggregate base course for pavement replacement has been placed and compacted or, if outside of a pavement area, until the excavated area is brought to finish grade or natural grade.

**Owner:** City of Evans, State of Colorado, acting through its legally constituted officials, officers or employees.

**Pavement:** Any surface of streets, alleys, sidewalks, courts, driveways, etc., consisting of mineral aggregate bound into a rigid or semi-rigid mass by a suitable binder such as, but not limited to, portland cement or asphalt cement.

**Pavement Structure:** The combination of sub-base, base course, and surface course placed on a sub-grade to support the traffic load and distribute it to the roadbed.

**Pay Item:** A detail of work for which individual payments are to be made under the Contract, as specified in the proposal.

**Payment Bond:** The security provided by the CONTRACTOR solely for the protection of claimants, supplying labor and materials to the CONTRACTOR or his Subcontractors.

**Performance Bond:** The security by the CONTRACTOR solely for the protection of the Contracting Agency and conditioned upon the faithful performance of the contract in accordance with the contract documents, drawings, specifications and conditions thereof.

**Permit:** The license to do construction in public rights-of-way and/or easements; issued by an Agency to a CONTRACTOR working for another party.

**Plans:** All approved drawings or reproductions thereof pertaining to the work and details therefor, which are made a part of the Project Manual and Contract Documents.

**Plant:** The Contractors' and/or subcontractors' facilities, including but not limited to small tools and mobile equipment, located on and/or offsite, necessary for

preparation of materials and prosecution of work for the project.

**Principal:** The individual, firm or corporation primarily liable on an obligation, as distinguished from a surety.

**Profile Grade:** The trace of a vertical plane intersecting the top surface of the proposed wearing surface, usually along the longitudinal centerline of the roadbed. Profile grade means either elevation or gradient of such trace according to the context.

**Project:** A specific coordinated construction or similar undertaking identified by a single project number and bid and awarded as one contract. On occasion two or more projects may be bid and awarded as a single contract.

**Project Manual:** All the integral documents of the contract including but not limited to, Contract Documents, General Conditions, Supplemental Conditions, Specifications and drawings.

**Project Supplemental Conditions:** See definition for Supplemental Conditions.

**Proposal:** The offer of a bidder on the prescribed form, to perform the work and to furnish the labor and materials at the prices quoted.

**Proposal Form:** The approved form on which the Contracting Agency requires bids to be prepared and submitted for the work.

**Proposal Guarantee:** The security furnished with a bid to guarantee that the bidder will enter into the contract if his bid is accepted.

**Proposal Pamphlet:** The book or pamphlet pertaining to a specific project, containing proposal forms, special provisions and other information necessary for and pertinent to the preparation of the proposal or bid.

**Referred Documents:** On all work authorized by the Contracting Agency, any referenced documents in the specification, i.e., Bulletins, Standards, Rules, Methods of Analysis or test. Codes and Specifications of other Agencies, Engineering Societies or Industrial Associations, refer to the Latest Edition thereof, including Amendments, which are in effect and published at the time of Advertising for Bids or the issuing of a permit for the work, unless otherwise stated.

**Resident Project Representative:** The authorized representative of ENGINEER who may be assigned to the site or any part thereof. Also called the Inspector.

**Reasonably Close Conformity:** Compliance with reasonable and customary manufacturing and construction tolerances where working tolerances are not specified. Where working tolerances are specified, reasonably close conformity means compliance with such working tolerances.

**Right-of-Way:** A general term denoting, land, property or interest therein, usually in a strip, acquired for or devoted to a street, highway, or other public improvement.

**Road:** A general term denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way.

**Roadside:** A general term denoting the area adjoining the outer edge of the roadway. Extensive areas between the roadways of a divided highway may also be considered roadside.

**Roadside Development:** Those items necessary to the complete roadway that provide for the preservation of landscape materials and features; the rehabilitation and protection against erosion of all areas disturbed by construction through seeding, sodding, mulching and the placing of other ground covers; such suitable planting and other improvements as may increase the effectiveness and enhance the appearance of the roadway.

**Roadway:** The portion of the right-of-way intended primarily for vehicular traffic, and including all appurtenant structures and other features necessary for proper drainage and protection. Where curbs exist, it is that portion of roadway between the faces of the curbs.

**Salvageable Material:** Material that can be saved or salvaged. Unless designated or directed by the ENGINEER or shown on the drawings, all salvageable material shall remain the property of the CONTRACTOR.

**Sewers:** Conduits and related appurtenances employed to collect and carry off water and waste matter to a suitable point of final discharge.

**Shop Drawings:** Drawings or reproduction of drawings, detailing; fabrication and erection of structural elements, falsework and forming for structures, fabrication of reinforcing steel, installed equipment and installation of systems, or any other supplementary drawings or similar data, which the CONTRACTOR is required to submit for approval.

**Shoulder:** The portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles, for emergency use, and for lateral support of base and surface courses.

**Sidewalk:** That portion of the roadway primarily constructed for the use of pedestrians.

**Supplemental Conditions:** The special conditions, requirements, additions, and/or revisions to the General Conditions and Standard Specifications, applicable to the work, to cover conditions or requirements peculiar to the project under consideration. Supplemental Conditions fall within one of the two following

categories and take precedence over the General Conditions.

(a) **Project Special Conditions.** Special Conditions peculiar to the project and not otherwise thoroughly nor appropriately set forth in the general conditions or standard specifications or drawings.

(b) **Standard Special Conditions.** Special directions or requirements not otherwise thoroughly or appropriately set forth in the standard specifications, and which are peculiar to a selected group of projects or which are intended for temporary use.

**Specifications:** The descriptions, directions, provisions, and requirement for performing the work as contained in the Contract Documents.

**State:** The State of Colorado.

**Standard Details:** Uniform detail drawings of structures or devices adopted as Standard Details by the ENGINEER.

**Standard:** Uniform general specifications adopted as Standard Specifications by the ENGINEER.

**Storm Drain:** Any conduit and appurtenance intended for the reception and transfer of stormwater.

**Street:** Streets, avenues, alleys, highways, crossings, lanes, intersections, courts, places, and grounds now open or dedicated or hereafter opened or dedicated to public use and public ways.

**Structures:** Bridges, culverts, catch basins, drop inlets, retaining walls, cribbing, manholes, endwalls, sewers, service pipes, underdrains, foundation drains, fences, swimming pools, and other features which may be encountered in the work and not otherwise classed herein.

**Sub-base:** The lower course of the base of a roadway, immediately above the sub-grade.

**Subcontractors:** Those having direct contracts with the CONTRACTOR and those who furnish material worked into a special design according to the Drawings and Specifications for the work, but not those who merely furnish material not so worked.

**Sub-grade:** The supporting structures on which the pavement and its special undercourses rest.

**Substantial Completion:** The work (or a specified part thereof) has progressed to the point where, in the opinion of ENGINEER and OWNER as evidenced by a letter of Substantial Completion, it is sufficiently complete, in accordance with the Contract

Documents, so that the Work (or specified part) can be utilized for the purposes for which it was intended. The terms "substantially complete" and "substantially completed" as applied to any work refer to Substantial Completion thereof. The work must meet the following criteria for Substantial Completion to apply:

- X At least 90% of all pay items have been completed and are eligible for payment.
- X The facilities constructed by CONTRACTOR are ready for use.
- X All traffic features have been completed.
- X A list of incomplete work items has been issued by the OWNER or ENGINEER to the CONTRACTOR and the CONTRACTOR has accepted and acknowledge the list.

**Substructure:** All of that part of the structure or building below the bearings of simple and continuous spans, skewbacks of arches and tops of footings of rigid frames, together with the backwalls, wingwalls, and wing protection railings.

**Superintendent:** The Contractor's authorized representative in responsible charge of the work.

**Superstructure:** The entire structure or building except the substructure.

**Supplemental Specifications:** Additions and revisions to the Standard Specifications that are adopted subsequent to issuance of the printed Project Manual.

**Surety:** The individual, firm or corporation, bound with and for the CONTRACTOR for the acceptable performance, execution, and completion of the work, and for the satisfaction of all obligations incurred.

**Surface Course:** The finish or wearing course of an asphalt concrete pavement structure.

**Title or Headings:** The titles or headings or the sections and subsections herein are intended for convenience of reference and shall not be considered as having any bearing on their interpretation.

**Township, City, Town or District:** A subdivision of the COUNTY used to designate or identify the location of the proposed work.

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

**Utility:** Pipe lines, conduits, ducts, transmission lines, overhead or underground wires, railroads, storm drains, sanitary sewers, irrigation facilities, street lighting traffic signals, and fire alarm systems, and appurtenances of public utilities and those of private industry, businesses or individuals solely for their own use or use of

their customers which are operated or maintained in, on, under, over or across public right-of-way or public or private easement.

**Waterworks (Water Supply System):** The reservoirs, pipe lines, wells, pumping equipment, purification works, mains, service pipes, and all related appliances and appurtenances utilized in the procurement, transportation and delivery of an adequate, safe, and palatable water supply for the Contracting Agency.

**Work:** Any of all of the improvements mentioned and authorized to be made, and the construction, demolition, reconstruction, and repair of all or any portion of such improvements, and all labor, services, incidental expenses, and material necessary or incidental thereto.

**Working Day:** A calendar day, exclusive of Saturdays, Sundays and Contracting Agency recognized legal holidays, on which weather and other conditions not under the control of the CONTRACTOR will permit construction operations to proceed for the major part of the day with the normal working force engaged in performing the controlling item or items of work which would be in progress at that time.

## **2.2 GENERAL CONTRACT REQUIREMENTS**

### **2.2.1 FAMILIARITY WITH WORK**

The CITY has endeavored to ascertain all pertinent information regarding site conditions, and subsurface conditions, and has, to the best of his ability, furnished all such information to the CONTRACTOR. Such information is given, however, as being the best factual information available to the CITY, but is advisory only. The CONTRACTOR, by careful examination, shall satisfy himself as to the nature and location of the work, the character of equipment and facilities needed preliminary to and during the prosecution of the work, the general and local conditions, and all other matters that can in any way affect the work under this Contract.

Bidder shall examine the site of the proposed work and all documents pertaining to the work. It is mutually agreed that the submission of a proposal shall be considered prima facie evidence that the bidder has made such examination and is familiar with the character, quality and quantity of the work to be performed and material to be furnished.

Logs of test hole, ground water levels, and any accompanying soil reports as furnished by the Contracting Agency are furnished for general information only. The field condition so set forth shall not constitute a representation or warranty, expressed or implied, that such conditions are actually existent. Bidders shall make their own investigations and form their own estimates of the site conditions. After the submission of the proposal, no complaint or claim that there was any misunderstanding as to the quantities, conditions or nature of the work will be entertained.

### **2.2.2 CHANGED CONDITIONS**

The CONTRACTOR shall promptly, and before such conditions are disturbed, except in the event of any emergency, notify the CITY in writing of: (1) Subsurface or latent physical conditions at the site differing materially from those indicated in this Contract; or (2), previously unknown physical or other conditions at the site, of an unusual nature, not generally recognized as inherent in work of the character provided for in this Contract. The ENGINEER shall promptly investigate the conditions, and if he finds that such conditions do so materially differ and cause an increase or decrease in the cost of, or the time required for, performance of this Contract, an equitable adjustment shall be made and the Contract modified in writing accordingly. Any claim of the CONTRACTOR for adjustment hereunder shall not be allowed unless he has given notice as above required, provided that the ENGINEER may, if he determines the facts so justify, consider and adjust any such claims assessed before the date of final settlement of the Contract. If the parties fail to agree upon the adjustment to be made, the dispute shall be determined as provided in Paragraph 2.2.33 hereof.

### **2.2.3 ORDER OF COMPLETION**

The CONTRACTOR shall submit, at such times as may reasonably be requested by the ENGINEER, schedules which shall show the order in which the CONTRACTOR proposes to carry on the work, with dates at which the CONTRACTOR will start the several parts. The special provisions or plans may require that certain phases or parts of the work be completed first or in a certain order. If the CONTRACTOR elects to use PERT or CPM charts, he shall furnish copies of them to the ENGINEER upon request.

### **2.2.4 DESIGN AND INSTRUCTIONS**

It is agreed that the CITY will be responsible for the adequacy of design and Specifications. The CITY, through the ENGINEER, shall furnish Specifications, which adequately represent the requirements of the work to be performed under the Contract. All such instructions shall be consistent with the Contract Documents and shall be true developments thereof. Specifications that adequately represent the work to be done shall be furnished prior to the time of entering into the Contract. The ENGINEER may, during the life of the Contract, and in accordance with Paragraph 2.2.15, issue additional instructions, by means of drawings or other media, necessary to illustrate changes in the work.

### **2.2.5 SURVEYS**

The CITY has provided a suitable number of bench marks adjacent to the work. From the information provided by the CITY, the CONTRACTOR shall develop and make all detail surveys needed for construction, such as slope stakes, batter boards, stakes for pile locations, and other working points, lines, and elevations. The CONTRACTOR shall be responsible for any mistakes made in his detail surveys.

The CONTRACTOR shall carefully preserve bench marks, reference points and stakes, and in case of willful or careless destruction, he shall be charged with the resulting expense and shall be responsible for any mistakes that may be caused by their necessary loss or disturbance.

### **2.2.6 CLAIMS**

If the CONTRACTOR claims that any instructions by drawings or otherwise, issued after the date of the Contract, involve extra cost under the Contract, he shall give the ENGINEER written notice thereof within ten (10) days, after the receipt of such instruction, and in any event before proceeding to execute the work, except emergency endangering life or property, and the procedure shall than be as provided for changes in the work. No such claim shall be valid unless so made.

### **2.2.7 EXECUTION AND CORRELATION OF DOCUMENTS**

The Agreement shall be signed in duplicate by the CITY and the CONTRACTOR.

The Contract Documents are complimentary and what is called for by anyone shall be as

binding as if called for by all. In case of conflict between Drawings and Specifications, the Specifications shall govern. Special Specifications shall govern over Standard Specifications. Materials or work described in words which so applied have a well-known technical or trade meaning shall be held to refer to such recognized standards.

### **2.2.8 MATERIALS AND APPLIANCES**

Unless otherwise stipulated, the CONTRACTOR shall provide and pay for all materials, labor, water, tools, equipment, light, power, transportation and other facilities necessary for the execution and completion of work. The CONTRACTOR shall, if required, furnish satisfactory evidence as to the kind and quality of materials.

### **2.2.9 EMPLOYEES**

The CONTRACTOR shall, at all times, enforce strict discipline and good order among his employees, and shall seek to avoid employing, for the Contract, any unfit person or anyone not skilled in the work assigned to him.

Adequate sanitary facilities shall be provided by the CONTRACTOR.

Employees of the CONTRACTOR and/or any subcontractor working on the project shall not be considered as employees of the City of Evans, nor shall they be entitled to any of the benefits provided to City of Evans employees.

### **2.2.10 ROYALTIES AND PATENTS**

The CONTRACTOR shall pay all applicable royalties and license fees. He shall defend all suits or claims for infringement for any patent rights and save the CITY harmless from loss on accounts thereof, except that the CITY shall be responsible for any such loss when a particular process, design, or the product of a particular manufacturer or manufacturers is specified, unless the CITY has notified the CONTRACTOR prior to the signing of the Contract that the particular process, design, or product is patented or is believed to be patented.

### **2.2.11 PERMITS, LICENSES AND REGULATIONS**

Permits and licenses of a temporary nature, necessary for the prosecution of the work, shall be secured and paid for by the CONTRACTOR. Permits, licenses and easements for permanent structures or permanent changes in existing facilities shall be secured and paid for by the CITY, unless otherwise specified. The CONTRACTOR shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the work as drawn and specified. If the CONTRACTOR observes that the Specifications are at variance therewith, he shall promptly notify the ENGINEER in writing, and any necessary changes shall be adjusted in the Contract for changes in the work.

### **2.2.12 INSPECTION OF WORK**

All materials and equipment used in the construction of the project shall be subject to adequate testing in accordance with generally accepted standards as required by the Contract Documents.

The CITY shall provide sufficient competent personnel, working under qualified supervision for the inspection of the work, while such work is in progress, to ascertain that the completed work will comply in all respects with the standards and requirements set forth in the Specifications. The inspection of the Contract will be as it relates to the compliance with the Specifications, quality of workmanship, and material. Notwithstanding such inspection, the CONTRACTOR will be held responsible for the acceptability of the work.

The ENGINEER and his representatives shall at all times have access to work whenever it is in preparation or progress, and the CONTRACTOR shall provide proper facilities for such access and for inspection.

If the Specifications, the ENGINEER's instructions, laws, ordinances, or any public authority require any work to be specially tested or approved, the CONTRACTOR shall give the ENGINEER timely notice to its readiness for inspection, and if the inspection is by an authority other than the ENGINEER, a date shall be fixed for such an inspection. Inspections by the ENGINEER shall be promptly made, and where applicable, at the source of supply. Any work required by the ENGINEER to be uncovered for examination shall be properly restored at the CONTRACTOR's expense unless the ENGINEER has unreasonably delayed inspection.

Re-examination of any work may be ordered by the ENGINEER, and if so ordered, the work must be uncovered by the CONTRACTOR. If such work is found to be in accordance with the Contract Documents, the CITY shall pay the cost of re-examination. If such work is not in accordance with the Contract Document, the CONTRACTOR shall pay such cost.

### **2.2.13 SUPERINTENDENTS**

The CONTRACTOR shall keep on his work at all times during its progress, competent superintendents and/or responsible assistants. The superintendent shall represent the CONTRACTOR and all directions given to him shall immediately be confirmed in writing to the CONTRACTOR. Superintendent shall be named in writing by CONTRACTOR at the beginning of the work.

### **2.2.14 PRECONTRACT EXAMINATION AND DISCOVERY OF DISCREPANCIES DURING WORK**

Before submitting his proposal, the CONTRACTOR will examine all construction plans and the entire and complete specifications. The CONTRACTOR will become well and fully informed as to the materials and the character of the work required, the relationship of all of the particular parts of the work, and he will visit and inspect the site, observing and examining the conditions existing.

After the execution of the Contract, no consideration will be granted for any misunderstanding of the materials to be furnished or the work to be done, it being mutually understood that the tender of the proposal carried with it an agreement to this end and all other conditions mentioned in the Contract and the Specifications, and implied a full and complete understanding of them and all construction plans, drawings, notes, indications, and requirements.

Should anything be omitted from the construction plans or specifications necessary to the proper completion of the work herein described, it shall be the duty of the CONTRACTOR to so notify the CITY before signing the Contract, and in the event of failure of the CONTRACTOR to give such notice, he shall make good any damage or defect in his work caused thereby without extra charge. No allowance will be made for lack of full knowledge of all conditions, except such underground conditions as are determined after commencement of the work and were unknown to the CONTRACTOR.

If the CONTRACTOR, in the course of the work, finds any discrepancy between the Specifications and the physical conditions of the locality, or any errors or omissions in the layout as given by survey points and instruction, he shall immediately inform the ENGINEER, in writing, and the ENGINEER shall promptly verify the same. Any work done after such discovery, until authorized, will be done at the CONTRACTOR's risk, except in the event of an emergency.

#### **2.2.15 CHANGES IN THE WORK**

At any time by written order, the CITY may make changes in the Specifications or scheduling of the Contract within the general scope. All such work shall be executed under the time constraints of the original contract except that any claim for extension of time caused thereby shall be allowed and adjusted at the time of ordering such change or at such time as it can be ascertained.

In giving instruction, the ENGINEER shall have authority to make minor changes in the work not involving extra cost, and not inconsistent with the purpose of the work. Except in an emergency endangering life and property, no claim for an addition to the contract sum shall be valid unless the additional work was so ordered by the ENGINEER.

The CONTRACTOR shall proceed with the work as changed and the value of any such work or change shall be determined as provided for in the Agreement herein.

The CITY may at any time, as the need arises, order changes within the scope of the work without invalidating the Agreement. If such changes increase or decrease the amount due under the Contract Documents, or in the time required for performance of the work, the CONTRACTOR shall perform the same at the unit prices or lump sum indicated in the bid. Changes may occur to a maximum of twenty-five percent (25%) of the contract price. After exceeding twenty-five percent (25%), the applicable unit price or lump sum may be negotiable and an equitable adjustment shall be authorized by change order.

### **2.2.16 EXTENSION OF TIME**

a. Extension of time stipulated in the Contract for completion of the work will be made when changes in the work occur, as provided in Paragraph 2.2.15; when the work is suspended as provided in Paragraph 2.2.17; and when the work of the CONTRACTOR is delayed on account of conditions which could not have been foreseen, or which were beyond the control of the CONTRACTOR, his subcontractors or suppliers, and which were not the result of their fault or negligence.

Extension of time for completion shall also be allowed for any delays in the progress of the work that in the opinion of the ENGINEER entitles the CONTRACTOR to an extension of time.

b. The CONTRACTOR shall notify the ENGINEER promptly of any occurrence or condition which in the CONTRACTOR's opinion entitles him to an extension of time. Such notice shall be in writing and shall be submitted in ample time to permit full investigation and evaluation of the CONTRACTOR's claim. Failure to provide such notice shall constitute a waiver by the CONTRACTOR of any claim.

### **2.2.17 SUSPENSION OF WORK**

The CITY may at anytime suspend the work, or any part thereof, by giving three (3) days' notice to the CONTRACTOR in writing.

### **2.2.18 THE CITY'S RIGHT TO TERMINATE CONTRACT**

If the CONTRACTOR should be adjudged bankrupt, or if he should make a general assignment for the benefit of his creditors, or if a receiver should be appointed as a result of his insolvency, or if he should persistently or repeatedly refuse or should fail, except for cases in which extensions of time are provided, to supply enough properly-skilled workmen or materials, or if he should fail to make payments to subcontractors or for materials or labor so as to affect the progress of the work or persistently be guilty of a substantial violation of the Contract, then the CITY, upon written notice from the ENGINEER that sufficient cause exists to justify such action and without prejudice to any other right or remedy, and after giving the CONTRACTOR and his Surety seven (7) days' written notice, terminate the employment of the CONTRACTOR and take possession of the premises and of all materials, tools, equipment and other facilities installed on the work and paid for by the CITY, and finish the work by whatever method the ENGINEER may be deem expedient.

In such case, the CONTRACTOR shall not be entitled to receive any further payment until the work is finished. If the unpaid balance of the contract price shall exceed the expense of finishing the work, including compensation for additional managerial and administrative services, such excess shall be paid to the CONTRACTOR. If such expense shall exceed such unpaid balance, the CONTRACTOR shall pay the difference to the CITY. The expense incurred by the CITY as herein provided, and the damage incurred through the CONTRACTOR's default, shall be certified by the ENGINEER.

Where the Contract has been terminated by the CITY, said termination shall not affect or terminate any of the rights of the CITY then existing or which may thereafter accrue because of such default as against the CONTRACTOR or his Surety. Any retention or

payment of moneys by the CITY due to the CONTRACTOR under the terms of the Contract, shall not release the CONTRACTOR or his Surety from liability for the CONTRACTOR's default.

#### **2.2.19 CONTRACTOR'S RIGHT TO STOP WORK OR TERMINATE CONTRACT**

If the work should be stopped under an order of any court, or other public authority, for a period of more than three (3) months, through no act or fault of the CONTRACTOR of an undisputed sum with forty-five (45) days of its maturity and presentation, then the CONTRACTOR may, upon seven (7) days' written notice to the ENGINEER, stop work or terminate this Contract and recover from the CITY payment for all work executed, plus any loss sustained upon any plant or materials, plus reasonable profit and damages.

#### **2.2.20 CANCELLATION OF CONTRACT**

Failure of the CONTRACTOR to comply with any of the requirements of the Contract and the Specifications may be considered as evidence of the inability on the part of the CONTRACTOR to maintain the quality and service standards deemed necessary, and shall be sufficient cause for the cancellation of the Agreement and the initiating of legal action against the Performance Bond of the CONTRACTOR.

#### **2.2.21 CORRECTION OF WORK BEFORE FINAL PAYMENT**

The CONTRACTOR shall promptly remove from the premises all materials and work condemned by the ENGINEER as failing to meet contract requirements, whether incorporated in the work or not, and the CONTRACTOR shall promptly replace and re-execute his own work in accordance with the Contract and without expense to the CITY and shall bear the expense of making good all work of other CONTRACTORS destroyed or damaged by such removal or replacement.

All removal and replacement work shall be done at the CONTRACTOR's expense. If the CONTRACTOR does not take action to remove such condemned work and materials within ten (10) days after written notice, the CITY may remove them and store the material at the expense of the CONTRACTOR. If the CONTRACTOR does not pay the expense of such removal and storage within ten (10) days' time thereafter, the CITY may, upon ten (10) days' written notice, sell such materials at auction or at private sale and shall pay the CONTRACTOR any net proceeds thereof, after deducting all costs and expenses that should have been borne by the CONTRACTOR.

#### **2.2.22 REMOVAL OF EQUIPMENT**

In the case of termination of this Contract before completion for whatever cause, the CONTRACTOR, if notified to do so by the CITY, shall promptly remove any part or all of his equipment and supplies from the property of the CITY, failing which, the CITY shall have the right to exercise control over and to remove such equipment and supplies at the expense of, and without recourse, by the CONTRACTOR.

### **2.2.23 RESPONSIBILITY FOR WORK**

The CONTRACTOR assumes full responsibility for the work. Until final acceptance, the CONTRACTOR shall be responsible for damage to or destruction of the work, except for any part covered by partial acceptance as set forth in Paragraph 2.2.24 and except such damage or destruction that is caused by the negligent or willful acts of the CITY.

### **2.2.24 PARTIAL COMPLETION AND ACCEPTANCE**

If at any time prior to the issuance of the final certificate, referred to in Paragraph 2.2.34 hereinafter, any portion of the permanent construction has been satisfactorily completed to the ENGINEER's satisfaction, and if the ENGINEER determines that such portion of the permanent construction is not required for the operations of the CONTRACTOR, but is needed by the CITY, the ENGINEER shall issue to the CONTRACTOR a Certificate of Partial Completion, and thereupon or at any time thereafter, the CITY may take over and use the portion of the permanent construction described in such certificate.

The issuance of a Certificate of Partial Completion shall not be construed to constitute an extension of the CONTRACTOR's time to complete the portion of the permanent construction to which it relates, if he fails to complete it in accordance with the terms of this Contract. The issuance of such a certificate shall not operate to release the CONTRACTOR or his Sureties from any obligations under this Contract or the Performance Bond.

If such prior use increases the cost of or delays the work, the CONTRACTOR shall be entitled to extra compensation, or extension of time, or both, as the ENGINEER may determine, unless otherwise provided.

### **2.2.25 PAYMENT WITHHELD PRIOR TO FINAL ACCEPTANCE OF WORK**

As a result of subsequently discovered evidence, the CITY may withhold or nullify the whole or part of any certificate of payment to such extent as may be necessary to protect himself from loss occasioned by:

- (a) Defective work not remedied by the CONTRACTOR
- (b) Claims filed or reasonable evidence indicating probable filing of claims by other parties against the CONTRACTOR for work done on the project
- (c) Failure of the CONTRACTOR to make payments properly to subcontractors or for material or labor
- (d) Damage by the CONTRACTOR to subcontractors or to another contractor

When the above grounds are removed, or the CONTRACTOR provides Surety Bond satisfactory to the CITY that will protect the CITY in the amount withheld, payment shall be made for amounts withheld because of them. No moneys may be withheld under (b) and

(c) if a Payment Bond is included in the Contract.

### **2.2.26 CONTRACTOR'S INSURANCE AND INDEMNIFICATION**

The CONTRACTOR shall secure and maintain such insurance policies as will protect himself, his subcontractors, and City of Evans, its employees and agents, from claims for bodily injuries, death, or property damage, which may arise from operations under this Contract, whether such operations be by himself or by any subcontractor or anyone employed by them directly or indirectly. The following insurance policies are required and must be evidenced by Certificates of Insurance:

(a) Statutory Workers' Compensation

(b) Commercial General Liability

General Aggregate	\$1,200,000
Products/ (Completed Operations Aggregate)	\$1,200,000
Each Occurrence	\$ 600,000
Personal & Advertising Injury	\$ 600,000
Fire Damage	\$ 50,000
Medical Expense	\$ 5,000

(c) Automobile Liability

Bodily Injury and Property Damage (Combined Single Limit)	\$ 600,000
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Certificates of Insurance must show "City of Evans, its employees and agents" as an Additional Insured.

All policies shall be for not less than the amount set forth above or as stated in the Special Conditions. Other forms of insurance shall also be provided if called for by the Special Conditions.

All Certificates of Insurance must be filed with the ENGINEER along with the Performance and Payment Bonds and shall be subject to his approval as to adequacy of protection, within the requirements as stated herein. Said Certificates of Insurance shall contain a thirty (30) days' written notice of cancellation in favor of the CITY.

The CONTRACTOR shall indemnify and hold harmless the City of Evans, its employees and agents, from and against any and all claims, damages, losses, injuries and expenses, including attorney's fees, arising out of or resulting from the performance of work.

All insurance and bonding companies providing coverage or surety under this contract shall have a Best Insurance Rating of "A" or better.

### **2.2.27 SURETY BONDS**

The CITY shall have the right, prior to the signing of the Contract, to require the CONTRACTOR to furnish Payment and Performance Bonds in such form as the CITY may prescribe in the bidding documents and executed by one or more financially responsible Sureties licensed to do business in the State of Colorado. The premiums for said Bonds shall be paid by the CONTRACTOR. Such Bonds shall cover the entire Contract amount, regardless of changes therein, shall remain in full effect for a period of one year from the date of issuance of a Certificate of Completion, and shall be filed with the ENGINEER prior to the commencement of any work on the project.

### **2.2.28 CONTRACTOR'S INSURANCE**

The CONTRACTOR shall secure and maintain insurance to one hundred percent (100%) of the insurable value of the entire work in the Contract and any structures attached or adjacent thereto against fire, earthquake, flood, and other perils as he may deem necessary and shall name the CITY and subcontractors as Additional Insured.

All insurance and bonding companies providing coverage or surety under this contract shall have a Best Insurance rating of "A" or better.

### **2.2.29 ASSIGNMENT**

Neither party to the Contract shall assign the Contract or sublet it as a whole without the written consent of the other and its Surety, nor shall the CONTRACTOR assign any moneys due or to become due to him hereunder, except to a bank or financial institution acceptable to the CITY.

### **2.2.30 RIGHTS OF VARIOUS INTERESTS**

Wherever work being done by the CITY's forces, utility companies, or by other CONTRACTOR's forces is contiguous to work covered by this Contract, the respective rights of the various interest invoiced shall be established by the ENGINEER, to secure the completion of the various portions of the work in general harmony.

(a) Before issuance of final payment, the CONTRACTOR, if required in the Special Conditions, shall certify in writing to the ENGINEER that all payrolls, material bills, and other indebtedness connected with the work, have been paid or otherwise satisfied. If the Contract does not include a payment Bond the CONTRACTOR may submit, in lieu of certification of payment, a Surety Bond in the amount of the disputed indebtedness or liens, guaranteeing payment of all such disputed amounts, including all related costs and interest in connection with said disputed indebtedness or liens, which the CITY may be compelled to pay upon adjudication.

(b) The making and acceptance of the final payment shall constitute a waiver of all claims by the CITY, other than those arising from unsettled liens, from faulty work appearing within the guarantee period, provided in the Special Conditions, from the requirements of the Drawings and Specifications, or from manufacturer's guarantees. It shall also constitute a waiver of all claims by the CONTRACTOR, except those previously made and still

unsettled.

(c) If after the work has been substantially completed, full completion thereof is materially delayed through no fault of the CONTRACTOR, and the ENGINEER so certifies, the CITY shall, upon certificate of the ENGINEER, and without terminating the Contract, make payment of the balance due for that portion of the work fully and completed and accepted. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

(d) If the CITY fails to make payment as herein provided, there shall be added to each payment daily interest at the rate of six percent (6%) per annum commencing on the first day after said payment is due and continuing until the payment is delivered or mailed to the CONTRACTOR.

### **2.2.31 ENGINEER'S STATUS**

The ENGINEER shall perform technical inspection of the work. He has authority to stop the work whenever such stoppage may be necessary to insure the proper execution of the Contract. He shall also have authority to reject all work and materials which do not conform to the Contract and to decide questions which arise in the execution of the work.

### **2.2.32 ENGINEER'S DECISIONS**

The ENGINEER shall, within a reasonable time after their presentation to him, make decisions in writing on all claims of the CONTRACTOR and on all other matters relating to the execution and progress of the work or the interpretation of the Contract Documents.

### **2.2.33 ARBITRATION**

Any controversy or claim arising out of or relating to this Contract, or the breach thereof, which cannot be resolved by mutual agreement, shall be settled by arbitration in accordance with the Rules of the American Arbitration Association, and judgment upon the award rendered by the Arbitrator(s) may be entered in any court having jurisdiction thereof.

### **2.2.34 ACCEPTANCE AND FINAL PAYMENT**

Upon receipt of written notice that the work is substantially complete or ready for final inspection and acceptance, the ENGINEER will promptly make such inspection and when he finds the work acceptable under the Contract and the Contract fully performed or substantially completed, he shall promptly issue a certificate, over his own signature, stating that the work required by this Contract has been substantially completed and is accepted by him under the terms and conditions thereof, and the entire balance found to be due the CONTRACTOR, including the retained percentage, unless a retention based on the ENGINEER's estimate of the fair value of the claims against the CONTRACTOR and the cost of completing the uncompleted or unsatisfactory items of work with specified amounts for each incomplete or defective item of work, is due and payable. No final payment shall be made by the CITY unless and until the CONTRACTOR has certified in writing to the ENGINEER that all payroll, material bills, and other indebtedness connected with the work have been paid or otherwise satisfied.

The making and acceptance of the final payment shall constitute a waiver of all claims by the CITY, other than those arising from unsettled liens, from faulty work appearing within the guarantee period provided in the Special Conditions, from the requirements of the Drawings and Specifications, or from the manufacturer's guarantees. It shall also constitute a waiver of all claims by the CONTRACTOR, except those previously made and still unsettled.

If, after the work has been substantially completed, full completion thereof is materially delayed through no fault of the CONTRACTOR and the ENGINEER so certifies, the CITY shall, upon certificate of the ENGINEER, and without terminating the Contract, make payment of balance due for that portion of the work fully completed and accepted. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

The CONTRACTOR shall cause appropriate provisions to be inserted in all subcontracts relative to the project to bind the subcontractors to the CONTRACTOR by the terms of the Contract Documents, and to give the CONTRACTOR the same power as regard to terminating any subcontract that the CITY may exercise over the CONTRACTOR under any provision of the Contract Documents.

Nothing contained in this Agreement shall create any contractual relationship between any subcontractor and the CITY.

Subcontracts, or transfer of Contract, shall not release the CONTRACTOR of his liability under the Contract and Bonds.

**2.2.35 LIQUIDATED DAMAGES**

The CONTRACTOR agrees that he can and will complete the project within the prescribed time limit as stated in Article 1.5.9 (Notice to Proceed) and within the time as may be extended. In the event the CONTRACTOR fails to complete the work within the allotted time limit, the following liquidated damages will be applied:

From More Than	Original Contract Amount To And Including	Daily Charge
\$ 0	\$ 25,000	\$ 85
25,000	50,000	140
50,000	100,000	205
100,000	500,000	280
500,000	1,000,000	420
1,000,000	2,000,000	560
2,000,000	4,000,000	840
4,000,000	8,000,000	1,120
8,000,000	10,000,000	1,400

These rates will be assessed per calendar day for each day which the CONTRACTOR fails to finish the work in excess of the time period allotted. The parties agree that the liquidated

damages, as stated herein, are not a penalty and are reasonable, given the expected harm from a delay in completion, the difficulty of proving actual loss, and the inadequacy of any other remedy.

### **2.2.36 ADVANCE NOTICE**

It shall be the responsibility of the CONTRACTOR to notify the ENGINEER or inspector sufficiently in advance of his operations to enable the ENGINEER or inspector to set the required control stakes and marks.

In order to assure proper availability of construction supervision or other personnel from the ENGINEER's staff, the following notices will be required as minimums:

- (a) One (1) week notice for major additions or modifications to construction staking.
- (b) Two (2) working days' notice for all staking except for emergencies.
- (c) Two (2) days' written notice shall be delivered to the ENGINEER or inspector prior to any work done on Saturday, Sunday, nights, and legal holidays.

The failure of the CONTRACTOR to provide minimum notices will not be considered for time extensions or extra compensations.

### **2.2.37 WORK DONE WITHOUT LINES OR GRADES**

Any work done without having been properly located and established as determined by the Engineer may be ordered removed and replaced at the CONTRACTOR's expense.

### **2.2.38 TAXES**

Except as may be otherwise provided in this Contract, the contract price is to include all applicable taxes, but does not include any tax from which the CITY and the Contractor are exempt. Upon request by the CONTRACTOR, the CITY shall furnish a tax exemption certificate or similar evidence of exemption with respect to any such tax not included in the contract price, pursuant to this provision.

## **2.3 LEGAL RELATIONS & RESPONSIBILITIES TO PUBLIC**

### **2.3.1 LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC**

Laws and Regulations: The CONTRACTOR shall keep himself fully informed of all city and county ordinances and regulations, and state and federal laws which in any manner affect the work herein specified. He shall at all times observe and comply with said ordinances, regulations, or laws, caused by the negligent actions of the CONTRACTOR, his agent, or employees.

### **2.3.2 PROJECT SAFETY**

The CONTRACTOR is solely responsible for and shall take reasonable precautions in the performance of the work under this Contract to protect all persons from hazards to life and property. The CONTRACTOR shall comply with all health, safety and fire protection regulations and requirements.

### **2.3.3 PROTECTION OF THE PUBLIC AND OF WORK AND PROPERTY**

The CONTRACTOR shall provide and maintain all necessary watchmen, barricades, warning lights, and signs in accordance with the Manual of Uniform Traffic Control Devices, and take all reasonable precautions for the protection and safety of the public. He shall continuously maintain reasonable protection of all work from damage, and shall take all reasonable precautions to protect the CITY's property from injury or loss arising in connection with this Contract. Streets and highways shall be kept free of dirt and litter from CONTRACTOR's handling operations. The CONTRACTOR shall take reasonable precautions to protect private property adjacent to the project from such nuisances as dust and dirt, rock, and excessive noise. He shall make good any damage, injury or loss to his work and to the property owner resulting from lack of reasonable protective precautions, except such as may be due to errors in the Contract Documents, or caused by agents of adjacent private and public property, as provided by law and the Contract Documents.

### **2.3.4 NON-DISCRIMINATION**

In connection with the performance of work under this Contract, the CONTRACTOR agrees not to refuse to hire, discharge, promote, or demote, or discriminate in matters of compensation against any person otherwise qualified, solely because of race, creed, sex, color, national origin, handicap status or ancestry; and further agrees to inset the foregoing provision in all subcontracts hereunder.

## **2.4 MATERIALS & WORKMANSHIP**

### **2.4.1 GUARANTEES**

The CONTRACTOR shall guarantee his work against defective materials or workmanship for a period of two (2) years from the date of initial acceptance.

Contractor warrants and guarantees to the CITY that all equipment and materials furnished under this Contract are free from all defects in workmanship and materials.

Contractor shall remove from the project area all work or materials rejected by the CITY or its inspector for failure to comply with the Contract Documents, whether incorporated in the construction or not. The CONTRACTOR shall promptly replace the materials or re-execute the work in accordance the Contract Documents and without expense to the CITY which are or become defective due to such defects within two (2) years after the date of receipt by the CITY. The CONTRACTOR shall also bear the expense of making good all work of other contractors destroyed or damaged by such removal or replacement.

## **2.4.2 WARRANTIES**

The CONTRACTOR shall guarantee his work against defective materials and workmanship for a period of two (2) years from the date of initial acceptance.

## **2.5 MEASUREMENT & PAYMENT**

### **2.5.1 PAYMENT**

Partial payment under the Contract shall be made at the request of the CONTRACTOR once each month, based upon partial estimates to be furnished by the CONTRACTOR and approved by the CONTRACTOR once each month, based upon partial estimates to be furnished by the CONTRACTOR and approved by the ENGINEER or inspector. In making such partial payment, there shall be retained three percent (3%) of the estimated amounts until final completion and acceptance of all work covered by the Contract; provided, however, that the ENGINEER, at any time after fifty percent (50%) of the work has been completed, finds that satisfactory progress is being made, shall recommend that the remaining partial payment be paid in full.

In preparing estimates for partial payments, the material delivered on the site and preparatory work done may be taken into consideration.

Payments for work under subcontracts of the CONTRACTOR shall be subject to the above conditions applying to the contract after the work under a subcontract has been fifty percent (50%) completed. In preparing estimates for partial payments, the material delivered on the site and preparatory work done may be taken into consideration.

Should the CONTRACTOR fail to proceed properly and in accordance with the Guarantee, the CITY may have such work performed at the expense of the CONTRACTOR.

### **2.5.2 PAY QUANTITIES**

The CONTRACTOR shall be paid on a unit price basis as indicated by the proposal for the actual quantities installed.

## **2.6 SCOPE OF WORK**

### **2.6.1 CHANGES IN THE WORK**

At any time by written order, the CITY may make changes in the Drawings and Specifications or scheduling of the Contract within the general scope. All such work shall be executed under the time constraints of the original Contract, except that any claim for extension of time caused thereby shall be allowed and adjusted at the time of ordering such change or at such time as it can be ascertained.

- (a) Unit prices previously approved
- (b) An agreed lump sum
- (c) The actual cost of labor, direct overhead, materials, supplies, equipment and

other services necessary to complete the work. In addition, there shall be added on an amount to be agreed upon, but not to exceed fifteen percent (15%) of the actual cost of the work, to cover the cost of general overhead and profit.

### **2.6.2 SUBLETTING OF CONTRACT**

The CONTRACTOR shall not sublet, sell, transfer, assign, or otherwise dispose of the Contract, or of his rights, title, or interest therein, without written consent of the CITY. The CONTRACTOR may utilize the services of specialty subcontractors on those parts of the project which, under normal contraction practices, are performed by specialty subcontractors.

The CONTRACTOR shall not award work to subcontractors in excess of fifty percent (50%) of the contract price without prior written approval of the CITY.

The CONTRACTOR shall be as fully responsible to the CITY for the acts and omissions of his subcontractors and of persons directly or indirectly employed by him, as he is for the acts and omissions of persons directly employed by him.

### **2.6.3 SEPARATE CONTRACTS**

The CITY reserves the right to let other contracts in connection with this project. The CONTRACTOR shall afford other contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work, and shall properly connect and coordinate his work with theirs. If the proper execution or results of any part of the CONTRACTOR's work depends upon the work of any other contractor, the CONTRACTOR shall inspect and promptly report to the ENGINEER any defects in such work that render it unsuitable for such proper execution and results.

### **2.6.4 SUBCONTRACTS**

The CONTRACTOR shall, as soon as practicable after signing the Contract, but in any event prior to the performance of any work by any subcontractor, notify the CITY, in writing, of the names of the subcontractors proposed for the work, designating the portions of work to be performed by each.

The CONTRACTOR agrees that he is as fully responsible to the CITY for the acts and omissions of his subcontractors and of persons either directly or indirectly employed by them, as he is for the acts and omissions of persons directly employed by him.

Nothing contained in the Contract Documents shall create any contractual relation between any subcontractor and the CITY.

### **2.6.5 UNDERGROUND OBSTRUCTIONS**

The CONTRACTOR shall anticipate all underground obstructions, such as water lines, gas lines, sewer lines, concrete, debris, and all other types of utility lines. No extra payment will be allowed for the removal, protection, replacement, repair or possible increased cost caused by underground obstruction. Any such lines or obstructions indicated on the Drawings show only the approximate location from the information available and must be verified in the field by the CONTRACTOR. The ENGINEER will endeavor to familiarize the CONTRACTOR with all underground utilities and obstructions, but this will not relieve the CONTRACTOR from full responsibility for anticipating all underground obstructions.

In accordance with C.R.S. Section 9-1.5-103 (1973), the CONTRACTOR shall not make or begin excavation without first notifying the owners, operators or association of owners and operators having underground facilities in the area of such excavation. Notice may be given in person, by telephone, or in writing and shall be given at least two business days prior to beginning work.

The CONTRACTOR shall protect the existing utilities in a manner as requested by the respective utility owners at no extra compensation. The CONTRACTOR, by his signature on this proposal and subsequently on the Agreement, agrees to hold City of Evans, the agencies thereof, and their officers and employees, harmless from any and all losses, damages or claims which may arise out of, or be connected with, construction performed where said utilities are located.

Should it be necessary to relocate utilities in the area of construction, the CITY, at its own expense, will coordinate these relocations with the utility owner and the CONTRACTOR.

### **2.6.6 EMERGENCY WORK**

In an emergency affecting the safety of life or of the work or of adjoining property, the CONTRACTOR is, without special instructions or authorization from the ENGINEER, hereby permitted to act at his discretion to prevent such threatening loss or injury. He shall also act, without appeal, if so authorized or instructed by the ENGINEER. Any compensation claimed by the CONTRACTOR as a result of emergency work, shall be determined by agreement or in accordance with Article 2.2.33.

### **2.6.7 CLEANING UP**

The CONTRACTOR shall remove, at his own expense, from the CITY's property and from all public and private property, all temporary structures, rubbish and waste materials resulting from his operations. This requirement shall not apply to property used for permanent disposal of rubbish or waste materials in accordance with permission of such disposal granted to the CONTRACTOR by the CITY thereof where such disposal is in accordance with local ordinances and is approved by the ENGINEER.

## ARTICLE 3.0

### SPECIAL CONDITIONS

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### **3.1 GOVERNING DOCUMENTS**

The governing documents for this Work are as follows:

- Contract Documents Articles 1.0 through 6.0
- The City of Evans, "Specifications for Street Design & Construction", dated April 2004.
- The City of Evans, "Specifications for Water and Sanitary Sewer Systems", dated April 2004.
- State Department of Highways, Division of Highways, State of Colorado, "Standard Specifications for Road and Bridge Construction", current edition.
- Construction Drawings, "17<sup>th</sup> Avenue Drop Structure Replacement", dated March, 2008.
- Construction Drawings, "Prairie View Drive", dated February, 2008.
- Construction Drawings, "Parker Meadows Non-Potable Irrigation System", dated June, 2006.

In the case of conflict, documents shall have the following priorities: (1) Contract Documents Articles 4.0 through 6.0 – Supplemental Technical Specification, (2) Contract Documents Article 3.0 – Special Conditions, (3) Contract Documents Article 2.0 – General Conditions, (4) Construction Drawings, (5) City of Evans Street and Water & Sanitary Sewer Specifications, and (5) CDOT Standard Specifications for Road and Bridge Construction.

### **3.2 SCOPE**

#### **3.2.1 DESCRIPTION OF WORK**

The work covered under the City of Evans 2012 Combined Non-Potable / Irrigation Improvements Project will consist of the 17<sup>th</sup> Avenue Drop Structure Replacement Project, the Prairie View Drive Irrigation Project and the Parker Meadows Non-Potable Irrigation System Project which includes the following:

##### 17<sup>th</sup> Avenue Drop Structure Replacement

- removal of an existing diversion structure and material disposal,
- installation of a new diversion structure and motor operated radial gate,
- construction of gravel roadway and riprap channel armoring,
- and general excavation and earthwork.

##### Prairie View Drive Irrigation System

- installation of a non-potable mainline including non-pot & potable meters,
- and installation of the lateral systems including sprinkler heads.

##### Parker Meadows Non-Potable Irrigation System

- installation of pump station including electrical service to power it,
- and installation of the pipe delivery system.

#### **3.2.2 CONTRACT DRAWINGS**

The separate contract drawings for each project include the following types of sheets: cover, survey, demolition plan, erosion control plan, site plans, irrigation plans, structural plans, and details.

### **3.3 GENERAL PROJECT SPECIFICATIONS**

It is the intent of these Special Conditions to require a functionally complete project (or part thereof) to be constructed in accordance, and in conjunction with, all Contract Documents as defined within Article 1.0 – Contracting Procedures and Article 2.0 – General Conditions. Any work, materials, or equipment that may be reasonable inferred, as being required to produce the intended result will be provided whether or not specifically called for. When words, 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 that meaning.

Use of these Special Conditions in conjunction with related Contract Documents to establish the total requirements of the project. The CONTRACTOR shall obtain all required documents and have them available during the execution of work.

#### **3.3.1 EXISTING CONDITIONS**

Prior to starting work on the project, the CONTRACTOR shall walk the project site in the areas scheduled for work with the ENGINEER to discuss conditions that may affect the work being performed. These conditions may include: fencing, curbs, walls, berms, driveways, asphalt, lawns, sprinklers and other existing improvements (collectively surface improvements) that are to remain on both public and private property. The ENGINEER may record the existing conditions and/or features using a video camera for future reference and/or comparisons prior to final project acceptance.

If in the opinion of the ENGINEER, there is sufficient operating space to perform the work in a reasonable manner without disturbing, destroying and/or removing existing improvements, the CONTRACTOR shall perform the work without disturbing, destroying and/or removing said improvements. In no event shall the CONTRACTOR remove trees, shrubs, vines, or other items without receiving prior approval (in writing) of the ENGINEER.

The CONTRACTOR shall make every effort to prevent or limit damage to surface improvements within or adjacent to the work area. The CONTRACTOR is responsible for protecting or restoring all such surface improvements to their original or improved condition. Any of these surface improvements damaged by the CONTRACTOR shall be replaced by the CONTRACTOR at his/her own expense.

#### **3.3.2 SALES TAX**

Sales Tax shall not be paid for materials purchased for use on this project.

#### **3.3.3 WORKING HOURS**

The CONTRACTOR shall restrict working hours to between 7:00 A.M. and 5:00 P.M. on normal City of Evans business days unless prior approval has been obtained from the City.

#### **3.3.4 PROJECT WARRANTY**

The CONTRACTOR shall provide a two-year warranty for all construction beginning on the date of initial acceptance. All work that fails or deteriorates during the first or second year shall be replaced under this warranty. There will be no additional cost to the CITY for material, equipment, labor and/or traffic control for warranty work. Warranty work shall be completed in accordance with these contract specifications within 30 days of written notification by the CITY.

#### **3.3.5 MATERIALS, MANUFACTURER'S CERTIFICATES & RECOMMENDATIONS**

Shop drawings or samples required by these specifications shall be submitted before confirmation of orders.

Certifications by the manufacturer that the material or equipment conforms to all applicable requirements shall be submitted. These certifications shall reference the standard specifications with which compliance is required.

Shop drawings shall be submitted in triplicate to the ENGINEER and shall bear the CONTRACTOR's certification that he has reviewed, checked, and approved the shop drawings and that they are in conformance with the requirements of the Contract Documents.

The ENGINEER shall return shop drawings to the CONTRACTOR within 14 days from the time of receipt. If they are returned noted "disapproved," they shall be re-submitted with necessary revisions and the 14-day review period again shall be required.

The CONTRACTOR shall maintain a set of reviewed shop drawings in good order at the site of work. Said drawings shall be available to the ENGINEER.

### **3.3.6 EROSION AND DUST CONTROL**

The CONTRACTOR is responsible for the control of erosion and dust within the project limits. The contractor will be solely responsible for executing the permit requirements and for all record keeping and reporting requirements. Dust shall be controlled at all times in accordance with applicable regulations and as directed by the Engineer.

### **3.3.7 CONSTRUCTION WATER**

Construction water shall consist of providing a water supply sufficient for the needs of the project and the hauling and applying of all water required. The CONTRACTOR SHALL NOT use water from local residences for construction purposes or to provide water to laborers.

The CONTRACTOR is encouraged to use water obtained from the Evans Ditch whenever possible. Contact the City of Evans Public Works Department to arrange for use of Evans Ditch water. Evans Ditch water may not be available at the time of construction.

The CONTRACTOR shall make arrangements for and provide all necessary water for his construction operation and domestic use at his own expense. The CONTRACTOR shall secure permission from the water utility and notify the ENGINEER and Fire Department/District before obtaining water from the fire hydrants.

If the CONTRACTOR purchases water from a water utility at a fire hydrant on or near the project, he shall make all arrangements at his own expense and payment made direct to the water utility as agreed upon. The CONTRACTOR shall follow all rules and regulations of the respective district. Use only special hydrant-operating wrenches to open hydrants. Make certain that the hydrant valve is open "full" since cracking the valve causes damage to the hydrant. If any hydrants are damaged, the CONTRACTOR will be held responsible and shall immediately notify the appropriate agencies so that all damages can be repaired as quickly as possible. Fire hydrants shall be completely accessible to the Fire Department/District at all times. Upon completion of the work, the CONTRACTOR shall remove all temporary piping from the facilities.

The CONTRACTOR shall meet all applicable requirements of OSHA, state, and other governing agencies pertaining to sanitary facilities for workers. No separate payment will be made for construction water. All of the CONTRACTOR's costs of whatsoever nature shall be included in all associated Bid Items on the bid schedule.

### **3.3.8 REMOVALS**

The CONTRACTOR shall be responsible for locating sites and making arrangements for disposal of all materials removed from the site. The CONTRACTOR's handling and disposition

of excavation material shall be to a disposal site designated and/or approved by the ENGINEER. This includes concrete, asphalt, unsuitable or unstable sub-grade material, and any other trash, rubbish, or debris generated as a result of the construction. No trash, rubbish, or debris shall be allowed on the lawns of local residences by the CONTRACTOR's work force. No separate payment will be made for disposal of excavation material generated. This disposal shall be considered incidental to the construction and all costs thereof shall be included in various unit CONTRACT process.

### **3.3.9 SAMPLES AND TESTING**

All testing shall be completed by an independent testing laboratory hired by the CONTRACTOR.

### **3.3.10 SUBCONTRACTORS**

All subcontractors are subject to approval by the CITY.

### **3.3.11 MINOR ITEMS OF CONSTRUCTION**

Minor items of construction that do not have a bid item provided will not be paid for separately. The costs of these items shall be merged with unit prices shown on the bid form.

### **3.3.12 CLEANING DURING CONSTRUCTION**

During execution of work, the CONTRACTOR shall clean the sites, adjacent properties, and public access roadways on a daily basis at a minimum or as directed by the ENGINEER and shall dispose of waste materials, debris, and rubbish to assure that buildings, grounds, and public properties are maintained free from accumulations of waste materials and rubbish. The CONTRACTOR shall wet down dry materials and rubbish to lay dust and prevent blowing dust.

The CONTRACTOR shall provide containers for collection and disposal of waste materials, debris, and rubbish.

The CONTRACTOR shall cover or wet loads of excavated material leaving the site or of material being imported to prevent blowing dust. The CONTRACTOR shall also clean the public access roadways to the site of any material falling from the trucks or equipment.

The CONTRACTOR shall clean debris from pipelines and manhole structures, as necessary and as directed by the ENGINEER.

### **3.3.13 FINAL CLEANUP**

At the completion of the work and immediately prior to final inspection, the CONTRACTOR shall remove from the Construction Site all temporary structures and all materials, equipment, and appurtenances not required a part of, or appurtenant to, the completed work. The CONTRACTOR shall notify the CITY when final cleanup is ready for inspection.

The CONTRACTOR shall repair, patch, and touch-up marred surfaces to specified finish to match adjacent surfaces.

The CONTRACTOR shall broom-clean paved surfaces and rake clean other surfaces of ground as necessary and as directed by the ENGINEER.

## **3.4 PROJECT SCHEDULE AND SEQUENCE**

It is the intent of the CITY to award this project as soon as possible after receiving bids. The CONTRACTOR will have sixty (60) working days after the Notice to Proceed to complete the work prescribed herein.

At the Pre-Construction Conference, the CONTRACTOR shall submit their baseline construction schedule for review and discussion. This schedule shall clearly present the key milestones of the project and outlining the overall sequencing of work. After acceptance, the CONTRACTOR will maintain the schedule and update the CITY as required throughout the project.

### **3.5 PROJECT COORDINATION**

The CONTRACTOR is responsible for contracting and coordinating with all project affected stakeholders. These affected stakeholders may include:

- Property Owners
- Utility Companies (listing of possible companies can be obtained from the CITY)
- Evans Police Department
- Evans Fire Department
- Weld County Sheriffs Department
- Weld County Ambulance
- Greeley-Evans School District 6

The locations of utilities shown on the drawings are approximate. It is the responsibility of the CONTRACTOR to field verify locations of utilities prior to initiating construction. In addition, any street closures must be properly coordinated with any and/or all the affected stakeholders listed above. Proper traffic control measures per an approved Traffic Control Plan will be implemented – All anticipated closure times shall be approved by the CITY.

### **3.6 MEASUREMENT AND PAYMENT**

#### **3.6.1 GENERAL**

All materials will be measured and paid for in accordance with the Contract Documents. All material shall arrive at the job site with load or batch tickets indicating time loaded or batched, material type, material quantity, and date. A copy of the tickets shall be given to the ENGINEER on site the day the material arrives. Material delivered and placed without a load ticket will not be paid for. The CITY will not pay for any material if the load ticket indicates that the vehicle and its load exceeded the legal weight limit for the vehicle type.

All work performed and all materials furnished shall conform to the requirements, including tolerances, provided within the Contract Documents. Materials not in conformance with the Contract Documents, but allowed to remain in place by the ENGINEER may be subject to applicable price reductions as specified in Section 105.03 of the CDOT Specifications.

The CONTRACTOR is responsible for providing a product to be in conformance with the Governing Document. The suitability of the finished product will be determined by the ENGINEER. A finished product that is not found suitable by the ENGINEER may be subject to:

1. Disapproval and subsequent removal and replacement of the material/product at the CONTRACTOR'S expense.
2. A reduction in pay as discussed with the ENGINEER. Only the ENGINEER will determine suitability for material/products related to this project.
3. The ENGINEER allows questionable material/product to remain in place with the CONTRACTOR providing some type of remedial action to make the material/product suitable. The type of remedial action to be used will be determined by the ENGINEER and paid for by the CONTRACTOR.

4. The addition of an extended warranty for questionable material/product to allow further review to determine suitability and any further action by CONTRACTOR at end of warranty period.

The work performed under this Agreement shall be paid for on a unit price basis at the rate for the respective items provided on the Article 1.0 – Bid Proposal. The quantities provided on the Bid Schedule of the Article 1.0 – Bid Proposal are only estimates of the actual quantities of the work to be performed, and are only included for purposes of making the award. The CITY reserves the right to alter and/or eliminate any item of work. Modifications, if any, will be made by Change Order.

Unless otherwise provided for specifically in this section, all lump sum bid items will be paid for upon completion of all work associated with the lump sum bid item.

Payment shall be made only for those items included in the accepted proposal. All other costs incurred shall comply with the provisions of the Contract Documents and shall be included in the unit price bid for the associated items in the proposal. Except as may be otherwise stipulated, no material, labor, or equipment will be furnished by the CITY. The quantity of work that will be considered for payment is the actual number of units completed in accordance with all relative Contract Documents. The basis of measurement and payment are as noted, herein.

### **3.6.2 MEASUREMENTS**

- A. No measurement for payment shall be made for any of the work, materials, and equipment required for mobilization. A lump sum payment will be made based on Section 3.4.3.
- B. The quantities of work to be paid will be measured as identified within Article 1.0 – Bid Proposal to perform work, including but not limited to, the furnishing and installation of all components and accessories, in accordance with the Contract Documents. No payment for items outside of the dimensions shown on the Drawings or field markings, unless directed and approved by the ENGINEER, will be included in the amount computed for payment.
- C. No separate measurement shall be made for fittings and accessories necessary to install bid item.
- D. No measurement for payment shall be made for removal or replacement of materials and/or existing features damaged by the CONTRACTOR in his operation.

### **3.6.3 PAYMENTS**

- A. Mobilization & demobilization lump sum bid prices shall include all CONTRACTOR costs, whatsoever the nature required for mobilization of personnel, equipment, construction trailers, or supplies at the project site in preparation for work on the project, and demobilization, location and protection of utilities. This item shall also include the establishment of all necessary facilities, on-site restrooms, and all other costs incurred or labor and operations that must be performed prior to beginning the other items under Contract. Also to be included shall be all costs whatsoever to obtain any and all required permits, taxes, licenses, fees and bonds necessary as required by the CITY, water and sanitary districts, and other municipal governments to perform the work. This item may also include the cost of required bonds, insurance, preparation of the project schedule, required shop drawings and clean-up of the site.

- B. Mobilization & demobilization payment will be made as the work progresses. Fifty percent (50%) of the lump sum bid price will be paid at the time of the first monthly progress payment. An additional thirty percent (30%) will be paid when one-half the original contract is earned separately on each of the bid schedules. The remaining twenty percent (20%) will be paid upon final acceptance of the Project. The total amount for mobilization shall not exceed five percent (5%) of the total bid.
- C. Payment for the Bid Item other than mobilization & demobilization shall include full compensation for, but is not limited to, all materials, labor, supplies, transportation, disposal, equipment required to complete the work in accordance with the Contract Documents.
- D. No separate payment shall be made for fittings and accessories necessary to install bid item.
- E. CONTRACTOR will not be reimbursed for the re-testing of any materials that fail, or due to inclement weather, or for any other reason. All samples required for testing will be provided by the CONTRACTOR and at no cost to the OWNER.
- F. Excess excavation shall be disposed of off-site and shall not be paid for separately.

**ARTICLE 4.0**

**SUPPLEMENTAL TECHNICAL SPECIFICATIONS**

**17<sup>th</sup> AVENUE DROP STRUCTURE**

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1 2006/06/28

2 **SECTION 01340**  
3 **SUBMITTALS**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
- 7 1. Mechanics and administration of the submittal process for:
    - 8 a. Shop Drawings.
    - 9 b. Samples.
    - 10 c. Miscellaneous submittals.
    - 11 d. Operation and Maintenance Manuals.
  - 12 2. General content requirements for Shop Drawings.
  - 13 3. Content requirements for Operation and Maintenance Manuals.
- 14 B. Related Sections include but are not necessarily limited to:
- 15 1. Articles 1.0 – 3.0
  - 16 2. Sections in Article 4.0 identifying required submittals.

17 **1.2 DEFINITIONS**

- 18 A. Shop Drawings:
- 19 1. See General Conditions.
  - 20 2. Product data and samples are Shop Drawing information.
- 21 B. Operation and Maintenance Manuals (O&M Manuals):
- 22 1. Data collected for the Owner's use.
  - 23 2. Contain information related to the operation and maintenance of equipment and packaged  
24 systems.
- 25 C. Miscellaneous Submittals:
- 26 1. Submittals other than Shop Drawings and O&M Manuals.
  - 27 2. Representative types of miscellaneous submittal items include but are not limited to:
    - 28 a. Construction schedule.
    - 29 b. Concrete, soil compaction, and pressure test reports.
    - 30 c. HVAC test and balance reports.
    - 31 d. Installed equipment and systems performance test reports.
    - 32 e. Manufacturer's installation certification letters.
    - 33 f. Instrumentation and control commissioning reports.
    - 34 g. Warranties.
    - 35 h. Service agreements.
    - 36 i. Construction photographs.
    - 37 j. Survey data.
    - 38 k. Cost breakdown (Schedule of Values).

39 **1.3 SUBMITTAL SCHEDULE**

- 40 A. Schedule of Shop Drawings:
- 41 1. Submitted and approved within 10 days of receipt of Notice to Proceed.
  - 42 2. Account for multiple transmittals under any specification section where partial submittals  
43 will be transmitted.
- 44 B. Shop Drawings: Submittal and approval prior to 50 percent completion.

- 
- 1 C. Operation and Maintenance Manuals: Initial submittal within 60 days after date Shop Drawings  
2 are approved.

3 **1.4 PREPARATION OF SUBMITTALS**

4 A. General:

- 5 1. All submittals and all pages of all copies of a submittal shall be completely legible.  
6 2. Submittals which, in the Engineer's sole opinion, are illegible will be returned without  
7 review.

8 B. Shop Drawings:

- 9 1. Scope of any submittal and letter of transmittal:  
10 a. Limited to one specification section.  
11 b. Do not submit under any specification section entitled (in part) "Basic Requirements"  
12 unless the product or material submitted is specified in a "Basic Requirements" section.  
13 2. Numbering letter of transmittal:  
14 a. Include as prefix the specification section number followed by a series number, "-xx",  
15 beginning with "01" and increasing sequentially with each additional transmittal.  
16 b. If more than one submittal under any specification section, assign consecutive series  
17 numbers to subsequent transmittal letters.  
18 3. Describing transmittal contents:  
19 a. Provide listing of each component or item in submittal capable of receiving an  
20 independent review action.  
21 b. Identify for each item:  
22 1) Manufacturer and Manufacturer's drawing or data number.  
23 2) Contract Document tag number(s).  
24 3) Unique page numbers for each page of each separate item.  
25 c. When submitting "or-equal" items that are not the products of named manufacturers,  
26 include the words "or-equal" in the item description.  
27 4. Contractor stamping:  
28 a. General:  
29 1) Contractor's review and approval stamp shall be applied either to the letter of  
30 transmittal or a separate sheet preceding each independent item in the submittal.  
31 a) Contractor's signature and date shall be original ink signature.  
32 b) Shop Drawing submittal stamp shall read "(Contractor's Name) has satisfied  
33 Contractor's obligations under the Contract Documents with respect to  
34 Contractor's review and approval as stipulated under General Conditions."  
35 c) Letters of transmittal may be stamped only when the scope of the submittal is  
36 one item.  
37 2) Submittals containing multiple independent items shall be prepared with an index  
38 sheet for each item listing the discrete page numbers for each page of that item,  
39 which shall be stamped with the Contractor's review and approval stamp.  
40 a) Individual pages or sheets of independent items shall be numbered in a manner  
41 that permits Contractor's review and approval stamp to be associated with the  
42 entire contents of a particular item.  
43 b. Electronic stamps:  
44 1) Contractor may electronically embed Contractor's review and approval stamp to  
45 either the letter of transmittal or a separate index sheet preceding each independent  
46 item in the submittal.  
47 2) Contractor's signature and date on electronically applied stamps shall be original  
48 ink signature.  
49 5. Resubmittals:  
50 a. Number with original root number and a suffix letter starting with "A" on a (new)  
51 duplicate transmittal form.  
52 b. Do not increase the scope of any prior transmittal.  
53 c. Account for all components of prior transmittal.

- 
- 1) If items in prior transmittal received "A" or "B" Action code, list them and indicate "A" or "B" as appropriate.
- a) Do not include submittal information for items listed with prior "A" or "B" Action in resubmittal.
- 2) Indicate "Outstanding-To Be Resubmitted At a Later Date" for any prior "C" or "D" Action item not included in resubmittal.
- a) Obtain Engineer's approval to exclude items.
6. For 8-1/2 x 11 IN, 8-1/2 x 14 IN, and 11 x 17 IN size sheets, provide three (3) copies of each page for Engineer plus the number required by the Contractor.
- a. The number of copies required by the Contractor will be defined at the Preconstruction Conference, but shall not exceed 5.
- b. All other size sheets:
- 1) Submit one (1) reproducible transparency or high resolution print and one (1) additional print of each drawing until approval is obtained.
- 2) Utilize mailing tube; do not fold.
- 3) The Engineer will mark and return the reproducible to the Contractor for his reproduction and distribution.
7. Provide clear space (3 IN SQ) for Engineer stamping of each component defined in PREPARATION OF SUBMITTALS – Contractor Stamping.
8. Contractor shall not use red color for marks on transmittals.
- a. Duplicate all marks on all copies transmitted, and ensure marks are photocopy reproducible.
- b. Outline Contractor marks on reproducible transparencies with a rectangular box.
9. Transmittal contents:
- a. Coordinate and identify Shop Drawing contents so that all items can be easily verified by the Engineer.
- b. Identify equipment or material use, tag number, drawing detail reference, weight, and other project specific information.
- c. Provide sufficient information together with technical cuts and technical data to allow an evaluation to be made to determine that the item submitted is in compliance with the Contract Documents.
- d. Submit items such as equipment brochures, cuts of fixtures, product data sheets or catalog sheets on 8-1/2 x 11 IN pages.
- 1) Indicate exact item or model and all options proposed.
- e. When a Shop Drawing submittal is called for in any specification section, include as appropriate, scaled details, sizes, dimensions, performance characteristics, capacities, test data, anchoring details, installation instructions, storage and handling instructions, color charts, layout drawings, rough-in diagrams, wiring diagrams, controls, weights and other pertinent data in addition to information specifically stipulated in the specification section.
- 1) Arrange data and performance information in format similar to that provided in Contract Documents.
- 2) Provide, at minimum, the detail specified in the Contract Documents.
- f. If proposed equipment or materials deviate from the Contract Drawings or Specifications in any way, clearly note the deviation and justify the said deviation in detail in a separate letter immediately following transmittal sheet.
10. Samples:
- a. Identification:
- 1) Identify sample as to transmittal number, manufacturer, item, use, type, project designation, tag number, standard specification section or drawing detail reference, color, range, texture, finish and other pertinent data.
- 2) If identifying information cannot be marked directly on sample without defacing or adversely altering samples, provide a durable tag with identifying information securely attached to the sample.
- b. Include application specific brochures, and installation instructions.

- 
- 1 c. Provide Contractor's stamp of approval on samples or transmittal form as indication of  
2 Contractor's checking and verification of dimensions and coordination with interrelated  
3 work.  
4 d. Resubmit samples of rejected items.
- 5 C. Miscellaneous Submittals:  
6 1. Prepare in the format and detail specified in specification requiring the miscellaneous  
7 submittal.
- 8 D. Operation and Maintenance Manuals:  
9 1. Number transmittals for Operation and Maintenance Manual with original root number of  
10 the approved Shop Drawing for the item.  
11 2. Submittal format:  
12 a. Interim and final submittals:  
13 1) Submit electronically on Compact Disk (CDROM) in Portable Document Format  
14 (PDF).  
15 2) Each manual shall have a Table of Contents or Index with each listed item linked  
16 to its corresponding topic.  
17 3) All pages within the PDF document are to be generated at actual size for optimal  
18 resolution quality (i.e., 22 IN x 34 IN drawings rendered as such, etc.).  
19 4) Ensure all pages are rotated properly so that the majority of the text or drawing  
20 border is upright on the screen.  
21 5) Do not password protect and/or lock the PDF document.  
22 6) Submit two (2) paper copies.  
23 b. Final submittals:  
24 1) Ensure that all comments and annotations that are made on the interim submittals  
25 are addressed.  
26 3. Identify resubmittals with the original number plus a suffix letter starting with "A."  
27 4. Paper copy submittals:  
28 a. Submit Operation and Maintenance Manuals printed on 8-1/2 x 11 IN size heavy first  
29 quality paper with standard three-hole punching and bound in stiff metal hinged binder  
30 constructed as a three- ring style.  
31 1) Provide binders with titles on front and on spine of binder.  
32 2) Tab each section of manuals for easy reference with plastic-coated dividers.  
33 3) Provide index for each manual.  
34 4) Provide plastic sheet lifters prior to first page and following last page.  
35 b. Reduce drawings or diagrams bound in manuals to an 8-1/2 x 11 IN or 11 x 17 IN size.  
36 1) However, where reduction is not practical to ensure readability, fold larger  
37 drawings separately and place in vinyl envelopes which are bound into the binder.  
38 2) Identify vinyl envelopes with drawing numbers.
- 39 5. Transmittal contents:  
40 a. Submission of Operation and Maintenance Manuals is applicable but not necessarily  
41 limited to:  
42 1) Major equipment.  
43 2) Equipment used with electrical motor loads of 1/6 HP nameplate or greater.  
44 3) Specialized equipment including valves and instrumentation and control system  
45 components for HVAC and process systems such as meters, recorders, and  
46 transmitters.  
47 4) Valves greater than 12 IN DIA.  
48 5) Water control gates.  
49 b. Operation and maintenance manuals shall include, but not necessarily be limited to, the  
50 following detailed information, as applicable:  
51 1) Equipment function, normal operating characteristics, limiting operations.  
52 2) Assembly, disassembly, installation, alignment, adjustment, and checking  
53 instructions.  
54 3) Operating instructions for start-up, routine and normal operation, regulation and  
55 control, shutdown, and emergency conditions.

- 
- 1 4) Lubrication and maintenance instructions.
  - 2 5) Guide to "troubleshooting."
  - 3 6) Parts list and predicted life of parts subject to wear.
  - 4 7) Outline, cross-section, and assembly drawings; engineering data; and electrical
  - 5 diagrams, including elementary diagrams, wiring diagrams, connection diagrams,
  - 6 word description of wiring diagrams and interconnection diagrams.
  - 7 8) Test data and performance curves.
  - 8 9) As-constructed fabrication or layout drawings and wiring diagrams if different than
  - 9 approved Shop Drawings.
  - 10 10) A list of recommended spare parts with a price list and a list of spare parts
  - 11 provided under these Specifications.
  - 12 11) Copies of installation instructions, parts lists or other documents packed with
  - 13 equipment when delivered.
  - 14 12) Instrumentation or tag numbers relating the equipment back to the Contract
  - 15 Documents.

16 **1.5 TRANSMITTAL OF SUBMITTALS**

17 A. Shop Drawings, Samples and Operation and Maintenance Manuals:

18 1. Transmit all submittals to:

19

20 City of Evans, Department of Public Works  
21 1100 37<sup>th</sup> Street  
22 Evans, CO 80620  
23 Attn: Earl Smith  
24

- 25 2. Utilize two (2) copies of attached Exhibit "A" to transmit all Shop Drawings and samples.
- 26 3. Utilize two (2) copies of attached Exhibit "B" to transmit all Operation and Maintenance
- 27 Manuals.
- 28 4. All submittals must be from Contractor.
  - 29 a. Submittals will not be received from or returned to subcontractors.
  - 30 b. Operation and Maintenance Manual submittal stamp may be Contractor's standard
  - 31 approval stamp.
- 32 5. Provide submittal information defining specific equipment or materials utilized on the
- 33 project.
  - 34 a. Generalized product information, not clearly defining specific equipment or materials
  - 35 to be provided, will be rejected.

36 B. Miscellaneous Submittals:

- 37 1. Transmit under Contractor's standard letter of transmittal or letterhead.
- 38 2. Submit in triplicate or as specified in individual specification section.
- 39 3. Transmit to:

40

41 City of Evans, Department of Public Works  
42 1100 37<sup>th</sup> Street  
43 Evans, CO 80620  
44 Attn: Earl Smith  
45

- 46 4. Provide copy of letter of transmittal without attachments to Owner's Resident Project
- 47 Representative.
  - 48 a. Exception for concrete, soils compaction and pressure test reports.
    - 49 1) Transmit one copy of test reports to the Owner.
    - 50 2) Transmit one copy of test reports to location and individual indicated above for
    - 51 other miscellaneous submittals.

52 C. Electronic submittals will not be accepted.

53 D. Fax Transmittals:

- 
1. Permitted on a case-by-case basis to expedite review when approved by the Owner.
  2. Requires hard copy transmittal to immediately follow.
    - a. Engineer will proceed with review of fax transmittal.
    - b. Engineer's approval or rejection comments will be recorded and returned on hard copy transmittal.
  3. Provisions apply to both:
    - a. Initial transmittal contents.
    - b. Supplemental information required to make initial transmittal contents complete.

## 1.6 ENGINEER'S REVIEW ACTION

### A. Shop Drawings and Samples:

1. Items within transmittals will be reviewed for overall design intent and will receive one of the following actions:
  - a. A - FURNISH AS SUBMITTED.
  - b. B - FURNISH AS NOTED (BY ENGINEER).
  - c. C - REVISE AND RESUBMIT.
  - d. D - REJECTED.
  - e. E - ENGINEER'S REVIEW NOT REQUIRED.
2. Submittals received will be initially reviewed to ascertain inclusion of Contractor's approval stamp.
  - a. Submittals not stamped by the Contractor or stamped with a stamp containing language other than that specified herein will not be reviewed for technical content and will be returned without any action.
3. In relying on the representation on the Contractor's review and approval stamp, Owner and Engineer reserve the right to review and process poorly organized and poorly described submittals as follows:
  - a. Submittals transmitted with a description identifying a single item and found to contain multiple independent items:
    - 1) Review and approval will be limited to the single item described on the transmittal letter.
    - 2) Other items identified in the submittal will:
      - a) Not be logged as received by the Engineer.
      - b) Be removed from the submittal package and returned without review and comment to the Contractor for coordination, description and stamping.
      - c) Be submitted by the Contractor as a new series number, not as a re-submittal number.
  - b. Engineer, at Engineer's discretion, may revise the transmittal letter item list and descriptions, and conduct review.
    - 1) Unless Contractor notifies Engineer in writing that the Engineer's revision of the transmittal letter item list and descriptions was in error, Contractor's review and approval stamp will be deemed to have applied to the entire contents of the submittal package.
4. Submittals returned with Action "A" or "B" are considered ready for fabrication and installation.
  - a. If for any reason a submittal that has an "A" or "B" Action is resubmitted, it must be accompanied by a letter defining the changes that have been made and the reason for the resubmittal.
  - b. Destroy or conspicuously mark "SUPERSEDED" all documents having previously received "A" or "B" Action that are superseded by a resubmittal.
5. Submittals with Action "A" or "B" combined with Action "C" (Revise and Resubmit) or "D" (Rejected) will be individually analyzed giving consideration as follows:
  - a. The portion of the submittal given "C" or "D" will not be distributed (unless previously agreed to otherwise at the Preconstruction Conference).
    - 1) One copy or the one transparency of the "C" or "D" drawings will be marked up and returned to the Contractor.
      - a) Correct and resubmit items so marked.





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**EXHIBIT B**  
**O&M Manual Transmittal No. \_\_\_\_\_ - \_\_\_\_\_**  
**(Spec Section) (Series)**

Project Name:		Date Received:
Project Owner:		Checked By:
Contractor:	Owner:	Log Page:
Address:	Address:	HDR No.:
Attn:	Attn:	1st. Sub.                      ReSub.
Date Transmitted:		Previous Transmittal Date:

No. Copies	Description of Item	Manufacturer	Dwg. or Data No.	Action Taken*

Remarks:  
\_\_\_\_\_  
\_\_\_\_\_

To:	From: <i>HDR Engineering, Inc.</i>
Date:	

- \* The Action designated above is in accordance with the following legend:
- |   |   |
|---|---|
| <p>A - Acceptable, provide two additional copies and final electronic copy</p> <p>B - Furnish as Noted</p> <p>C - Revise and Resubmit<br/>This Operation and Maintenance Manual Submittal is deficient in the following area:</p> <ol style="list-style-type: none"> <li>1. Equipment record sheets.</li> <li>2. Functional description.</li> <li>3. Assembly, disassembly, installation, alignment, adjustment &amp; checkout instructions.</li> <li>4. Operating instructions.</li> </ol> | <ol style="list-style-type: none"> <li>5. Lubrication &amp; maintenance instructions.</li> <li>6. Troubleshooting guide.</li> <li>7. Parts list and ordering instructions.</li> <li>8. Organization (index and tabbing).</li> <li>9. Wiring diagrams &amp; schematics specific to installation.</li> <li>10. Outline, cross section &amp; assembly diagrams.</li> <li>11. Test data &amp; performance curves.</li> <li>12. Tag or equipment identification numbers.</li> <li>13. Other - see comments.</li> </ol> <p>D - Rejected</p> |
|---|---|

Comments:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Distribution:	Contractor <input type="checkbox"/>	File <input type="checkbox"/>	Field <input type="checkbox"/>	Owner <input type="checkbox"/>	Other <input type="checkbox"/>
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2 **SECTION 03002**  
3 **CONCRETE**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:  
7 1. Cast-in-place concrete and grout.  
8 B. Related Sections include but are not necessarily limited to:  
9 1. Articles 1.0 – 3.0.

10 **1.2 QUALITY ASSURANCE**

- 11 A. Referenced Standards:  
12 1. American Concrete Institute (ACI):  
13 a. 116R, Cement and Concrete Terminology.  
14 b. 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass  
15 Concrete.  
16 c. 212.3R, Chemical Admixtures for Concrete.  
17 d. 304R, Guide for Measuring, Mixing, Transporting, and Placing Concrete.  
18 e. 304.2R, Placing Concrete by Pumping Methods.  
19 f. 305R, Hot Weather Concreting.  
20 g. 306R, Cold Weather Concreting.  
21 h. 318, Building Code Requirements for Structural Concrete.  
22 i. 347R, Recommended Practice for Concrete Formwork.  
23 2. ASTM International (ASTM):  
24 a. A82, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.  
25 b. A185, Standard Specification for Steel Welded Wire Reinforcement, Plain, for  
26 Concrete.  
27 c. A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete  
28 Reinforcement.  
29 d. A775, Standard Specification for Epoxy-Coated Steel Reinforcing Bars.  
30 e. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.  
31 f. C33, Standard Specification for Concrete Aggregates.  
32 g. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete  
33 Specimens.  
34 h. C94, Standard Specification for Ready-Mixed Concrete.  
35 i. C138, Standard Method of Test for Density (Unit Weight), Yield, and Air Content  
36 (Gravimetric) of Concrete.  
37 j. C143, Standard Test Method for Slump of Hydraulic Cement Concrete.  
38 k. C150, Standard Specification for Portland Cement.  
39 l. C157, Standard Test Method for Length Change of Hardened Hydraulic-Cement,  
40 Mortar, and Concrete.  
41 m. C172, Standard Practice for Sampling Freshly Mixed Concrete.  
42 n. C173, Standard Test Method for Air Content of Freshly Mixed Concrete by the  
43 Volumetric Method.  
44 o. C231, Standard Test Method for Air Content of Freshly Mixed Concrete by the  
45 Pressure Method.  
46 p. C260, Standard Specification for Air-Entraining Admixtures for Concrete.  
47 q. C289, Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates  
48 (Chemical Method).

- 
- 1 r. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing
  - 2 Concrete.
  - 3 s. C494, Standard Specification for Chemical Admixtures for Concrete.
  - 4 t. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan
  - 5 for Use as a Mineral Admixture in Concrete.
  - 6 u. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having
  - 7 Special Properties for Curing and Sealing Concrete.
  - 8 v. D994, Standard Specification for Preformed Expansion Joint Filler for Concrete
  - 9 (Bituminous Type).
  - 10 w. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded
  - 11 Rubber.
  - 12 x. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete
  - 13 Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
  - 14 y. E329, Standard Specification for Agencies Engaged in the Testing and/or Inspection of
  - 15 Materials Used in Construction.
  - 16 3. Corps of Engineers (COE):
  - 17 a. CRD-C572, Specifications for Polyvinylchloride Waterstops.
  - 18 b. CRD-C621, Standard Specification for Packaged, Dry, Hydraulic-Cement Grout
  - 19 (Nonshrink).

20 B. Quality Control:

- 21 1. Concrete testing agency:
- 22 a. Contractor to employ and pay for services of a testing laboratory to:
- 23 1) Perform materials evaluation.
- 24 2) Design concrete mixes.
- 25 b. Concrete testing agency to meet requirements of ASTM E329.
- 26 2. Do not begin concrete production until proposed concrete mix design has been approved by
- 27 Engineer.
- 28 a. Approval of concrete mix design by Engineer does not relieve Contractor of his
- 29 responsibility to provide concrete that meets the requirements of this Specification.
- 30 3. Adjust concrete mix designs when material characteristics, job conditions, weather, strength
- 31 test results or other circumstances warrant.
- 32 a. Do not use revised concrete mixes until submitted to and approved by Engineer.
- 33 4. Perform structural calculations as required to prove that all portions of the structure in
- 34 combination with remaining forming and shoring system has sufficient strength to safely
- 35 support its own weight plus the loads placed thereon.

36 C. Qualifications:

- 37 1. Ready mixed concrete batch plant certified by National Ready Mixed Concrete Association
- 38 (NRMCA).
- 39 2. Formwork, shoring and reshoring for slabs and beams except where cast on ground to be
- 40 designed by a professional engineer currently registered in the state where the project is
- 41 located.

42 **1.3 DEFINITIONS**

43 A. Per ACI 116R except as modified herein:

- 44 1. Concrete fill: Non-structural concrete.
- 45 2. Concrete Testing Agency: Testing agency employed to perform materials evaluation,
- 46 design of concrete mixes or testing of concrete placed during construction.
- 47 3. Exposed concrete: Exposed to view after construction is complete.
- 48 4. Indicated: Indicated by Contract Documents.
- 49 5. Lean concrete: Concrete with low cement content.
- 50 6. Nonexposed concrete: Not exposed to view after construction is complete.
- 51 7. Required: Required by Contract Documents.
- 52 8. Specified strength: Specified compressive strength at 28 days.
- 53 9. Submitted: Submitted to Engineer.

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## 1 1.4 SUBMITTALS

### 2 A. Shop Drawings:

- 3 1. See Section 01340 for requirements for the mechanics and administration of the submittal  
4 process.
- 5 2. Concrete mix designs proposed for use.
  - 6 a. Concrete mix design submittal to include the following information:
    - 7 1) Sieve analysis and source of fine and coarse aggregates.
    - 8 2) Test for aggregate organic impurities.
    - 9 3) Test for deleterious aggregate per ASTM C289.
    - 10 4) Proportioning of all materials.
    - 11 5) Type of cement with mill certificate for cement.
    - 12 6) Type of fly ash with certificate of conformance to specification requirements.
    - 13 7) Slump.
    - 14 8) Air content.
    - 15 9) Brand, type, ASTM designation, and quantity of each admixture proposed for use.
    - 16 10) 28-day cylinder compressive test results of trial mixes per ACI 318 and as  
17 indicated herein.
    - 18 11) Shrinkage test results.
    - 19 12) Standard deviation value for concrete production facility.
  - 20 3. Product technical data including:
    - 21 a. Acknowledgement that products submitted meet requirements of standards referenced.
    - 22 b. Manufacturer's installation instructions.
    - 23 c. Manufacturers and types:
      - 24 1) Joint fillers.
      - 25 2) Curing agents.
      - 26 3) Chemical sealer.
      - 27 4) Bonding and patching mortar.
      - 28 5) Construction joint bonding adhesive.
      - 29 6) Non-shrink grout with cure/seal compound.
      - 30 7) Waterstops.
    - 31 4. Reinforcing steel:
      - 32 a. Show grade, sizes, number, configuration, spacing, location and all fabrication and  
33 placement details.
      - 34 b. In sufficient detail to permit installation of reinforcing without having to make  
35 reference to Contract Drawings.
      - 36 c. Obtain approval of Shop Drawings by Engineer before fabrication.
      - 37 d. Mill certificates.
    - 38 5. Strength test results of in place concrete including slump, air content and concrete  
39 temperature.

## 40 1.5 DELIVERY, STORAGE, AND HANDLING

### 41 A. Storage of Material:

- 42 1. Cement and fly ash:
  - 43 a. Store in moistureproof, weathertight enclosures.
  - 44 b. Do not use if caked or lumpy.
- 45 2. Aggregate:
  - 46 a. Store to prevent segregation and contamination with other sizes or foreign materials.
  - 47 b. Obtain samples for testing from aggregates at point of batching.
  - 48 c. Do not use frozen or partially frozen aggregates.
  - 49 d. Do not use bottom 6 IN of stockpiles in contact with ground.
  - 50 e. Allow sand to drain until moisture content is uniform prior to use.
- 51 3. Admixtures:
  - 52 a. Protect from contamination, evaporation, freezing, or damage.
  - 53 b. Maintain within temperature range recommended by manufacturer.
  - 54 c. Completely mix solutions and suspensions prior to use.

- 
- 1           4. Reinforcing steel: Support and store all rebars above ground.
- 2           B. Delivery:
- 3           1. Concrete:
- 4           a. Prepare a delivery ticket for each load for ready-mixed concrete.
- 5           b. Truck operator shall hand ticket to Owner's Representative at the time of delivery.
- 6           c. Ticket to show:
- 7           1) Mix identification mark.
- 8           2) Quantity delivered.
- 9           3) Amount of each material in batch.
- 10          4) Outdoor temp in the shade.
- 11          5) Time at which cement was added.
- 12          6) Numerical sequence of the delivery.
- 13          7) Amount of water added.
- 14          2. Reinforcing steel:
- 15          a. Ship to jobsite with attached plastic or metal tags with permanent mark numbers.
- 16          b. Mark numbers to match Shop Drawing mark number.

## 17   **PART 2 - PRODUCTS**

### 18   **2.1 ACCEPTABLE MANUFACTURERS**

- 19          A. Subject to compliance with the Contract Documents, the following products and manufacturers
- 20          are acceptable:
- 21          1. Nonshrink, nonmetallic grout:
- 22           a. Sika "SikaGrout 212."
- 23           b. Euclid Chemical "NS Grout."
- 24           c. BASF Admixtures, Inc. "Masterflow 713."
- 25          2. Epoxy grout:
- 26           a. BASF Admixtures, Inc. "Brutem MPG."
- 27           b. Euclid Chemical Company, "E3-G."
- 28           c. Fosroc, "Conbextra EPHF".
- 29          3. Expansion joint fillers:
- 30           a. Permaglaze Co.
- 31           b. Rubatex Corp.
- 32           c. Williams Products, Inc.
- 33          4. Waterstops, PVC:
- 34           a. Greenstreak Plastic Products, Inc.
- 35           b. W.R.Meadows, Inc.
- 36           c. Burke Company.
- 37          5. Form coating:
- 38           a. Richmond "Rich Cote."
- 39           b. Industrial Lubricants "Nox-Crete Form Coating."
- 40           c. Euclid Chemical "Eucoslip VOX."
- 41          6. Prefabricated forms:
- 42           a. Simplex "Industrial Steel Frame Forms."
- 43           b. Symons "Steel Ply."
- 44           c. Universal "Uniform."
- 45          7. Chemical sealer:
- 46           a. L & M Construction Chemicals, Inc.
- 47           b. Euclid Chemical Company.
- 48           c. Dayton Superior.
- 49          8. Bonding agent:
- 50           a. Euclid Chemical Co.
- 51           b. BASF Admixtures, Inc.
- 52           c. L & M Construction Chemicals Inc.

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## 1 2.2 MATERIALS

- 2 A. Portland Cement: Conform to ASTM C150 Type II.
- 3 B. Fly Ash:
- 4 1. ASTM C618, Class F or Class C.
- 5 2. Nonstaining.
- 6 a. Hardened concrete containing fly ash to be uniform light gray color.
- 7 3. Maximum loss on ignition: 4 percent.
- 8 4. Compatible with other concrete ingredients.
- 9 5. Obtain proposed fly ash from a source approved by the State Highway Department in the
- 10 state where the Project is located for use in concrete for bridges.
- 11 C. Admixtures:
- 12 1. Air entraining admixtures: ASTM C260.
- 13 2. Water reducing, retarding, and accelerating admixtures:
- 14 a. ASTM C494 Type A through E.
- 15 b. Conform to provisions of ACI 212.3R.
- 16 c. Do not use retarding or accelerating admixtures unless specifically approved in writing
- 17 by Engineer and at no cost to Owner.
- 18 d. Follow manufacturer's instructions.
- 19 e. Use chloride free admixtures only.
- 20 3. Maximum total water soluble chloride ion content contributed from all ingredients of
- 21 concrete including water, aggregates, cementitious materials and admixtures by weight
- 22 percent of cement:
- 23 a. 0.10 all concrete.
- 24 4. Do not use calcium chloride.
- 25 5. Pozzolanic admixtures: ASTM C618.
- 26 6. Provide admixtures of same type, manufacturer and quantity as used in establishing required
- 27 concrete proportions in the mix design.
- 28 D. Water: Potable, clean, free of oils, acids and organic matter.
- 29 E. Aggregates:
- 30 1. Normal weight concrete: ASTM C33, except as modified below.
- 31 2. Fine aggregate:
- 32 a. Clean natural sand.
- 33 b. No manufactured or artificial sand.
- 34 3. Coarse aggregate:
- 35 a. Crushed rock, natural gravel, or other inert granular material.
- 36 b. Maximum amount of clay or shale particles: 1 percent.
- 37 4. Gradation of coarse aggregate:
- 38 a. Lean concrete and concrete topping: Size #7.
- 39 b. All other concrete: Size #57 or #67.
- 40 F. Concrete Grout:
- 41 1. Nonshrink nonmetallic grout:
- 42 a. Nonmetallic, noncorrosive, nonstaining, premixed with only water to be added.
- 43 b. Grout to produce a positive but controlled expansion.
- 44 c. Mass expansion not to be created by gas liberation.
- 45 d. Minimum compressive strength of nonshrink grout at 28 days: 6500 psi.
- 46 e. In accordance with COE CRD-C621.
- 47 2. Epoxy grout:
- 48 a. 3-component epoxy resin system.
- 49 1) Two liquid epoxy components.
- 50 2) One inert aggregate filler component.
- 51 b. Each component packaged separately for mixing at jobsite.
- 52 G. Reinforcing Steel:

- 
- 1            1. Reinforcing bars: ASTM A615, Grade 60.  
2            2. Welded wire fabric: ASTM A185.  
3            a. Minimum yield strength: 60,000 psi.  
4            3. Column spirals: ASTM A82.
- 5            H. Forms:  
6            1. Prefabricated or job built.  
7            2. Wood forms:  
8            a. New 5/8 or 3/4 IN 5-ply structural plywood of concrete form grade.  
9            b. Built-in-place or prefabricated type panel.  
10           c. 4 x 8 FT sheets for built-in-place type except where smaller pieces will cover entire  
11           area.  
12           d. When approved, plywood may be reused.  
13           3. Metal forms:  
14           a. Metal forms excluding aluminum may be used.  
15           b. Forms to be tight to prevent leakage, free of rust and straight without dents to provide  
16           members of uniform thickness.  
17           4. Chamfer strips: Clear white pine, surface against concrete planed.  
18           5. Form ties:  
19           a. Removable end, permanently embedded body type with cones on outer ends not  
20           requiring auxiliary spreaders.  
21           b. Cone diameter: 3/4 IN minimum to 1 IN maximum.  
22           c. Embedded portion 1-1/2 IN minimum back from concrete face.  
23           d. If not provided with threaded ends, constructed for breaking off ends without damage to  
24           concrete.  
25           e. Provide ties with built-in waterstops at all walls that will be in contact with process  
26           liquid during plant operation.  
27           6. Form release: Nonstaining and shall not prevent bonding of future finishes to concrete  
28           surface.
- 29           I. Waterstops:  
30           1. Plastic: COE CRD-C572.  
31           2. Serrated with center bulb.  
32           3. Thickness: 3/8 IN.  
33           4. Length (general use): 6 IN unless indicated otherwise.  
34           5. Expansion joints:  
35           a. Length: 9 IN.  
36           b. Center bulb: 1 IN OD x 1/2 IN ID.  
37           6. Provide hog rings or grommets spaced at maximum 12 IN OC along the length of the water  
38           stop.  
39           7. Provide factory made waterstop fabrications at all changes of direction, intersections and  
40           transitions leaving only straight butt splices for the field.
- 41           J. Chairs, Runners, Bolsters, Spacers, and Hangers:  
42           1. Stainless steel, epoxy coated, or plastic coated metal.  
43           a. Plastic coated: Rebar support tips in contact with the forms only.
- 44           K. Chemical Floor Sealer:  
45           1. Colorless low VOC water-based solution containing acrylic copolymers.  
46           a. ASTM C1315, Class B, minimum 30 percent solids.  
47           2. Similar to L & M Construction Chemicals Inc. Dress & Seal WB 30.
- 48           L. Vapor Retarder:  
49           1. Vapor transmission not exceeding 0.1 perm.  
50           2. Tear strength 15 psi.  
51           3. Similar to: Alumiseal "Zero Perm".
- 52           M. Membrane Curing Compound:  
53           1. ASTM C309, Type I-D.

- 1           2. Resin based, dissipates upon exposure to UV light.
- 2           3. Curing compound shall not prevent bonding of any future coverings, coatings or finishes.
- 3           4. Curing compounds used in water treatment plant construction to be nontoxic and taste and
- 4           odor free.

5           N. Bonding Agent:

- 6           1. High solids acrylic latex base liquid for interior or exterior application as a bonding agent to
- 7           improve adhesion and mechanical properties of concrete patching mortars.
- 8           2. Euclid Chemical Co. "Flex-Con."
- 9           3. BASF Admixtures, Inc. "Acryl-Set."
- 10          4. L & M Construction Chemicals "Everbond."
- 11          5. Thoro System Products "Acryl 60."

12          O. Expansion Joint Filler:

- 13          1. In contact with water or sewage:
  - 14           a. Closed cell neoprene.
  - 15           b. ASTM D1056, Class SC (oil resistant and medium swell) of 2 to 5 psi compression
  - 16           deflection (Grade SCE41).
- 17          2. Exterior driveways, curbs and sidewalks:
  - 18           a. Asphalt expansion joint filler.
  - 19           b. ASTM D994.
- 20          3. Other use:
  - 21           a. Fiber expansion joint filler.
  - 22           b. ASTM D1751.

23       **2.3 CONCRETE MIXES**

24       A. General:

- 25          1. All concrete to be ready mixed concrete conforming to ASTM C94.
- 26          2. Provide concrete of specified quality capable of being placed without segregation and, when
- 27          cured, of developing all properties required.
- 28          3. All concrete to be normal weight concrete.

29       B. Strength:

- 30          1. Provide specified strength and type of concrete for each use in structure(s) as follows:

TYPE	WEIGHT	SPECIFIED STRENGTH*
Concrete fill	Normal weight	3000 psi
Lean concrete	Normal weight	3000 psi
Concrete topping	Normal weight and lightweight	4000 psi
Precast concrete	Normal weight and lightweight	5000 psi
All other general use concrete	Normal weight	4000 psi

31       \* Minimum 28-day compressive strength.

33       C. Air Entrainment:

- 34          1. Provide air entrainment in all concrete resulting in a total air content percent by volume as
- 35          follows:

MAX AGGREGATE SIZE	TOTAL AIR CONTENT PERCENT
1 IN or 3/4 IN	5 to 7
1/2 IN	5 1/2 to 8

- 37          2. Air content to be measured in accordance with ASTM C231, ASTM C173, or ASTM C138.

39       D. Slump - 4 IN maximum, 1 IN minimum:

- 1 1. Measured at point of discharge of the concrete into the concrete construction member.
- 2 2. Concrete of lower than minimum slump may be used provided it can be properly placed and
- 3 consolidated.
- 4 3. Pumped concrete:
- 5 a. Provide additional water at batch plant to allow for slump loss due to pumping.
- 6 b. Provide only enough additional water so that slump of concrete at discharge end of
- 7 pump hose does not exceed maximum slump specified above.
- 8 4. Determine slump per ASTM C143.

9 E. Selection of Proportions:

- 10 1. General:
- 11 a. Proportion ingredients to:
- 12 1) Produce proper workability, durability, strength, and other required properties.
- 13 2) Prevent segregation and collection of excessive free water on surface.
- 14 2. Minimum cement contents and maximum water cement ratios for concrete to be as follows:
- 15

SPECIFIED STRENGTH	MINIMUM CEMENT, LB/CY			MAXIMUM WATER CEMENT RATIO BY WEIGHT
	MAXIMUM AGGREGATE SIZE			
	1/2 IN	3/4 IN	1 IN	
3000	---	517	517	0.45
4000	611	611	611	0.45
5000	---	686	665	0.40

- 16
- 17 3. Substitution of fly ash: Maximum of 25 percent by weight of cement at rate of 1 LB fly ash
- 18 for 1 LB of cement.
- 19 4. Sand cement grout:
- 20 a. Three part sand.
- 21 b. One part Portland cement.
- 22 c. Entrained air: Six percent plus or minus one percent.
- 23 d. Sufficient water for required workability.
- 24 e. Minimum 28-day compressive strength: 3,000 psi.
- 25 5. Pan stair fill:
- 26 a. Coarse aggregate: 100 percent passing a 1/2 IN sieve.
- 27 b. Proportions:
- 28 1) 1 sack cement.
- 29 2) 150 LBS coarse aggregate.
- 30 3) 150 LBS fine aggregate (sand).
- 31 c. Adjust mix to obtain satisfactory finishing.
- 32 6. Normal weight concrete:
- 33 a. Proportion mixture to provide desired characteristics using one of methods described
- 34 below:
- 35 1) Method 1 (Trial Mix): Per ACI 318, Chapter 5, except as modified herein.
- 36 a) Air content within range specified above.
- 37 b) Record and report temperature of trial mixes.
- 38 c) Proportion trial mixes per ACI 211.1.
- 39 2) Method 2 (Field Experience): Per ACI 318, Chapter 5, except as modified herein:
- 40 a) Field test records must be acceptable to Engineer to use this method.
- 41 b) Test records shall represent materials, proportions and conditions similar to
- 42 those specified.
- 43 7. Required average strength to exceed the specified 28-day compressive strength by the
- 44 amount determined or calculated in accordance with the requirements of Paragraph 5.3 of
- 45 ACI 318 using the standard deviation of the proposed concrete production facility as
- 46 described in Paragraph 5.3.1 of ACI 318.
- 47 F. Allowable Shrinkage: 0.048 percent per ASTM C157.

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## 1 PART 3 - EXECUTION

### 2 3.1 FORMING AND PLACING CONCRETE

#### 3 A. Formwork:

- 4 1. Contractor is responsible for design and erection of formwork.
- 5 2. Construct formwork so that concrete members and structures are of correct size, shape,  
6 alignment, elevation and position.
  - 7 a. Allowable tolerances: As recommended in ACI 347R.
- 8 3. Provide slabs and beams of minimum indicated depth when sloping foundation base slabs or  
9 elevated floor slabs to drains.
  - 10 a. For slabs on grade, slope top of subgrade to provide floor slabs of minimum uniform  
11 indicated depth.
  - 12 b. Do not place floor drains through beams.
- 13 4. Openings: Provide openings in formwork to accommodate work of other trades.
  - 14 a. Accurately place and securely support items built into forms.
- 15 5. Chamfer strips: Place 3/4 IN chamfer strips in forms to produce 3/4 IN wide beveled edges  
16 on permanently exposed corners of members.
- 17 6. Clean and adjust forms prior to concrete placement.
- 18 7. Tighten forms to prevent mortar leakage.
- 19 8. Coat form surfaces with form release agents prior to placing reinforcing bars in forms.

#### 20 B. Reinforcement:

- 21 1. Position, support and secure reinforcement against displacement.
- 22 2. Locate and support with chairs, runners, bolsters, spacers and hangers, as required.
- 23 3. Set wire ties so ends do not touch forms and are directed into concrete, not toward exposed  
24 concrete surfaces.
- 25 4. Lap splice lengths: ACI 318 Class B top bar tension splices unless indicated otherwise on  
26 the Drawings.
- 27 5. Extend reinforcement to within 2 IN of concrete perimeter edges.
  - 28 a. If perimeter edge is earth formed, extend reinforcement to within 3 IN of the edge.
- 29 6. Minimum concrete protective covering for reinforcement: As shown on Drawings.
- 30 7. Do not weld reinforcing bars.
- 31 8. Welded wire fabric:
  - 32 a. Install welded wire fabric in maximum practical sizes.
  - 33 b. Splice sides and ends with a splice lap length measured between outermost cross wires  
34 of each fabric sheet not less than:
    - 35 1) One spacing of cross wires plus 2 IN.
    - 36 2) 1.5 x development length.
    - 37 3) 6 IN.
  - 38 c. Development length: ACI 318 basic development length for the specified fabric yield  
39 strength.

#### 40 C. Construction, Expansion, and Contraction Joints:

- 41 1. Provide at locations indicated.
- 42 2. Locate wall vertical construction joints at 30 FT maximum centers and wall horizontal  
43 construction joints at 10 FT maximum centers.
- 44 3. Locate construction joints in floor slabs and foundation base slabs so that concrete  
45 placements are approximately square and do not exceed 2500 SF.
- 46 4. Locate construction joints in columns and walls:
  - 47 a. At the underside of beams, girders, haunches, drop panels, column capitals, and at floor  
48 panels.
  - 49 b. Haunches, drop panels, and column capitals are considered part of the supported floor  
50 or roof and shall be placed monolithically therewith.
  - 51 c. Column based need not be placed monolithically with the floor below.
- 52 5. Locate construction joints in beams and girders:
  - 53 a. At the middle of the span, unless a beam intersects a girder at that point.

- 1                    b. If the middle of the span is at an intersection of a beam and girder, offset the joint in the
- 2                    girder a distance equal to twice the beam width.
- 3                    c. Provide satisfactory means for transferring shear and other forces through the
- 4                    construction joint.
- 5                    6. Locate construction joints in suspended slabs:
- 6                    a. At or near the center of span in flat slab or T-beam construction.
- 7                    b. Do not locate a joint between a slab and a concrete beam or girder unless so indicated
- 8                    on Drawings.
- 9                    7. In pan-formed joists:
- 10                   a. At or near span center when perpendicular to the joists.
- 11                   b. Centered in the slab, midway between joists, when parallel to the joists.
- 12                   8. Install construction joints perpendicular to main reinforcement with all reinforcement
- 13                   continued across construction joints.
- 14                   9. At least 48 HRS shall elapse between placing of adjoining concrete construction.
- 15                   10. Thoroughly clean and remove all laitance and loose and foreign particles from construction
- 16                   joints.
- 17                   11. Before new concrete is placed, coat all construction joints with an approved bonding
- 18                   adhesive used and applied in accordance with manufacturer's instructions.

- 19                   D. Embedments:
- 20                   1. Set and build in anchorage devices and other embedded items required for other work that is
- 21                   attached to, or supported by concrete.
- 22                   2. Use setting diagrams, templates and instructions for locating and setting.
- 23                   3. Secure waterstops in correct position using hog rings or grommets spaced along the length
- 24                   of the waterstop and wire tie to adjacent reinforcing steel.

- 25                   E. Placing Concrete:
- 26                   1. Place concrete in compliance with ACI 304R and ACI 304.2R.
- 27                   2. Place in a continuous operation within planned joints or sections.
- 28                   3. Begin placement when work of other trades affecting concrete is completed.
- 29                   4. Place concrete by methods which prevent aggregate segregation.
- 30                   5. Do not allow concrete to free fall more than 4 FT.
- 31                   6. Where free fall of concrete will exceed 4 FT, place concrete by means of tremie pipe or
- 32                   chute.

- 33                   F. Consolidation: Consolidate all concrete using mechanical vibrators supplemented with hand
- 34                   rodding and tamping, so that concrete is worked around reinforcement and embedded items into
- 35                   all parts of forms.

- 36                   G. Protection:
- 37                   1. Protect concrete from physical damage or reduced strength due to weather extremes.
- 38                   2. In cold weather comply with ACI 306R except as modified herein.
- 39                   a. Do not place concrete on frozen ground or in contact with forms or reinforcing bars
- 40                   coated with frost, ice or snow.
- 41                   b. Minimum concrete temperature at the time of mixing:
- 42

OUTDOOR TEMPERATURE AT PLACEMENT (IN SHADE)	CONCRETE TEMPERATURE AT MIXING
Below 30 DegF	70 DegF
Between 30-45 DegF	60 DegF
Above 45 DegF	50 DegF

- 43
- 44                   c. Do not place heated concrete that is warmer than 80 DegF.
- 45                   d. If freezing temperatures are expected during curing, maintain the concrete temperature
- 46                   at or above 50 DegF for 7 days or 70 DegF for 3 days.
- 47                   e. Do not allow concrete to cool suddenly.
- 48                   3. In hot weather comply with ACI 305R except as modified herein.

- 
- 1 a. At air temperature of 90 DegF and above, keep concrete as cool as possible during  
2 placement and curing.  
3 b. Do not allow concrete temperature to exceed 90 DegF at placement.  
4 c. Prevent plastic shrinkage cracking due to rapid evaporation of moisture.  
5 d. Do not place concrete when the actual or anticipated evaporation rate equals or exceeds  
6 0.2 LBS/SF/HR as determined from ACI 305R, Figure 2.1.5.

7 H. Curing:

- 8 1. Begin curing concrete as soon as free water has disappeared from exposed surfaces.  
9 2. Cure concrete by use of moisture retaining cover, burlap kept continuously wet or by  
10 membrane curing compound.  
11 3. Provide protection as required to prevent damage to concrete and to prevent moisture loss  
12 from concrete during curing period.  
13 4. Provide curing for minimum of 7 days.  
14 5. Form materials left in place may be considered as curing materials for surfaces in contact  
15 with the form materials except in periods of hot weather.  
16 6. In hot weather follow curing procedures outlined in ACI 305R.  
17 7. In cold weather follow curing procedures outlined in ACI 306R.  
18 8. If forms are removed before 7 days have elapsed, finish curing of formed surfaces by one of  
19 above methods for the remainder of the curing period.  
20 9. Curing vertical surfaces with a curing compound:  
21 a. Cover vertical surfaces with a minimum of two coats of the curing compound.  
22 b. Allow the preceding coat to completely dry prior to applying the next coat.  
23 c. Apply the first coat of curing compound immediately after form removal.  
24 d. Vertical surface at the time of receiving the first coat shall be damp with no free water  
25 on the surface.  
26 e. A vertical surface is defined as any surface steeper than 1 vertical to 4 horizontal.

27 I. Form Removal:

- 28 1. Remove forms after concrete has hardened sufficiently to resist damage from removal  
29 operations or lack of support.  
30 2. Where no reshoring is planned, leave forms and shoring used to support concrete until it has  
31 reached its specified 28-day compressive strength.  
32 3. Where reshoring is planned, supporting formwork may be removed when concrete has  
33 sufficient strength to safely support its own weight and loads placed thereon.  
34 a. While reshoring is underway, no superimposed loads shall be permitted on the new  
35 construction.  
36 b. Place reshores as soon as practicable after stripping operations are complete but in no  
37 case later than the end of working day on which stripping occurs.  
38 c. Tighten reshores to carry their required loads.  
39 d. Leave reshores in place until concrete being supported has reached its specified 28-day  
40 compressive strength.

41 **3.2 CONCRETE FINISHES**

42 A. Tolerances:

- 43 1. 1/8 IN in 10 FT.

44 B. Surfaces Exposed to View:

- 45 1. Provide a smooth finish for exposed concrete surfaces and surfaces that are:  
46 a. To be covered with a coating or covering material applied directly to concrete.  
47 b. Scheduled for grout cleaned finish.  
48 2. Remove fins and projections, and patch voids, air pockets, and honeycomb areas with  
49 cement grout.  
50 3. Fill tie holes with nonshrink nonmetallic grout.

51 C. Surfaces Not Exposed to View:

- 52 1. Patch voids, air pockets and honeycomb areas with cement grout.  
53 2. Fill tie holes with nonshrink nonmetallic grout.

- 
- 1 D. Grout Cleaned Finish:
- 2 1. Mix one part Portland cement and 1-1/2 parts fine sand with sufficient bonding agent/water
- 3 mixture to produce a grout with the consistency of thick paint.
- 4 a. White Portland cement shall be substituted for gray Portland cement to produce a color
- 5 that matches color of surrounding concrete as determined by trial patch for areas not to
- 6 be painted.
- 7 2. Wet surface of concrete to prevent absorption of water by grout and uniformly apply grout
- 8 with brushes or spray gun.
- 9 3. Immediately scrub the surface with a cork float or stone to coat and fill air bubbles and
- 10 holes.
- 11 4. While grout is still plastic, remove all excess grout by working surface with rubber float,
- 12 sack or other approved means.
- 13 5. After the surface whitens from drying, rub vigorously with clean burlap.
- 14 6. Keep final finish damp for a minimum of 36 HRS after final rubbing.
- 15 E. Slab Float Finish:
- 16 1. After concrete has been placed, consolidated, struck off, and leveled, do no further work
- 17 until ready for floating.
- 18 2. Begin floating when water sheen has disappeared and surface has stiffened sufficiently to
- 19 permit operation.
- 20 3. During or after first floating, check planeness of entire surface with a 10 FT straightedge
- 21 applied at not less than two different angles.
- 22 4. Cut down all high spots and fill all low spots during this procedure to produce a surface
- 23 within Class B tolerance throughout.
- 24 5. Refloat slab immediately to a uniform sandy texture.
- 25 F. Troweled Finish:
- 26 1. Float finish surface.
- 27 2. Next power trowel, and finally hand trowel.
- 28 3. Produce a smooth surface which is relatively free of defects with first hand troweling.
- 29 4. Perform additional trowelings by hand after surface has hardened sufficiently.
- 30 5. Final trowel when a ringing sound is produced as trowel is moved over surface.
- 31 6. Thoroughly consolidate surface by hand troweling.
- 32 7. Leave finished surface essentially free of trowel marks, uniform in texture and appearance
- 33 and plane to a Class A tolerance.
- 34 8. On surfaces intended to support floor coverings remove any defects of sufficient magnitude
- 35 that would show through floor covering by grinding.
- 36 G. Broom Finish: Immediately after concrete has received a float finish as specified, give it a
- 37 transverse scored texture by drawing a broom across surface.
- 38 H. Apply chemical floor hardener to permanently exposed interior concrete floor slab surfaces
- 39 where indicated.
- 40 1. Apply in accordance with manufacturer's instructions.

### 41 3.3 GROUT

- 42 A. Preparation:
- 43 1. Nonshrinking nonmetallic grout:
- 44 a. Clean concrete surface to receive grout.
- 45 b. Saturate concrete with water for 24 HRS prior to grouting.
- 46 2. Rock anchors:
- 47 a. Clean rock anchors of all loose material.
- 48 b. Orient hook or bends in anchor bars to clear anchor bolts, reinforcements, and other
- 49 embedments to be installed later.
- 50 3. Epoxy grout: Apply only to clean, dry, roughened, sound surface.
- 51 B. Application:
- 52 1. Nonshrinking nonmetallic grout:

- 
- 1 a. Mix in a mechanical mixer.
  - 2 b. Use no more water than necessary to produce flowable grout.
  - 3 c. Place in accordance with manufacturer's instructions.
  - 4 d. Completely fill all spaces and cavities below the bottom of baseplates.
  - 5 e. Provide forms where baseplates and bedplates do not confine grout.
  - 6 f. Where exposed to view, finish grout edges smooth.
  - 7 g. Except where a slope is indicated on Drawings, finish edges flush at the baseplate,
  - 8 bedplate, member, or piece of equipment.
  - 9 h. Protect against rapid moisture loss by covering with wet rags or polyethylene sheets.
  - 10 i. Wet cure grout for 7 days, minimum.
  - 11 2. Rock anchors:
  - 12 a. See Item 1 above.
  - 13 b. If rodded:
  - 14 1) Fill each hole so that it overflows when anchor bar is inserted.
  - 15 2) Force anchor bars into place.
  - 16 c. If pressure placed, set anchor bar before grouting.
  - 17 d. Take special care to avoid any movement of anchors that have been placed.
  - 18 3. Epoxy grout:
  - 19 a. Mix and place in accordance with manufacturer's instructions.
  - 20 b. Completely fill all cavities and spaces around dowels and anchors without voids.
  - 21 c. Obtain manufacturer's field technical assistance as required to ensure proper placement.

### 22 3.4 FIELD QUALITY CONTROL

- 23 A. Owner will employ and pay for services of a concrete testing laboratory to perform testing of
- 24 concrete placed during construction.
- 25 1. Contractor to cooperate with Owner in obtaining and testing samples.
- 26 B. Tests During Construction:
- 27 1. Strength test - procedure:
- 28 a. Three cylinders, 6 IN DIA x 12 IN high, will be taken from each sample per
- 29 ASTM C172 and ASTM C31.
- 30 b. Cylinders will be tested per ASTM C39:
- 31 1) One at 7 days.
- 32 2) Two at 28 days.
- 33 2. Strength test - frequency:
- 34 a. Not less than one test each day concrete placed.
- 35 b. Not less than one test for each 50 CY or major fraction thereof placed in one day.
- 36 c. Not less than one test for each type of concrete poured.
- 37 d. Not less than one test for each concrete structure exceeding 2 CY volume.
- 38 3. Slump test:
- 39 a. Per ASTM C143.
- 40 b. Determined for each strength test sample.
- 41 c. Additional slump tests may be taken.
- 42 4. Air content:
- 43 a. Per ASTM C231, ASTM C173, and ASTM C138.
- 44 b. Determined for each strength test sample.
- 45 5. Temperature: Determined for each strength test sample.
- 46 C. Evaluation of Tests:
- 47 1. Strength test results:
- 48 a. Average of 28-day strength of two cylinders from each sample.
- 49 1) If one cylinder manifests evidence of improper sampling, molding, handling,
- 50 curing or testings, strength of remaining cylinder will be test result.
- 51 2) If both cylinders show any of above defects, test will be discarded.
- 52 D. Acceptance of Concrete:

- 
1. Strength level of each type of concrete shall be considered satisfactory if both of the following requirements are met:
    - a. Average of all sets of three consecutive strength tests equals or exceeds the required specified 28-day compressive strength.
    - b. No individual strength test falls below the required specified 28-day compressive strength by more than 500 psi.
  2. If tests fail to indicate satisfactory strength level, perform additional tests and/or corrective measures as directed by Engineer.
    - a. Perform additional tests and/or corrective measures at no additional cost to Owner.

### 3.5 SCHEDULES

#### A. Form Types:

1. Surfaces exposed to view:
  - a. Prefabricated or job-built wood forms.
  - b. Laid out in a regular and uniform pattern with long dimensions vertical and joints aligned.
  - c. Produce finished surfaces free from offsets, ridges, waves, and concave or convex areas.
  - d. Construct forms sufficiently tight to prevent leakage of mortar.
2. Surfaces normally submerged or not normally exposed to view: Wood or steel forms sufficiently tight to prevent leakage of mortar.
3. Other types of forms may be used:
  - a. For surfaces not restricted to plywood or lined forms.
  - b. As backing for form lining.

#### B. Grout:

1. Nonshrinking nonmetallic grout: General use.
2. Epoxy grout:
  - a. Grouting of dowels and anchor bolts into existing concrete.
  - b. Other uses indicated on Drawings.
3. Sand cement grout: Keyways of precast members.

#### C. Concrete:

1. Precast concrete: Where indicated on Drawings.
2. Lean concrete: Where indicated on Drawings.
3. Concrete fill: Where indicated on Drawings.
4. Lightweight concrete: Where indicated on Drawings.
5. Normal weight concrete: All concrete.
6. Concrete pan fill: Stair and landings where indicated on Drawings.
7. General use concrete: All other locations.

#### D. Concrete Finishes:

1. Grout cleaned finish: Where indicated on Drawings.
2. Slab finishes:
  - a. Use following finishes as applicable, unless otherwise indicated:
    - 1) Floated finish: Surfaces intended to receive roofing, concrete topping, lean concrete, concrete fill and waterproofing.
    - 2) Troweled finish: Interior floor slabs, exposed roof slabs and base slabs of structures, equipment bases, and column bases.
    - 3) Broom finish: Sidewalks, docks, concrete stairs, and ramps.

**END OF SECTION**

**SECTION 15116**  
**IRRIGATION OVERFLOW GATE**  
**(OVERSHOT GATE)**

**PART 1 - GENERAL**

**1.1 SCOPE**

This specification covers the requirements for design and supply of Overshot Gates and their hoist systems. The gates shall be furnished complete with embedded sill angle, gate leaf assembly, operating lift systems, anchoring fasteners and all required accessories for a complete field installation by the contractor.

Primary gate operation will be via an electric actuator and gear box. The gate actuation will be driven by a 12V DC motor, initially powered with a vehicle's 12V battery. In the future, AC power will be extended to the site to charge/maintain a battery for operation of the 12V gate motor.

**1.2 GENERAL**

The gates, hoist systems and accessories shall be of the size, type of material and construction, and quantity shown on the drawings and specified herein. The manufacturer shall be responsible for the design, supply and supervision of the installation of the embedments, gate and hoist system. Field installation shall be done according to the manufacturer's recommended installation procedures. Similar installations shall have operated successfully for at least five years.

**1.3 GOVERNING STANDARDS**

All welding shall be done in accordance with the latest USA Welding Bureau Specifications for welding stainless steel and carbon steel. Gate manufacturers shall be certified to CWB Division 2.1 or better for the welding of carbon steel or stainless steel.

**1.4 QUALITY ASSURANCE**

The gate manufacturer shall have at least ten years experience in the manufacture of overshot gates and shall be able to provide evidence to show successfully operating installations of similar size. The manufacturer must be able to provide evidence that shop welds, welding procedures and welders are qualified and certified to the latest specifications of the USA Welding Bureau in welding stainless steel and carbon steel. The gates shall be shop inspected.

**1.5 SUBMITTALS**

Installation drawings are to be provided for the Engineer's approval prior to fabrication show the following information:

- a) Anchor bolt layout and block outs.
- b) Material specifications and Painting requirements.
- c) Embedments installation.
- d) Field welding requirements.
- e) Gate and hoist installation.
- f) Field connection details.
- g) Sealing details.
- h) Required installation tolerances as recommended by supplier.
- i) Copy of manufacture shop inspection report.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURES**

- a) Armtec Limited
- b) Or Equal

### **2.2 MATERIALS**

All materials must be of sound quality and workmanship and meet the accepted specifications of the manufacturer.

Structural steel gate weldment	CSA G40.21 grade 300W
Seal retainers, hinge, anchors bolts	ASTM A276 304
Rubber seal	Molded Neoprene Rubber ASTM D2000
Fasteners	ASTM F593/4 304

### **2.3 COATINGS**

Gate Leaf, and control cabinet

Blast to SSPC 10 "near white" then direct coat with a minimum of two coats of a polyamine epoxy paint to a total minimum dry film thickness of 275-300um

Hoist Equipment- drive unit and pillow blocks

Coat to manufacturers standard.

Cross shafts and materials not otherwise designated shall be coated in accordance with Manufacturers Standard.

## **PART 3 - EXECUTION**

### **3.1 DESIGN CRITERIA**

Gate sill elevation is	4672.00	feet
Top of concrete structure elevation	4676.50	feet
Maximum upstream water elevation	4675.50	feet
Operational temperature range is	30 degrees to 110 degrees, (F)	

### **3.2 EMBEDMENT**

Embedment shall include a sill anchorage unit with hinge anchors, hoist deck equipment anchors, and under gate vent piping as shown on the manufacturer's standard drawings. The sill anchorage embedment shall consist of a Stainless Steel nose angle with tiebacks, and stainless steel anchor bolts secured and spaced to accept the hinge.

Adequate vent piping shall be provided by the contractor, and embedded in the sidewall to equalize air pressure beneath the gate leaf, in accordance with the manufacturer's recommendations.

Stainless steel equipment anchors shall be embedded in the hoist deck as required to mount the wire rope hoist components.

Provision shall be made in the hoist deck slab to allow the wire rope to pass through without interference throughout the travel of the system. Suitable recesses shall be formed in to the end walls and piers to allow operating clearance of control cables and connections.

### **3.3 GATE LEAF**

The gate leaf shall consist of rectangular welded steel and epoxy coated structure with a lifting point at each side of the downstream edge. The weir edge of the gate shall be designed so that maximum

deflection of the weir from a straight line, under maximum hydrostatic loading, shall not exceed 1/360 of the gate width. The gate leaf shall have provisions to attach a continuous piano style hinge along the upstream edge.

The sides of the gate leaf shall have seals affixed to minimize leakage where the gate interfaces with the structure walls. Seals shall be of the "J" type or flat type attached with stainless steel fasteners and retainer bar.

### **3.4 GATE HINGE**

The gate hinge shall be of a continuous piano type construction. The hinge shall consist of two steel interlocking halves joined together by a bronze rod. The hinge shall be matched and fastened to the upstream edge of the gate and to the sill anchors with stainless steel fasteners. The hinge shall include a rubber cover to minimize leakage thought the hinge. The hinge shall be constructed such that it is easily removed for maintenance or replacement.

### **3.5 SIDE SEAL RUBBING PLATES**

Stainless steel rubbing plate shall provide a smooth contact surface for the side seals throughout the full range of movement of the gate. The rubbing plates shall be adjustable on the anchor bolts to permit vertical alignment of the contact surfaces. The plates shall extend to the top of the wall or a minimum of one gate height above the top of gate when the gate is in the fully closed position. Rubbing plate shall be a 9.5-mm thick x 152-mm plate minimum in size.

### **3.6 OVERSHOT GATE HOIST SYSTEM**

The hoist shall consist of wire rope with attachments, cable drums, gearboxes, cross shafts, shaft couplers, base plates, with a manual and electric lift system. The hoist shall be designed to raise the gate leaf with the stated water head from a horizontal position (open) to a 60 degree from horizontal position (closed) at an approximate speed of 6 inches per minute.

#### **A. Wire Rope**

Wire rope shall be galvanized or stainless steel designed with a safety factor to breaking strength of approximately 5:1. Construction shall be 6 by 19 wire core. The connection to the gate shall be a forged galvanized open spelter socket.

#### **B. Drums**

Cable drums shall be constructed of solid steel bar stock and shall be grooved for the cable. Provision shall be made for a minimum of 2 dead wraps plus the normal hoisting requirements. Provision shall also be made for securing the cable end to the drum. Drums shall be placed such that a minimal fleet angle exists when the gate is in full closed position. Drum to cable ratio shall be a minimum of 12:1

#### **C. Cross shafts**

Cross shafts shall be machined from precision ground steel shafting.

#### **D. Shaft Couplings**

Couplings shall be of the geared type with either flange or sleeve type connection.

#### **E. Shaft bearing supports**

Support bearings shall be self aligning cast iron pillow block bearing assemblies, conservatively sized for the deign loads. Bearing blocks shall contain replaceable bearing surfaces, and shall be grease lubricated.

#### **F. Gearboxes**

The side mounted gearbox shall be in line helical gear reducer. The steel machined drums are attached to a steel cross shaft, which is attached to the gear box via

flex/rigid steel machined coupler. The gearbox shall be of the helical worm type with at least a worm ratio of 40:1. All gearboxes shall be fully enclosed of cast iron construction with oil bath lubrication. Gear shall be precision cut steel and shaft mounted on ball bearing races.

1. Manual Operator

To consist of one 24" diameter cast aluminum handwheel mounted to input shaft of gearbox, designed for 25lbs of pull.

### 3.7 ELECTRIC ACTUATORS

The manufacturer's standard electric actuator shall be mounted vertically to a drive gearbox. The actuator shall be designed for a 12VDC electric motor, and shall incorporate motor, reversing starter, local controls and terminals for remote control.

Also included shall be upper and lower position limit switches, torque overload switches, and a handwheel for manual operation.

The actuator reduction gearing shall be totally enclosed in an oil bath environment for operation at any angle.

A. 12VDC Powered System

Standard 12VDC electric motor shall be mounted vertically to a drive gearbox. Design allows for 12VDC Electrical and manual motor control using the **12VDC** system that comprises of two 12VDC battery cables (an estimated 10ft long) leading from the control panel housed inside the steel pedestal to the 12VDC Automobile battery system. (By Others)

System is comprised of (1) **12VDC UP/STOP/DOWN** (electrical) panel, (2) 12VDC battery cables c/w clamps, (1) 12VDC rotary limit switch.

1. Controls Cabinet

One fabricated steel cabinet shall be furnished to house the electrical panel and battery cables and as shown on the drawings will be provided with a gasketed weatherproof door, suitable latch and hasp for padlocking. Cabinet will be vented.

### 3.8 INSTALLATION

The contractor shall perform installation of all the gate and hoist components in a professional and workmanlike manner. The manufacturer shall provide installation drawings and an operation and maintenance manual. It shall be the contractor's responsibility to handle, store and install the gate components in strict compliance with the manufacturer's drawings, specifications and recommendations.

Care must be taken when storing the gates prior to installation and during the installation of the gate assemblies and parts to avoid any warping or damage to any of the components.

After installation, the equipment shall be cleaned, lubricated and serviced in accordance with the manufacturer's Instruction. The cable shall be adjusted to equalize tension and prevent racking of the gates. Check for proper installation of the seal with the aid of a feeler gauge. Adjust using the seals and seal rubbing plates. The gate shall be operated through at least one complete cycle before grouting or placing second stage concrete.

### 3.9 FIELD TESTING

Manufacturer shall have a representative on site during commissioning. Notification of at least 5 - 7 working days prior to the tests being done to allow arrangement of representative's schedule.

Hoist shall be operated through one complete cycle to show the following

- a) Gate operates from fully closed to fully open position.
- b) Gate tracks vertically with no apparent racking and or binding.

- c) Cable wraps smoothly onto the machined drums
- d) Machined drum demonstrates that there are sufficient grooves on the drum when the gate is fully opened

Manufacturer shall submit written documentation verifying all testing and that the overshot gates are acceptable for complete operation

### **3.10 TRAINING**

Manufacturer shall provide on site training to two employees designated by the OWNER. A minimum of 4 hours of training covering complete operations and maintenance.

### **3.11 ACCEPTANCE**

The acceptance of the work covered under this section will be based on the Engineer's visual inspection, measured or tested conformance and Certificates of Compliance.

**SECTION 15117**  
**IRRIGATION VERTICALLY HINGED GATE**  
**(LOPAC GATE)**

**PART 1 - GENERAL**

**1.1 SCOPE**

This specification covers the requirements for design and supply of Lopac Gates and their actuator systems. The gates shall be furnished complete with embedded sill angle, gate leaf assembly, operating lift systems, anchoring fasteners and all required accessories for a complete field installation by the contractor.

Primary gate operation will be via an electric pump and hydraulic cylinder. The gate actuation will be driven by a 12V DC pump, initially powered with a vehicle's 12V battery. In the future, AC power will be extended to the site to charge/maintain a battery for operation of the 12V gate pump.

**1.2 GENERAL**

The gates, actuator systems and accessories shall be of the size, type of material and construction, and quantity shown on the drawings and specified herein. Aqua Systems 2000 Inc. shall be responsible for the design, supply and supervision of the installation of the embedments, gate and actuator system. Field installation shall be done according to Aqua Systems 2000 Inc. recommended installation procedures. Similar installations shall have operated successfully for at least five years.

**1.3 SUBMITTALS**

Installation drawings are to be provided for the Engineer's approval prior to fabrication show the following information:

- a) Anchor bolt layout.
- b) Material specifications and Painting requirements.
- c) Embedments installation.
- d) Field welding requirements.
- e) Gate and actuator installation.
- f) Field connection details.
- g) Sealing details.
- h) Required installation tolerances as recommended by supplier.
- i) Copy of manufacture shop inspection report.

**PART 2 - PRODUCTS**

**2.1 ACCEPTABLE MANUFACTURES**

- a) Aqua Systems 2000 Inc.

**2.2 MATERIALS AND COATINGS**

All metal components to be coated with 2-part epoxy coating, light gray in color.

## **PART 3 - EXECUTION**

### **3.1 DESIGN CRITERIA**

The proposed vertically-hinged gate will have dimensions while closed of 4'x8' (height x width.) Manufacturer developed rating curves must demonstrate that the gate is capable of passing a minimum flowrate of 60 cfs with 0.2' of headloss when fully opened. Critical elevations are as follows:

Gate sill elevation is	4672.00	feet
Top of concrete structure elevation	4676.50	feet
Maximum upstream water elevation	4675.50	feet
Operational temperature range is	30 degrees to 110 degrees, (F)	

### **3.2 ELECTRIC ACTUATORS**

The manufacturer's standard electric actuator shall be mounted within the top of the LOPAC gate assembly. The actuator shall be designed for 12VDC power, and shall incorporate a pump driven hydraulic cylinder, local controls and terminals for remote control.

#### **A. 12VDC Powered System**

Standard 12VDC electric pump shall be mounted within the LOPAC assembly. Design allows for 12VDC Electrical and manual motor control using the **12VDC** system that comprises of two 12VDC battery cables (an estimated 10ft long) leading from the control panel housed inside the steel pedestal to the 12VDC Automobile battery system. (By Others)

System is comprised of (1) **12VDC UP/STOP/DOWN** (electrical) panel, (2) 12VDC battery cables c/w clamps, (1) 12VDC rotary limit switch.

#### **1. Controls Cabinet**

One fabricated steel cabinet shall be furnished to house the electrical panel and battery cables and as shown on the drawings will be provided with a gasketed weatherproof door, suitable latch and hasp for padlocking. Cabinet will be vented.

### **3.3 INSTALLATION**

The contractor shall perform installation of all the gate and actuator components in a professional and workmanlike manner. The manufacturer shall provide installation drawings and an operation and maintenance manual. It shall be the contractor's responsibility to handle, store and install the gate components in strict compliance with the manufacturer's drawings, specifications and recommendations.

Care must be taken when storing the gates prior to installation and during the installation of the gate assemblies and parts to avoid any warping or damage to any of the components.

After installation, the equipment shall be cleaned, lubricated and serviced in accordance with the manufacturer's Instruction.

### **3.4 FIELD TESTING**

Manufacturer shall have a representative on site during commissioning. Notification of at least 5 - 7 working days prior to the tests being done to allow arrangement of representative's schedule.

Hoist shall be operated through one complete cycle to show the following

- a) Gate operates from fully closed to fully open position.
- b) Gate tracks smoothly with no apparent racking and or binding.

Manufacturer shall submit written documentation verifying all testing and that the Lopac gates are acceptable for complete operation

### **3.5 TRAINING**

Manufacturer shall provide on site training to two employees designated by the OWNER. A minimum of 4 hours of training covering complete operations and maintenance.

### **3.6 ACCEPTANCE**

The acceptance of the work covered under this section will be based on the Engineer's visual inspection, measured or tested conformance and Certificates of Compliance.

**ARTICLE 5.0**  
**SUPPLEMENTAL TECHNICAL SPECIFICATIONS**  
**PRAIRIE VIEW DRIVE NON-POTABLE IRRIGATION**

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## **DIVISION 2-SITE WORK**

### **SECTION 02810-IRRIGATION**

#### **PART 1: GENERAL**

##### **1.01 SCOPE:**

Provide labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete installation of the irrigation system, and guarantee/warranty as shown on the drawings, the installation details, and as specified herein. Items of work specifically included are:

- A. Procurement of applicable licenses, permits, and fees.
- B. Coordination of service line, curb stop, and meter with the City of Evans.
- C. Coordination of Utility Locates ("Call Before You Dig").
- D. Sleeving for irrigation pipe and wire.
- E. Provision and connection of electrical power supply to irrigation control system.
- F. Preparation of Record Drawings.
- G. Maintenance period.

##### **1.02 SUBMITTALS:**

- A. Deliver four (4) copies of submittals to Owner's Representative within 10 working days from date of Notice to Proceed. Furnish information in 3-ring binder with table of contents and index sheet. Index sections for different components and label with specification section number and name of component. Furnish submittals for components on material list. Indicate which items are being supplied on catalog cut sheets when multiple items are shown on one sheet. Owner's Representative. Incomplete submittals will be returned without review.
- B. Materials List: Include sleeving, pipe, fittings, remote control valves, sprinkler components, drip irrigation components, control system components, shop drawings and other components shown on drawings and installation details or described herein. Include pipe sealant, wire, wire connectors, ID tags, and other miscellaneous items. Quantities of materials need not be included.
- C. Manufacturers' Data: Submit manufacturers' catalog cuts, specifications, and operating instructions for equipment shown on materials list.
- D. Shop Drawings: Submit shop drawings called for in installation details. Show products required for proper installation, their relative locations, and critical dimensions. Note modifications to installation detail.

### 1.03 RULES AND REGULATIONS:

- A. Provide work and materials in accordance with latest edition of National Electric Code, Uniform Plumbing Code as published by the Western Plumbing Officials Association, and applicable laws, regulations and codes of governing authorities.
- B. When contract documents call for materials or construction of better quality or larger size than required by above-mentioned rules and regulations, provide quality and size required by contract documents.
- C. If quantities are furnished either in specifications or on drawings, quantities are furnished for information only. It is Contractor's responsibility to determine actual quantities of material, equipment, and supplies required by the project and to complete independent estimate of quantities and wastage.
- D. Notify engineer in writing prior to construction about discrepancies between contract documents and existing site conditions or manufacturer's specific recommendations for use of their product.
- E. Contractor is responsible for damage to site amenities during construction. Replace damaged items with identical materials of equal value to match existing conditions. Make replacements at no additional cost to contract price. Penalty determination for specific damage as mutually agreed to by owner and contractor.

### 1.04 TESTING:

- A. Schedule testing with Owner's Representative a minimum of three days in advance of testing.
- B. Mainline pipe jointed with rubber gaskets or threaded connections may be subjected to pressure test at any time after partial completion of backfill. Allow irrigation pipe jointed with solvent-welded PVC joints to cure at least 24 hours before testing.
- C. Subsections of mainline pipe may be tested independently, subject to review of Irrigation Engineer.
- D. Provide clean, clear water, pumps, labor, fittings, and equipment necessary to conduct tests or retests.
- E. Hydrostatic Pressure Test:
  - 1. Subject mainline pipe to hydrostatic pressure equal to 140 PSI for two hours. Test with mainline components installed.
  - 2. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
  - 3. Purge air from mainline pipe before test. Attach pressure gauge to mainline pipe in test section.

4. Observe pressure loss on pressure gauge. If pressure loss is greater than 5 PSI, identify reason for pressure loss. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat test until pressure loss is equal to or less than 5 PSI.
5. Visually inspect irrigation pipe for leakage and replace defective pipe, fitting, joint, valve, or appurtenance. Repeat test until pipe passes test.
6. Cement or caulking to seal leaks is prohibited.

F. Volumetric Leakage Test:

1. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
2. Purge air from pipeline before test.
3. Subject mainline pipe to 140 PSI for two hours. Maintain constant pressure.
4. Provide all necessary pumps, bypass piping, storage tanks, meters, 3-inch test gauge, supply piping, and fittings in order to properly perform testing.
5. Testing pump must provide a continuous 140-PSI pressure to the mainline pipe. Allowable deviation in test pressure is 5-PSI during test period. Restore test pressure to 140-PSI at end of test.
6. Water added to mainline pipe must be measured volumetrically to nearest 0.10 gallons.
7. Use following table to determine maximum allowable volume lost during test:

Leakage Allowable (Gallons per (100 Joints) / Hour)

PIPE SIZE (INCHES)	Test Pressure (PSI)								
	60	70	80	90	100	110	120	130	140
3"	0.31	0.34	0.36	0.38	0.41	0.43	0.44	0.46	0.48
4"	0.42	0.45	0.48	0.51	0.54	0.57	0.59	0.62	0.64

Note: Allowable Leakage calculated using  $L = (ND\sqrt{P})/7400$

Where: L = Allowable Leakage (gph)  
 N = Number of Joints  
 D = Nominal Diameter of Pipe (inches)  
 P = Average Test Pressure (psi)

8. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat test until pipe passes test.

9. Cement or caulking to seal leaks is prohibited.
10. Contractor may sub-contract testing to pipeline testing company approved by Owner.

G. Operational Test:

1. Activate each remote control valve in sequence from controller. Provide either one additional personnel with radio or use handheld remote to activate remote control valves from controller. Manually activating remote control valve using manual bleed mechanism at remote control valve is not an acceptable method of activation. Owner's Representative will visually observe operation, water application patterns, and leakage.
2. Replace defective remote control valve, solenoid, wiring, or appurtenance to correct operational deficiencies.
3. Replace, adjust, or move water emission devices to correct operational or coverage deficiencies.
4. Replace defective pipe, fitting, joint, valve, sprinkler, or appurtenance to correct leakage problems. Cement or caulking to seal leaks is prohibited.
5. Repeat test(s) until each lateral passes all tests. Repeat tests, replace components, and correct deficiencies at no additional cost to Owner.

H. Sensor Cable:

1. Test for leaks to ground per manufacturer's recommendations. Test results must meet or exceed manufacturer's guidelines for acceptance.
2. Test cable for continuity if cable is being installed for future expansion of the irrigation system.
3. Replace defective wire, underground splices, or appurtenances. Repeat test until manufacturer's guidelines are met.

I. Control System Grounding:

1. Test for proper grounding of control system per manufacturer's recommendations. Must be tested to less than 5 ohms resistance.
2. Replace defective wire, grounding rods, grounding plates, or appurtenances. Repeat test until manufacturer's guidelines are met.

J. Testing Review:

1. Failure of initial testing review will require additional review. Payment of costs, including travel expenses and site visits by Owner's Representative, for additional reviews that may be required due to non-compliance with the Construction Documents will be Contractor's responsibility.

1.05 CONSTRUCTION REVIEW:

The purpose of on-site reviews by Owner's Representative is to periodically observe work in progress, Contractor's interpretation of construction documents, and to address questions with regard to installation.

- A. Schedule reviews for irrigation system layout or testing with Owner's Representative as required by these specifications.
- B. Impromptu reviews may occur at any time during project.
- C. Sprinkler layout must be reviewed and approved by Owner's Representative prior to installation of sprinklers or lateral pipe.
- D. Mainline layout must be reviewed and approved by Owner's Representative prior to installation of mainline pipe, control wiring, gate valves, and remote control valve assemblies.
- E. A review will occur at completion of irrigation system installation and Project Record Drawing submittal.

1.06 GUARANTEE/WARRANTY AND REPLACEMENT:

The purpose of guarantee/warranty is to ensure that Owner receives irrigation materials of prime quality, installed and maintained in thorough and careful manner.

- A. Guarantee/warranty irrigation materials, equipment, and workmanship against defects for period of one year from formal written acceptance by Owner's Representative. Fill and repair depressions. Restore landscape, utilities, structures and site features damaged by settlement of irrigation trenches or excavations. Repair damage to premises caused by defective items. Make repairs within seven days of notification from Owner's Representative.
- B. Replace damaged items with identical materials and methods per contract documents or applicable codes. Make replacements at no additional cost to contract price.
- C. Guarantee/warranty applies to originally installed materials and equipment, and replacements made during guarantee/warranty period.

## PART 2: MATERIALS

### 2.01 QUALITY:

Use new materials without flaws or defects, and which are the best of their class and kind.

### 2.02 SUBSTITUTIONS:

- A. Use specified equipment, or pre-approved equal. Alternative equipment must be approved by Engineer prior to bidding. Changes and associated design costs to accommodate alternative equipment are Contractor's responsibility.
- B. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at Contractor's option.

### 2.03 IRRIGATION TAP AND WATER METER

- A. Furnish materials required by local codes for installation of municipal water tap and associated piping.
- B. Furnish materials required by local code for installation of water meter and associated piping.

### 2.04 SLEEVING:

- A. Provide sleeve beneath hardscape for irrigation pipe. Provide separate sleeve beneath hardscape for wiring bundle.
- B. Provide PVC Class 200 pipe with solvent welded joints for sleeving material beneath hardscape.
- C. Provide HDPE SDR9 pipe, rated at 200 PSI, for horizontal boring material beneath roadways. Join pipe lengths using butt-fusion techniques as recommended by pipe manufacturer.
- D. Sleeve sizing: A minimum of twice the nominal diameter of solvent-welded pipe or wiring bundle, or as indicated on drawings. Sleeve diameter for gasketed pipe must accommodate outside diameter of joint-restraint casing spacers, refer to joint-restraint manufacturer's sizing recommendations.

### 2.05 PIPE AND FITTINGS:

- A. Mainline Pipe and Fittings:
  - 1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with integral belled end.

2. Use Class 200, SDR-21, rated at 200 PSI, conforming to dimensions and tolerances established by ASTM Standard D2241.

Use solvent weld pipe for mainline pipe with nominal diameter less than 3-inches. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784. Use primer approved by pipe manufacturer. Use solvent cement conforming to ASTM Standard D2564.

3. Use rubber-gasketed pipe equipped with factory installed reinforced gaskets for mainline pipe with nominal diameter greater than or equal to 3-inches. Use Gasketed pipe joints conforming to "Laboratory Qualifying Tests" section of ASTM D3139. Use gasket material conforming to ASTM F477. Use Harco or approved equal rubber-gasketed deep bell ductile iron fittings conforming to ASTM A-536 and ASTM F-477. Use lubricant approved by pipe manufacturer.

For C900 or C905 pipe, use ductile iron mechanical joint fittings, gaskets, and hardware conforming to ANSI/AWWA C153/A21.53, ANSI/AWWA C110/A21.10, and ANSI/AWWA C111/A21.11.

4. Mainline pipe within sleeves: Use solvent weld pipe for mainline pipe with nominal diameter 3-inches and smaller installed within sleeves. Use pipe equipped with factory installed reinforced gaskets for mainline pipe with nominal diameter of 4-inches and larger installed within sleeves. Provide restrained casing spacers where gasketed joints occur within sleeve.

B. Lateral Pipe and Fittings:

1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with integral belled end suitable for solvent welding.
2. Use Class 160, SDR-26, rated at 160 PSI, conforming to dimensions and tolerances established by ASTM Standard D2241. Use PVC pipe rated at higher pressures than Class 160 in cases where small nominal diameters are not manufactured in Class 160.

Use solvent weld pipe for lateral pipe. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Use primer approved by pipe manufacturer. Solvent cement to conform to ASTM Standard D2564, of type approved by pipe manufacturer.

C. Specialized Pipe and Fittings:

1. Galvanized steel pipe: Use Schedule 40 conforming to ASTM Standard A53.

Use galvanized, threaded, standard weight, malleable iron fittings.

2. Ductile iron pipe: Use Class 50 conforming to ANSI A21.51 (AWWA C151). Use minimum of Class 53 thickness pipe for flanged piping.  
  
Use mechanical joints conforming to ANSI A 21.10 (AWWA C110) and ANSI A21.11 (AWWA C111) or flanged fittings conforming to ANSI/AWWA C110 and ANSI B16.1 (125#).
3. Low Density Polyethylene Hose:
  - a. Use pipe specifically intended for use as flexible swing joint.  
Inside diameter:  $0.490 \pm 0.010$  inch.  
Wall thickness:  $0.100 \pm 0.010$  inch.  
Color: Black.
  - b. Use spiral barb fittings supplied by same manufacturer as hose.
4. Use stainless steel fasteners and rubber gaskets for flanged connections.
5. Use PVC Schedule 80 nipples and PVC Schedule 80 threaded fittings for threaded pipe connections.
6. Joint sealant: Use non-hardening, nontoxic pipe thread sealant formulated for use on threaded connections and approved by pipe fitting or valve manufacturer.

D. Thrust Blocks:

1. Use 3,000 PSI concrete. Use commercially pre-mixed concrete unless written approval is provided by Owner's Representative prior to construction.
2. Use 2 mil plastic protective sheeting.
3. Use No. 4 Rebar.

E. Joint Restraint Harness:

1. Provide joint restraint harness components as recommended by pipe and fitting manufacturer and in accordance with accepted industry practices. For joint restraints on ductile iron pipe applications, use restraint components constructed of 60-42-10 ductile iron conforming to ASTM A536. For joint restraints on PVC pipe applications, use restraint components constructed of 60-42-10 ductile iron conforming to ASTM A536-80 and ASTM F1674-96.
2. Use bolts, nuts, retaining clamps, all-thread, or other joint restraint harness materials which are zinc plated or galvanized.

3. Restrained Casing Spacers: Provide Ford Uni-Flange Restrained Casings Spacers or equal. Use restrainer body and runner supports constructed of high strength ductile iron meeting ASTM A536 and grade 65-42-12. Use Connecting rods conforming to ASTM A242, ANSI/AWWAC111/A21.11. Use runners constructed of ultra high molecular weight polymer.

2.06 NON-POTABLE WATER METER ASSEMBLY AND IRRIGATION WATER CONNECTION ASSEMBLY:

- A. Non-Potable Water Meter Assembly: as presented in the installation details.
- B. Irrigation Water Connection Assembly: as presented in the installation details. Provide shop drawings of the aluminum enclosure. Order the pre-fabricated aluminum enclosure from Perry Hendricks (cell: 970-261-1448, office: 970-263-2206) with Munroe Pumps.

2.07 MAINLINE COMPONENTS:

- A. Winterization Assembly: as presented in the installation details. Install a separate valve box over a 3-inch depth of 3/4-inch gravel for each assembly.
- B. Master Valve Assembly: as presented in the installation details. Install a separate valve box over a 3-inch depth of 3/4-inch gravel for each assembly.
- C. Flow Sensor Assembly: as presented in the installation details. Install a separate valve box over a 3-inch depth of 3/4-inch gravel for each assembly.
- D. Isolation Gate Valve Assembly: as presented in the installation details. Install a separate valve box over a 3-inch depth of 3/4-inch gravel for each assembly.
- E. Quick Coupling Valve Assembly: double swing joint arrangement as presented in the installation details.

2.08 SPRINKLER IRRIGATION COMPONENTS:

- A. Remote Control Valve (RCV) Assembly for Sprinkler Laterals: as presented in drawings and installation details. Use wire connectors and waterproofing sealant to join control wires to solenoid valves. Use standard Christy I.D. tags with hot-stamped black letters on a yellow background. Install a separate valve box over a 3-inch depth of 3/4-inch gravel for each assembly.
- B. Sprinkler Assembly: as presented in drawings and installation details.

2.09 DRIP IRRIGATION COMPONENTS:

- A. Remote Control Valve (RCV) Assembly for Drip Laterals: as presented in drawings and installation details.

- B. Inline Drip Tubing:
  - 1. Tubing: Use UV resistant polyethylene drip tubing with integral pressure compensating drip emitters. Emitter spacing as noted in drawings and installation details. Use emitters that are pressure compensating from 7 to 70 PSI. Use tubing with O.D. of 0.67", and I.D. of 0.57". Use fittings compatible with inline drip tubing.
  - 2. Blank Drip Tubing: Use UV resistant polyethylene blank drip tubing for exhaust manifold tubing, as noted in drawings and installation details. Use tubing with O.D. of 0.67", and I.D. of 0.57". Use fittings compatible with inline drip tubing. Use blank tubing from same manufacturer as Inline drip tubing.
- C. Inline Drip Flush Valve Assembly: as presented in drawings and installation details.
- D. Swing Check Valve Assembly: as presented in drawings and installation details.

## 2.10 CENTRAL CONTROL SYSTEM COMPONENTS:

- A. Satellite Control Unit:
  - 1. Description: Rain Bird ESP-SAT LW (LINK) wall mounted satellite controller with Maxi-Link radio compatible with City of Evans Maxi-Com Central Control System.
  - 2. Provide Rain Bird Services pre-start inspection of system and perform radio survey to confirm radio operation between CCU and satellite controller. Rain Bird Services phone number is 720-493-4770.
  - 3. Rain Bird Services is to perform radio test to verify antenna required for adequate communication between CCU and field satellite. Assume a high gain antenna for base bid and allow for a change request if actual antenna's requirements are different than the base bid. If a different antenna is required, provide documentation for required antenna for review and approval by Owner. The satellite controller must communicate via radio with the CCU located at the City of Evan Parks and Recreation maintenance facility.
  - 4. Provide primary surge protection (Hubble Outlet) on the incoming 120 Volt power to the controller and provide lightning protection on the output side of the controller to protect all control system from an electrical surge or lightning.
  - 5. Provide grounding as recommended by control system manufacturer. At minimum, provide one 4" x 96" x 0.06" copper ground plate, one 5/8"x10 foot copper clad UL listed grounding rod, 30 feet of #6 AWG bare copper grounding wire, and one CADWELD connector, and one 6-inch round valve box.

B. Satellite Assembly:

1. Provide a pre-assembled and pretested assembly provided by Rain Bird Services consisting of the satellite controller, pulse decoders, terminal strips, surge protection and other equipment as required.
2. Controller to be installed in a stainless steel enclosure as noted on the installation details.
3. Submit shop drawing of satellite assembly for review and approval prior to installation.

C. Control Wire:

1. It is assumed that existing low-voltage control wire between existing controller and solenoid valves is in workable condition. Report concerns regarding existing control wire in writing to engineer prior to renovation or construction.
2. Use American Wire Gauge (AWG) No. 14-1 solid copper, 600 volt, Type UF or PE cable, UL approved for direct underground burial for individual control wires and spare control wires from the controller assembly to each remote control valve or stub-out location. Use American Wire Gauge (AWG) No. 12-1 solid copper, 600 volt, Type UF or PE cable, UL approved for direct underground burial for common ground wire and spare common wires from controller assembly to each remote control valve or stub-out location.
3. Color: Use white for common ground wire. Use easily distinguished colors for other control wires. Spare control wires shall be of a color different from that of active control wire. Wire color shall be continuous over its entire length.
4. Electrical conduit: Use PVC Schedule 40 conduit conforming to dimensions and tolerances established by ASTM Standard D-1785. Use Schedule 40, Type 1, PVC solvent weld sweep fittings for PVC conduit conforming to ASTM Standards D2466 and D1784 for buried installations. Use rigid metallic conduit with sweep elbows for above grade installations.
5. Warning tape: Inert plastic film highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils. Three inches wide, colored red, and imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW."
6. Splices: Use 3M DBY or 3M DBR wire connector.
7. Encase wiring not located near PVC irrigation pipe in PVC Schedule 40 electrical conduit.

D. Power Wire:

1. Use AWG #12, solid or stranded copper, Type UF single-conductor cable or multi-conductor with ground cable, UL approved for direct underground burial from power source to Cluster Control Unit or Satellite Controller Assembly.
2. Splices: Use 3M #82-A2 Series with Split Bolts or Butt Connectors for inline splices and 82-B1 or 90-B1 Series for wye splices.
3. Electrical conduit: Use PVC Schedule 40 conduit conforming to dimensions and tolerances established by ASTM Standard D-1785. Use Schedule 40, Type 1, PVC solvent weld sweep fittings for PVC conduit conforming to ASTM Standards D2466 and D1784 for buried installations. Use rigid metallic conduit with sweep elbows for above grade installations.
4. Warning tape: Inert plastic film highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils. Three inches wide, colored red, and imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW."

E. Sensor Cable:

1. Use sensor cable designed for direct burial, as recommended by central control system manufacturer.
2. Splices: Use sensor cable splices as recommended by central control system manufacturer.
3. Connect sensor cable to satellite controller using pulse decoder per central control system manufacturer.
4. Electrical conduit: Use PVC Schedule 40 conduit conforming to dimensions and tolerances established by ASTM Standard D-1785. Use Schedule 40, Type 1, PVC solvent weld sweep fittings for PVC conduit conforming to ASTM Standards D2466 and D1784 for buried installations. Use rigid metallic conduit with sweep elbows for above grade installations.
5. Warning tape: Inert plastic film highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils. Three inches wide, colored red, and imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW."

F. Instrumentation:

1. As presented in the drawings and installation details.

## 2.11 OTHER COMPONENTS:

- A. Tools and Spare Parts: Furnish operating keys, servicing tools, spare parts and other items indicated in drawings and specifications.
- B. Other Materials: Provide other materials or equipment shown on drawings or installation details that are part of irrigation system, even though items may not have been referenced in specifications.

## PART 3: EXECUTION

### 3.01 INSPECTIONS AND REVIEWS:

- A. Site Inspections:
  - 1. Verify construction site conditions and note irregularities affecting work of this section. Report irregularities in writing to Owner's Representative prior to beginning work.
  - 2. Commencement of work implies acceptance of existing site conditions.
- B. Utility Locates ("Call Before You Dig"):
  - 1. Arrange and coordinate Utility Locates with local authorities prior to construction.
  - 2. Repair underground utilities that are damaged during construction. Make repairs at no additional cost to contract price.
- C. Irrigation System Layout Review: Irrigation system layout review will occur after the stationing has been completed. Notify the Owner's Representative one week in advance of review. Modifications will be identified by the Owner's Representative at this review.

### 3.02 LAYOUT OF WORK:

- A. Stake out irrigation system. Items staked include: sprinklers, pipe, sleeves, control valves, isolation valves, and controller assemblies. Inspection required by City of Evans representative prior to installation of staked components.
- B. Install irrigation components inside of project property lines.

### 3.03 EXCAVATION, TRENCHING, AND BACKFILLING:

- A. Excavate and install pipes at minimum cover indicated in drawings or specifications. Excavate trenches at appropriate width for connections and fittings.

- B. Minimum cover (distance from top of pipe or control wire to finish grade):
  - 1. Mainline pipe: 30-inch to top of pipe.
  - 2. Control wire: 2-inches deeper than bottom of mainline pipe.
  - 3. Lateral pipe to sprinklers: 12-inches to top of pipe.
  - 4. Lateral pipe to drip components: 12-inches to top of drip lateral pipe.
- C. Maintain at least 10-foot clearance from centerline of trees where possible.
- D. PVC may be pulled into soil if soil conditions allow, utilizing vibratory plow device specifically manufactured for pipe pulling. Install pipe at burial depths listed above.
- E. Backfill only after lines have been reviewed and tested.
- F. Excavated material is generally satisfactory for backfill. Use backfill free from rubbish, vegetable matter, frozen materials, and stones larger than 2-inches in maximum diameter. Remove material not suitable for backfill. Use backfill free of sharp objects next to pipe.
- G. Backfill buried unsleeved pipe in either of the following manners:
  - 1. Backfill and puddle lower half of trench. Allow to dry 24 hours. Backfill remainder of trench in 6-inch layers. Compact to density of surrounding soil.
  - 2. Backfill trench by depositing backfill material equally on both sides of pipe in 6-inch layers and compacting to density of surrounding soil.
- H. Enclose pipe and wiring beneath roadway and hardscapes in separate sleeves. Minimum compaction of backfill for sleeves shall be 95 percent Standard Proctor Density, ASTM D698-78. Use of water for compaction around sleeves, "puddling", will not be permitted.
- I. Dress backfilled areas to original grade. Incorporate excess backfill into existing site grades. Dispose of excess backfill off site.
- J. Contact Owner's Representative for trench depth adjustments where utilities conflict with irrigation trenching and pipe work.

#### 3.04 IRRIGATION TAP AND WATER METER:

- A. Provide municipal water tap and associated piping materials in conformance with local regulations.
- B. Provide water meter assembly and associated piping in conformance with local regulations.

3.05 SLEEVING AND BORING:

- A. Provide sleeving at depth that permits encased pipe or wiring to remain at specified burial depth.
- B. Extend sleeve ends twelve inches beyond edge of hardscape. Cap sleeve ends and mark with stakes.
- C. Bore for sleeves under obstructions that cannot be removed. Employ equipment and methods designed for horizontal boring.

3.06 ASSEMBLING PIPE AND FITTINGS:

- A. General:
  - 1. Keep pipe free from dirt and debris. Cut pipe ends square, debur and clean as recommended by manufacturer.
  - 2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.
  - 3. Trenches may be curved to change direction or avoid obstructions within limits of the curvature of pipe. Curvature results from bending of pipe lengths. Do not exceed pipe and fitting manufacturer's allowable deflection at joints. Minimum radius of curvature and offset per 20-foot length of pipe-by-pipe size are shown in following table.

SIZE	RADIUS	OFFSET PER 20' LENGTH
1 ½"	25'	7'-8"
2"	25'	7'8"
2 ½"	100'	1'-11"
3"	100'	1'-11"
4"	100'	1'-11"

- B. Mainline Pipe and Fittings:
  - 1. Use only strap-type friction wrenches for threaded plastic pipe.
  - 2. PVC Rubber-Gasketed Pipe:
    - a. Use pipe lubricant. Join pipe in the manner recommended by manufacturer and in accordance with accepted industry practices.

- b. Ductile iron fittings shall not be struck with a metallic tool. Cushion blows with a wood block or similar shock absorber.
  - 3. PVC Solvent Weld Pipe:
    - a. Use primer and solvent cement. Join pipe in a manner recommended by the manufacturer and in accordance with accepted industry practices.
    - b. Cure for 30 minutes before handling and 24 hours before allowing water in pipe.
    - c. Snake pipe from side to side within the trench.
  - 4. Fittings: The use of cross type fittings is not permitted.
- C. Lateral Pipe and Fittings:
  - 1. Use only strap-type friction wrenches for threaded plastic pipe.
  - 2. PVC Solvent Weld Pipe:
    - a. Use primer and solvent cement. Join pipe in the manner recommended by the manufacturer and in accordance with accepted industry practices.
    - b. Cure for 30 minutes before handling and 24 hours before allowing water in the pipe.
    - c. Snake pipe from side to side within the trench.
  - 3. Fittings: The use of cross type fittings is not permitted.
- D. Specialized Pipe and Fittings:
  - 1. Galvanized Steel Pipe:
    - a. Join pipe with Teflon-type tape or pipe joint compound in manner recommended by manufacturer and in accordance with accepted industry practices.
    - b. Use factory-made threads whenever possible. Field-cut threads will be permitted only where necessary. Cut threads on axis using clean, sharp dies.
  - 2. Ductile Iron Pipe: Join pipe in the manner recommended by manufacturer and in accordance with accepted industry practices.
  - 3. Insert dielectric union or flange wherever copper-based metal (copper, brass, bronze) and iron-based metal (iron, galvanized steel, stainless steel) are joined.

4. Low Density Polyethylene Hose: Install hose and compatible fittings in manner recommended by manufacturer and in accordance with accepted industry practices.
  5. Flanged connections: Install fittings, fasteners and gaskets in manner recommended by manufacturer and in accordance with accepted industry practices.
  6. PVC Threaded Connections:
    - a. Use only factory-formed threads. Field-cut threads are not permitted.
    - b. Apply thread sealant in manner recommended by component, pipe and sealant manufacturers and in accordance with accepted industry practices.
    - c. Use plastic components with male threads and metal components with female threads where connection is plastic-to-metal.
- E. Thrust Blocks:
1. Must be inspected by City of Evans representative prior to pouring concrete.
  2. Use cast-in-place concrete bearing against undisturbed soil.
  3. Size, orientation and placement shall be as shown on the installation details.
  4. Wrap fitting with plastic to protect bolts, joint, and fitting from concrete.
  5. Install rebar with mastic coating as shown on the installation details.
- F. Joint Restraint Harness:
1. Use on pipe greater than or equal to 3-inch diameter or any diameter of rubber gasketed pipe. Use a joint restraint harness wherever joints are not positively restrained by flanged fittings, threaded fittings, and/or thrust blocks.
  2. Use a joint restraint harness with transition fittings between metal and PVC pipe, where weak trench banks do not allow use of thrust blocks, or where extra support is required to retain fitting or joint.
  3. Use restrained casing spacers for gasketed pipe routed through sleeving. Install harness in the manner recommended by the manufacturer and in accordance with accepted industry practices. Install self-restraining casing spacers at all gasketed pipe bell joints and every 10-feet along the gasketed mainline pipe installed through sleeving. Provide correct number and type of restraints per manufacturer's requirements.

3.07 NON-POTABLE WATER METER ASSEMBLY AND IRRIGATION WATER CONNECTION ASSEMBLY:

A. Non-Potable Water Meter Assembly:

1. Provide associated piping, fittings, and meters and keep free from dirt and debris. Cut pipe ends square, debur and clean as recommended by manufacturer.
2. Provide precast manhole that meets ASTM C478.
3. Coordinate installation with the Owner's Representative.

B. Irrigation Water Connection Assembly:

1. Provide associated piping, fittings, filter, and backflow preventor free from dirt and debris. Cut pipe ends square, debur, and clean as recommended by manufacturer.
2. Coordinate installation with the Owner's Representative.

3.08 INSTALLATION OF MAINLINE COMPONENTS:

A. Winterization Assembly: Provide where indicated on drawings. Brand "WA" on valve box lid in 2-inch high letters.

B. Master Valve Assembly: Provide where indicated on drawings. Brand "MV" on valve box lid in 2-inch high letters.

C. Flow Sensor Assembly: Provide where indicated on drawings. Brand "FS" on valve box lid in 2-inch high letters.

D. Isolation Gate Valve Assembly:

1. Install where indicated on the drawings.
2. Locate at least 12-inches from and align with adjacent walls or edges of paved areas.

E. Quick Coupling Valve Assembly: Install where indicated on the drawings.

3.09 INSTALLATION OF SPRINKLER IRRIGATION COMPONENTS:

A. Remote Control Valve (RCV) Assembly for Sprinkler Laterals:

1. Flush mainline before installation of RCV assembly.
2. Provide where indicated on drawings. Use wire connectors and waterproof sealant to connect control wires to remote control valve wires. Provide connectors and sealant per manufacturer's recommendations.

3. Provide only one RCV to a valve box. Locate valve box at least 12-inches from and align with nearby walls or edges of paved areas. Group RCV assemblies together where practical. Align grouped valve boxes in uniform patterns. Allow at least 12-inches between valve boxes. Brand controller letter and station number on valve box lid in 2-inch high letters.
  4. Adjust RCV assembly to regulate downstream operating pressure.
  5. Attach ID tag with controller station number to control wiring.
- B. Sprinkler Assembly:
1. Flush lateral pipe before installing sprinkler assembly.
  2. Provide per installation details at locations shown on drawings.
  3. Locate spray sprinklers 3-inches from adjacent walls, fences, or edges of paved areas.
  4. Install sprinklers perpendicular to finish grade.
  5. Provide appropriate nozzle or adjust arc of coverage of each sprinkler for best performance and uniform coverage.
  6. Adjust radius of throw of each sprinkler for best performance and uniform coverage.

### 3.10 INSTALLATION OF DRIP IRRIGATION COMPONENTS:

- A. Remote Control Valve (RCV) Assembly for Drip Laterals:
1. Flush mainline pipe before installing RCV assembly.
  2. Locate as shown on drawings. Connect control wires to remote control valve wires using wire connectors and waterproof sealant. Provide connectors and sealant per manufacturer's recommendations.
  3. Provide only one RCV to valve box. Locate at least 12-inches from and align with nearby walls or edges of paved areas. Group RCV assemblies together where practical. Align grouped valve boxes in uniform patterns. Allow at least 12-inches between valve boxes. Brand controller letter and station number on valve box lid in 2-inch high letters.
- B. Inline Drip Tubing: Install inline drip tubing components in strict accordance with tubing manufacturer details, guidelines, and recommendations.
- C. Inline Drip Flush Valve Assembly: Provide at end of each inline drip irrigation lateral pipe as shown and directed on drawings and installation details. Install at least 12-inches from and align with adjacent walls or edges of paved areas. Brand "FV" on valve box lid in 2-inch high letters.

- D. Swing Check Valve Assembly: Provide as shown and directed on drawings and installation details. Install at least 12-inches from and align with adjacent walls or edges of paved areas. Brand "CV" on valve box lid in 2-inch high letters.

### 3.11 INSTALLATION OF CENTRAL CONTROL SYSTEM COMPONENTS:

#### A. Satellite Controller Assembly:

1. Location of controller assembly as depicted on drawings is approximate; Owner's Representative will determine exact site location upon commencement of contract. Install controller assembly and enclosure in accordance with controller manufacturer recommendations.
2. Assemble satellite control unit and appurtenances so entire assembly can be installed on site as a unit. Shop fabricate and test prior to installation in the field. Installation and wire connections in the field are to be done by the manufacturer's personnel or trained distributor personnel.
3. Lightning protection: Drive full length of grounding rod into soil. Space rod and grounding plate as indicated in the installation details. Connect #6 AWG copper grounding wire to rod using CADWELD connection. Install 6-inch round valve box over each CADWELD connection and grounding plate connection. Provide connection of grounding wire between controllers in groups in accordance with controller manufacturer or distributor's recommendations.
4. Coordinate and provide installation of electrical service in accordance with local codes. Provide primary surge protection arrestors on incoming power lines in accordance with controller manufacturer recommendations.
5. Provide one valve output surge protection arrestor on each control wire and one for common wire.
6. Connect control wires to corresponding controller terminal. Attach wire markers to ends of control wires inside controller assembly housing. Label wires with identification number (see drawings) of remote control valve to which control wire is connected.

#### B. Power Wire:

1. Install with minimum number of field splices. If power wire must be spliced, make splice with recommended connector, installed per manufacturer's recommendations. Locate splices in jumbo rectangular valve box. Coil 3-feet of wire in valve box.
2. Install power wire using open trenches. Use of a vibratory plow is not permitted.
3. Use green wire as common ground wire from power source to controller assembly.

4. Carefully backfill around power wire to avoid damage to wire insulation or wire connectors.
  5. Install wire parallel with and below mainline pipe unless noted otherwise on plans. Install wire at depth required by local codes.
  6. Provide continuous run of warning tape above power wire. Install warning tape six inches above wire.
- C. Sensor Cable:
1. Route cable as directed on plans. Install with minimum number of field splices.
  2. Install cable using open trenches. Use of vibratory plow is not permitted.
  3. Carefully backfill around cable to avoid damage to wire insulation or wire connectors.
  4. If cable must be spliced, make splice with recommended connector, installed per manufacturer's recommendations. Locate splices in housing afforded by other control system components or separate 12-inch standard valve box. Coil 3-feet of cable in valve box.
  5. Install cable parallel with and below mainline pipe unless noted otherwise on plans.
  6. Provide continuous run of warning tape above cable. Install warning tape six inches above cable.
- D. Low Voltage Control Wire:
1. Bundle control wires where two or more are in same trench. Bundle with pipe wrapping tape spaced at 10-foot intervals. Do not tape wires together where contained within sleeving or conduit.
  2. Control wiring may be chiseled into the soil utilizing a vibratory plow device specifically manufactured for pipe pulling and wire installation. Appropriate chisel must be used so that wire is fed into a chute on the chisel, and wire is not subject to pulling tension. Minimum burial depth must equal minimum cover previously listed.
  3. Provide 24-inch excess length of wire in 8-inch diameter loop at each 90-degree change of direction, at both ends of sleeves, and at 100-foot intervals along continuous runs of wiring. Do not tape or tie wiring loop. Coil 30-inch length of wire within each remote control valve box.
  4. Install common ground wire and one control wire for each remote control valve. Multiple valves on single control wire are not permitted.

5. If control wire must be spliced, make splice with wire connectors and waterproof sealant, installed per manufacturer's instructions. Locate splice in valve box that contains irrigation valve assembly, or in separate standard rectangular valve box. Use same procedure for connection to valves as for in-line splices.
6. Install wire parallel with and below mainline pipe unless noted otherwise on plans.
7. Control wiring may be chiseled into soil utilizing vibratory plow device specifically manufactured for pipe pulling and wire installation. Use appropriate chisel so that wire is fed into a chute on chisel, and wire is not subject to pulling tension. Meet or exceed minimum burial depth for wire as previously specified.
8. Encase wiring within electrical conduit where installed above grade. Protect wire not installed with PVC mainline pipe with continuous run of warning tape placed in backfill six inches above wiring.

### 3.12 INSTALLATION OF OTHER COMPONENTS:

- A. Tools and Spare Parts: Prior to Review at completion of construction, supply to Owner operating keys, servicing tools, spare parts, and other items indicated in General Notes on the drawings.
- B. Other Materials: Provide other materials or equipment shown on drawings or installation details that are part of irrigation system, even though items may not have been referenced in specifications.

### 3.13 PROJECT RECORD (AS-BUILT) DRAWINGS:

- A. Submit Record Drawings. Document changes to design. Maintain on-site and separate from documents used for construction, one complete set of contract documents as Project Documents. Keep documents current. Do not permanently cover work until accurate "as-built" information is recorded.
- B. Record pipe and wiring network alterations on a daily basis. Record work that is installed differently than shown on construction drawings. Record accurate reference dimensions, measured from at least two permanent reference points, of each irrigation system valve, each controller assembly, each sleeve end, and other irrigation components enclosed within a valve box.
- C. Obtain from Owner's Representative a reproducible mylar copy of drawings prior to construction completion. Mylars or CAD data files compatible with AutoCAD software can be purchased from Engineer. Cost of mylar reproducible drawings is \$25 per sheet and cost of AutoCAD data files on diskette is \$150 per project set. If AutoCAD files are requested, the Contractor must sign a data release form before files will be released. Duplicate information contained on project drawings maintained on-site using technical drafting pen or CAD. Label each sheet "Record Drawing".

- D. Turn over "Record Drawings" to Owner's Representative. Completion of Record Drawings is required prior to final construction review at completion of irrigation system installation.

#### 3.14 WINTERIZATION AND SPRING START-UP:

- A. Winterize irrigation system in fall following completion, or partial completion, of irrigation system construction. Start-up irrigation system in spring following completion, or partial completion, of irrigation system construction. Repair any damage caused in improper winterization at no additional cost to Owner. Coordinate winterization and start-up with landscape maintenance personnel.

#### 3.15 MAINTENANCE:

- A. Maintain irrigation system for a duration of 30 calendar days from formal written acceptance by Owner's Representative. Make periodic examinations and adjustments to irrigation system components in order to achieve the most desirable application of water.
- B. Following completion of Contractor's maintenance period, Owner will be responsible for maintaining system in working order during remainder of guarantee/warranty period, for performing necessary minor maintenance, for trimming around sprinklers, for protecting against vandalism, and for preventing damage after landscape maintenance operation.

#### 3.16 CLEANUP:

- A. Remove from site machinery, tools, excess materials, and rubbish upon completion of work.

END OF SECTION

SECT. NO.	SECTION TITLE
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DIVISION 16 - ELECTRICAL

16050	BASIC ELECTRICAL MATERIALS AND METHODS
16060	GROUNDING AND BONDING
16140	WIRING DEVICES
16410	ENCLOSED SWITCHES
16442	PANELBOARDS
16491	FUSES
16511	INTERIOR LIGHTING

## SECTION 16050 - BASIC ELECTRICAL MATERIALS AND METHODS

## 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:
  - 1. Raceways.
  - 2. Building wire and connectors.
  - 3. Supporting devices for electrical components.
  - 4. Electrical identification.
  - 5. Electricity-metering components.
  - 6. Cutting and patching for electrical construction.
  - 7. Touchup painting.

## 1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. LFMC: Liquidtight flexible metal conduit.
- D. RNC: Rigid nonmetallic conduit.

## 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.
- B. Comply with NFPA 70.

## 1.5 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work.
- C. Coordinate electrical service connections to components furnished by utility companies.
  1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
  2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
- D. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

## PART 2 - PRODUCTS

### 2.1 RACEWAYS

- A. EMT: ANSI C80.3, zinc-coated steel, with set-screw or compression fittings.
- B. FMC: Zinc-coated steel.
- C. LFMC: Zinc-coated steel with sunlight-resistant and mineral-oil-resistant plastic jacket.
- D. RNC: NEMA TC 2, Schedule 40 PVC, with NEMA TC3 fittings.
- E. Raceway Fittings: Specifically designed for the raceway type with which used.

### 2.2 CONDUCTORS

- A. Conductors, No. 10 AWG and Smaller: Solid or stranded copper.
- B. Conductors, Larger Than No. 10 AWG: Stranded copper.
- C. Insulation: Thermoplastic, rated at 75 deg C minimum.
- D. Wire Connectors and Splices: Units of size, ampacity rating, material, type, and class suitable for service indicated.

### 2.3 SUPPORTING DEVICES

- A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.

- C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- (14-mm-) diameter slotted holes at a maximum of 2 inches (50 mm) o.c., in webs.
- D. Raceway Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- E. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- F. Expansion Anchors: Carbon-steel wedge or sleeve type.
- G. Toggle Bolts: All-steel springhead type.
- H. Powder-Driven Threaded Studs: Heat-treated steel.

## 2.4 ELECTRICAL IDENTIFICATION

- A. Identification Devices: A single type of identification product for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. Underground Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:
  - 1. Not less than 6 inches wide by 4 mils thick (150 mm wide by 0.102 mm thick).
  - 2. Compounded for permanent direct-burial service.
  - 3. Embedded continuous metallic strip or core.
  - 4. Printed legend that indicates type of underground line.
- C. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- D. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suit coding scheme.
- E. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch (1.6-mm) minimum thickness for signs up to 20 sq. in. (129 sq. cm) and 1/8-inch (3.2-mm) minimum thickness for larger sizes. Engraved legend in black letters on white background.
- F. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

## 2.5 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING

- A. Meter Sockets: Comply with requirements of electrical power utility company.

## 2.6 TOUCHUP PAINT

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

## PART 3 - EXECUTION

## 3.1 ELECTRICAL EQUIPMENT INSTALLATION

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- D. Right of Way: Give to raceways and piping systems installed at a required slope.

## 3.2 RACEWAY APPLICATION

- A. Use the following raceways for outdoor installations:
  - 1. Exposed: RGS.
  - 2. Concealed: EMT.
  - 3. Underground, Single Run: RNC.
  - 4. Underground, Grouped: RNC.
  - 5. Connection to Vibrating Equipment: LFMC.
  - 6. Boxes and Enclosures: NEMA 250, Type 3R or Type 4.
- B. Use the following raceways for indoor installations:
  - 1. Exposed: EMT.
  - 2. Concealed: EMT.
  - 3. Connection to Vibrating Equipment: LFMC.
  - 4. Damp or Wet Locations: EMT.
  - 5. Boxes and Enclosures: NEMA 250, Type 4, unless otherwise indicated.

## 3.3 RACEWAY AND CABLE INSTALLATION

- A. Conceal raceways and cables, unless otherwise indicated, within finished walls, ceilings, and floors.
- B. Locate horizontal raceway runs above water piping.
- C. Use temporary raceway caps to prevent foreign matter from entering.
- D. Make conduit bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
- E. Use raceway and cable fittings compatible with raceways and cables and suitable for use and location.

- F. Connect motors and equipment subject to vibration, noise transmission, or movement with a maximum of **72-inch (1830-mm)** flexible conduit. Install LFMC in wet or damp locations. Install separate ground conductor across flexible connections.

### 3.4 WIRING METHODS FOR POWER, LIGHTING, AND CONTROL CIRCUITS

- A. Feeders: Type THHN/THWN insulated conductors in raceway.
- B. Underground Feeders and Branch Circuits: Type THWN or single-wire in raceway.
- C. Branch Circuits: Type THHN/THWN insulated conductors in raceway.
- D. Remote-Control Signaling and Power-Limited Circuits: Type THHN/THWN insulated conductors in raceway for Classes 1, 2, and 3, unless otherwise indicated.

### 3.5 WIRING INSTALLATION

- A. Install splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- B. Install wiring at outlets with at least **12 inches (300 mm)** of slack conductor at each outlet.
- C. Connect outlet and component connections to wiring systems and to ground. 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.

### 3.6 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
- B. Dry Locations: Steel materials.
- C. Selection of Supports: Comply with manufacturer's written instructions.
- D. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of **200-lb (90-kg)** design load.

### 3.7 SUPPORT INSTALLATION

- A. Install support devices to securely and permanently fasten and support electrical components.
- B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

- D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.
- E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- F. Install **1/4-inch- (6-mm-)** diameter or larger threaded steel hanger rods, unless otherwise indicated.
- G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for **1-1/2-inch (38-mm)** and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.
- H. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than **24 inches (610 mm)** from the box.
- I. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, and other devices unless components are mounted directly to structural elements of adequate strength.
- J. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- K. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
  - 1. Wood: Fasten with wood screws or screw-type nails.
  - 2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
  - 3. New Concrete: Concrete inserts with machine screws and bolts.
  - 4. Existing Concrete: Expansion bolts.
  - 5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
  - 6. Steel: Welded threaded studs or spring-tension clamps on steel.
    - a. Field Welding: Comply with AWS D1.1.
  - 7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
  - 8. Light Steel: Sheet-metal screws.
  - 9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

### 3.8 IDENTIFICATION MATERIALS AND DEVICES

- A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.
- C. Self-Adhesive Identification Products: Clean surfaces before applying.
- D. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.
- E. Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate **6 to 8 inches (150 to 200 mm)** below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed **16 inches (400 mm)**, overall, use a single line marker.
- F. Color-code 240/120-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:
  - 1. Phase A: Black.
  - 2. Phase B: Red.

### 3.9 UTILITY COMPANY ELECTRICITY-METERING EQUIPMENT

- A. Install equipment according to utility company's written requirements. Provide grounding and empty conduits as required by utility company.
- B. Coordinate meter set with Marc Mascaranas with Excel (ph# 970-395-1235) after electrical inspection has passed

### 3.10 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

### 3.11 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:
  - 1. Raceways.
  - 2. Building wire and connectors.
  - 3. Supporting devices for electrical components.

4. Electrical identification.
5. Electricity-metering components.
6. Cutting and patching for electrical construction.
7. Touchup painting.

### 3.12 REFINISHING AND TOUCHUP PAINTING

#### A. Refinish and touch up paint.

1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

### 3.13 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 16050

## SECTION 16060 - 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 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 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.

## 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. Boggs, Inc.
    - c. Chance/Hubbell.
    - d. Copperweld Corp.
    - e. Dossert Corp.
    - f. Erico Inc.; Electrical Products Group.
    - g. Framatome Connectors/Burndy Electrical.
    - h. Galvan Industries, Inc.
    - i. Harger Lightning Protection, Inc.
    - j. Hastings Fiber Glass Products, Inc.
    - k. Heary Brothers Lightning Protection Co.
    - l. Ideal Industries, Inc.
    - m. ILSCO.

- n. Kearney/Cooper Power Systems.
- o. Korns: C. C. Korns Co.; Division of Robroy Industries.
- p. Lightning Master Corp.
- q. Lyncole XIT Grounding.
- r. O-Z/Gedney Co.; a business of the EGS Electrical Group.
- s. Raco, Inc.; Division of Hubbell.
- t. Robbins Lightning, Inc.
- u. Salisbury: W. H. Salisbury & Co.
- v. Superior Grounding Systems, Inc.
- w. Thomas & Betts, Electrical.

## 2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 16 Section "Basic Electrical Materials and Methods."
- B. Material: Copper.
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.
- D. Grounding Electrode Conductors: Stranded cable.
- E. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- F. Bare Copper Conductors: Comply with the following:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Assembly of Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
- G. Copper Bonding Conductors: As follows:
  - 1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, **1/4 inch (6.4 mm)** 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 (42 mm)** wide and **1/16 inch (1.5 mm)** thick.
- H. 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: Sectional type; copper-clad steel.
  - 1. Size: **3/4 by 120 inches (19 by 3000 mm)** in diameter.

## 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.
- D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

### 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.
- C. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by NEC:
  - 1. Feeders and branch circuits.
  - 2. Lighting circuits.
  - 3. Receptacle circuits.
  - 4. Single-phase motor and appliance branch circuits.
  - 5. Flexible raceway runs.
- D. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- E. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including heaters. Bond conductor to each unit and to air duct.

### 3.3 INSTALLATION

- A. Ground Rods: Install at least two rods.

1. Drive ground rod until top is 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
  2. Interconnect ground rod with grounding electrode conductors. Use exothermic welds, 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 Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water 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. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, and electric heaters. Use braided-type bonding straps.
- F. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, Paragraph 250-81(c), using a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within the base of the foundation. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.

### 3.4 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. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
  5. 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 noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- E. 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 and UL 486B.
- F. 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.
- G. 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.

### 3.5 FIELD QUALITY CONTROL

- A. 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.
    - a. Equipment Rated 500 kVA and Less: 10 ohms.
  - 2. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 16060

## SECTION 16140 - WIRING DEVICES

## 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 various types of receptacles, connectors, switches, and finish plates.

## 1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70 "National Electrical Code" for devices and installation.
- B. Listing and Labeling: Provide products that are listed and labeled for their applications and installation conditions and for the environments in which installed.
  - 1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.
  - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Wiring Devices:
    - a. Arrow Hart Div., Cooper Industries.
    - b. Bryant Electric, Inc.
    - c. Challenger Electrical Equipment Co.
    - d. Eagle Electric Mfg. Co., Inc.
    - e. General Electric Co.
    - f. Hubbell Inc.
    - g. Killark Electrical Mfg. Co.
    - h. Leviton Mfg. Co., Inc.
    - i. Pass & Seymour/Legrand.
    - j. Pyle-National Co.
    - k. Slater Electric, Inc.

## 2.2 WIRING DEVICES

- A. Straight-Blade Receptacles: Heavy-Duty, specification grade. Meets all requirements of Federal Specification WC-596.
- B. Enclosures: NEMA 3R equivalent.
- C. Color: Brown except as required by Code.
- D. Receptacles, Straight-Blade Type: Comply with UL Standard 498, "Electrical Attachment Plugs and Receptacles," heavy-duty grade except as otherwise indicated.
- E. Receptacles, Straight-Blade, Special Features: Comply with the basic requirements specified above for straight-blade receptacles of the class and type indicated, and with the following additional requirements:
  - 1. Ground-Fault Circuit Interrupter (GFCI) Receptacles: UL Standard 943, "Ground Fault Circuit Interrupters," feed-through type, with integral NEMA 5-20R duplex receptacle arranged to protect connected downstream receptacles on the same circuit. Design units for installation in a 2-3/4-inch (70-mm) deep outlet box without an adapter.
- F. Snap Switches: Quiet-type a.c. switches, heavy duty specification grade. NRTL listed and labeled as complying with UL Standard 20 "General Use Snap Switches," and with Federal Specification W-S-896.
- G. Wall Plates: Single and combination types that mate and match with corresponding wiring devices. Features include the following:
  - 1. Plate-Securing Screws: Metal with heads colored to match plate finish.
  - 2. Material for Finished Spaces: 0.04-inch-thick (1-mm-thick), type 302, satin-finished stainless steel, except as otherwise indicated. Weatherproof when noted on plans.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install devices and assemblies plumb and secure.
- B. Install wall plates when painting is complete.
- C. Arrangement of Devices: Except as otherwise indicated, mount surface, with long dimension vertical, and grounding terminal of receptacles on top.
- D. Protect devices and assemblies during painting.

### 3.2 FIELD QUALITY CONTROL

- A. Testing: Test wiring devices for proper polarity and ground continuity. Operate each operable device at least 6 times.
- B. Test ground-fault circuit interrupter operation with both local and remote fault simulations

according to manufacturer recommendations.

- C. Replace damaged or defective components.

### 3.3 CLEANING

- A. General: Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION 16140

## SECTION 16410 - ENCLOSED SWITCHES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

## 1.2 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
  - 1. Fusible switches.

## 1.3 DEFINITIONS

- A. GD: General duty.
- B. GFCI: Ground-fault circuit interrupter.
- C. HD: Heavy duty.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.

## 1.4 SUBMITTALS

- A. Product Data: For each type of enclosed switch, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current rating.
  - 4. UL listing for series rating of installed devices.
  - 5. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

## 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 NFPA 70.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

## 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
  - 1. Ambient Temperature: Not less than **minus 22 deg F (minus 30 deg C)** and not exceeding **104 deg F (40 deg C)**.
  - 2. Altitude: Not exceeding **6600 feet (2010 m)**.

## 1.7 COORDINATION

- A. Coordinate layout and installation of switches, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### 2.2 FUSIBLE SWITCHES

- A. Manufacturers:
  - 1. Eaton Corporation; Cutler-Hammer Products.
  - 2. General Electric Co.; Electrical Distribution & Control Division.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D/Group Schneider.

- B. Fusible Switch, 200 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper neutral conductors.

#### 0.1 TRANSIENT VOLTAGE SURGE SUPPRESSORS (480 VOLT SERVICE SWITCH)

- A. Description: IEEE C62.41, selected to meet requirements for category indicated.
  - 1. Exposure: High.
- B. Impulse sparkover voltage coordinated with system circuit voltage.
- C. Factory mounted with UL-recognized mounting device.

#### 2.3 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
  - 1. Outdoor Locations: NEMA 250, Type 3R.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches.
- B. Mount individual wall-mounting switches with tops at uniform height, unless otherwise indicated.

#### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Basic Electrical Materials and Methods."

- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 16 Section "Basic Electrical Materials and Methods."

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches. 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.

3.5 CLEANING

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 16410

## SECTION 16442 - PANELBOARDS

## 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:
  - 1. Lighting and appliance branch-circuit 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.

## 1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

## 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated.
- C. 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.

- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
  - 1. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
  - 2. Altitude: Not exceeding 6600 feet (2000 m).

#### 1.7 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.

#### 1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Keys: Six spares for each type of panelboard cabinet lock.

### 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 Corporation; Cutler-Hammer Products.
    - b. General Electric Co.; Electrical Distribution & Protection Div.
    - c. Siemens Energy & Automation, Inc.
    - d. Square D.

#### 2.2 MANUFACTURED UNITS

- A. Enclosures: Surface-mounted cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Locations: NEMA 250, Type **12, no exceptions.**

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions.
3. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
4. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door.

B. Phase and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.

C. Conductor Connectors: Suitable for use with conductor material.

1. Main and Neutral Lugs: Mechanical type.
2. Ground Lugs and Bus Configured Terminators: Compression type.

D. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

## 2.3 PANELBOARD SHORT-CIRCUIT RATING

- A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

## 2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Branch Overcurrent Protective Devices: Plug-in or Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- B. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

## 2.5 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: UL 489, with series-connected rating 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.
- 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 conductor materials.
  2. Multipole units enclosed in a single housing or factory-assembled to operate as a single unit.

## PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Mount top of trim **74 inches (1880 mm)** above finished floor, unless otherwise indicated.
- C. Mount plumb and rigid without distortion of box.
- D. Install overcurrent protective devices and controllers.
- E. Install filler plates in unused spaces.
- F. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

## 3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components.
- B. Create a directory to indicate installed circuit loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories in pencil are acceptable.
- C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

## 3.3 CONNECTIONS

- A. Ground equipment according to Division 16 Section "Grounding and Bonding."
- B. Connect wiring according to Division 16 Section "Basic Electrical Materials and Methods."

## 3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, 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.

## 3.5 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.

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END OF SECTION 16442

## SECTION 16491 - FUSES

## 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:
  - 1. Cartridge fuses rated 600 V and less for use in switches.

## 1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses from a single manufacturer.
- B. 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.
- C. Comply with NEMA FU 1.
- D. Comply with NFPA 70.

## 1.4 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

## 1.5 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

## 1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fuses: Quantity equal to 10 percent of each fuse type and size, but no fewer than 3 of each type and size.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Bussman, Inc.
  2. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.
  3. Ferraz Shawmut, Inc.
  4. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

## 2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 FUSE APPLICATIONS

- A. Service Entrance: Class RK1, time delay.
- B. Motor Branch Circuits: Class RK5, time delay.
- C. Other Branch Circuits: Class RK5, time delay.

## 3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

## 3.4 IDENTIFICATION

- A. Install labels indicating fuse replacement information on inside door of each fused switch.

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END OF SECTION 16491

## SECTION 16511 - INTERIOR LIGHTING

## 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:
  - 1. Interior lighting fixtures with lamps and ballasts.
  - 2. Lighting fixtures mounted on exterior building surfaces.

## 1.3 DEFINITIONS

- A. BF: Ballast factor. Ratio of light output of a given lamp(s) operated by the subject ballast to the light output of the same lamp(s) when operated on an ANSI reference circuit.
- B. CRI: Color rendering index.
- C. CU: Coefficient of utilization.
- D. LER: Luminaire efficiency rating, which is calculated according to NEMA LE 5. This value can be estimated from photometric data using the following formula:
  - 1. LER is equal to the product of total rated lamp lumens times BF times luminaire efficiency, divided by input watts.
- E. RCR: Room cavity ratio.

## 1.4 SUBMITTALS

- A. Product Data: For each type of lighting fixture scheduled, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
  - 1. Physical description of fixture, including dimensions and verification of indicated parameters.
  - 2. Fluorescent and high-intensity-discharge ballasts.
  - 3. Lamps.

## 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 NFPA 70.

## 1.6 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, and partition assemblies.

## 1.7 WARRANTY

- A. Special Warranty for Fluorescent Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Electronic Ballasts: Five years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for T8 Fluorescent Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
  - 1. Warranty Period: One year from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Products: Subject to compliance with requirements, provide one of the products specified.

## 2.2 FIXTURES AND COMPONENTS, GENERAL

- A. Fluorescent Fixtures: Comply with UL [1570] [1598]. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- B. Metal Parts: Free of burrs and sharp corners and edges.

- C. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- E. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
- F. Plastic Diffusers, Covers, and Globes:
  - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
    - a. Lens Thickness: At least [0.125 inch (3.175 mm)] minimum unless different thickness is scheduled.
    - b. UV stabilized.
  - 2. Glass: Annealed crystal glass, unless otherwise indicated.

## 2.3 LIGHTING FIXTURES

- A. As Specified on the plans.

## 2.4 FLUORESCENT LAMP BALLASTS

- A. Description: Include the following features, unless otherwise indicated:
  - 1. Designed for type and quantity of lamps indicated at full light output.
- B. Electronic ballasts for linear lamps shall include the following features, unless otherwise indicated:
  - 1. Comply with NEMA C82.11.
  - 2. Ballast Type: Instant start, unless otherwise indicated.
  - 3. Programmed Start: Ballasts with two-step lamp starting to extend life of frequently started lamps.
  - 4. Sound Rating: A.
  - 5. Total harmonic distortion rating of less than 10 percent according to NEMA C82.11.
  - 6. Transient Voltage Protection: IEEE C62.41, Category A.
  - 7. Operating Frequency: 20 kHz or higher.
  - 8. Lamp Current Crest Factor: Less than 1.7.

## 2.5 FLUORESCENT LAMPS

- A. T8 rapid-start low-mercury lamps, rated 32 W maximum, 2800 initial lumens (minimum), CRI of 75 (minimum), color temperature of 3500 K, and average rated life of 20,000 hours, unless otherwise indicated.

## 2.6 FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 16 Section "Basic Electrical Materials and Methods" for channel- and angle-iron supports and nonmetallic channel and angle supports.

## 2.7 FINISHES

- A. Fixtures: Manufacturers' standard, unless otherwise indicated.
  - 1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
  - 2. Metallic Finish: Corrosion resistant.

## PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

## 3.2 CONNECTIONS

- A. 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.

## 3.3 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Verify normal operation of each fixture after installation.
- C. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.

END OF SECTION 16511

**ARTICLE 6.0**  
**SUPPLEMENTAL TECHNICAL SPECIFICATIONS**  
**PARKER MEADOWS**  
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# RIPRAP SPECIFICATIONS

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## **DIVISION 2-SITE WORK**

### **SECTION 02275-RIPRAP**

#### **PART 1: GENERAL**

##### **1.01 SCOPE:**

Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete installation of the riprap, and guarantee/warranty as shown on the drawings, the installation details, and as specified herein. Items of work specifically included are:

- A. Provision and installation of riprap in the existing detention and irrigation ponds below the end of each discharge pipe.
- B. Coordination with site work, grading, utilities and non-potable irrigation pump system installation.

##### **1.02 DISCREPANCIES:**

It is the intent of these plans and specifications that the non-potable irrigation pump and distribution system be complete and workable. It is the Contractor's responsibility to make sure that the equipment furnished is compatible and adheres to all regulations. Any discrepancies should be noted immediately and should be reported to the Owner's Representative for clarification.

##### **1.03 SUBMITTALS:**

- A. Manufacturers' Data: Provide sufficient data to verify compliance with these specifications.

##### **1.04 RULES AND REGULATIONS:**

- A. Work and materials shall be in accordance with the latest edition of the Uniform Plumbing Code as published by the Western Plumbing Officials Association, and applicable laws and regulations of the governing authorities.
- B. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.
- C. If quantities are provided either in specifications or on these drawings, these quantities are provided for information only. It is the contractor's responsibility to determine the actual quantities of all material, equipment, and supplies required by the project and to complete an independent estimate of quantities and wastage.

#### 1.05 GUARANTEE/WARRANTY AND REPLACEMENT:

The purpose of this guarantee/warranty is to insure that the Owner receives materials of prime quality, installed and maintained in a thorough and careful manner.

- A. For a period of one year from commencement of the formal maintenance period, guarantee/warranty riprap and workmanship against defects. Fill and repair depressions. Restore landscape or structural features damaged by the settlement of trenches or excavations. Repair damage to the premises caused by a defective item. Make repairs within seven days of notification from the Owner's Representative.
- B. Contract documents govern replacements identically as with new work. Make replacements at no additional cost to the contract price.
- C. Guarantee/warranty applies to originally installed materials and equipment and replacements made during the guarantee/warranty period.

### PART 2: MATERIALS

#### 2.01 QUALITY:

Materials used in the system shall be without flaws or defects of any type, and shall be the best of their class and kind.

#### 2.02 RIPRAP:

- A. Provide in accordance with the Urban Drainage & Flood Control (Denver, Colorado). Reference riprap gradation indicated on drawings.

### PART 3: EXECUTION

#### 3.01 INSPECTIONS AND REVIEWS:

- A. Site Inspections:
  - 1. Verify site conditions and note irregularities affecting work of this section. Report irregularities to the Owner's Representative prior to beginning work.
  - 2. Do not place riprap over frozen or spongy subgrade surfaces.
  - 3. Beginning work of this section implies acceptance of existing conditions.
- B. Verify locations of underground utilities.

#### 3.02 PLACEMENT:

- A. Place riprap as indicated in the plans.

3.03 PROJECT RECORD (AS-BUILT) DRAWINGS:

- A. Maintain on-site and separate from documents used for construction, one complete set of contract documents as Project Documents. Keep documents current. Do not permanently cover work until as-built information is recorded.
- B. Record alterations. Record work which is installed differently than shown on the construction drawings. Record accurate reference dimensions, measured from at least two permanent reference points.
- C. Prior to project completion, obtain from the Owner's Representative a reproducible mylar copy of the drawings. Using technical drafting pen, duplicate information contained on the project drawings maintained on site. Label each sheet "Record Drawing". Completion of the Record Drawings will be a prerequisite for the project acceptance.

3.04 CLEANUP:

- A. Upon completion of work, remove from the site all machinery, tools, excess materials, and rubbish.
- B. Remove all debris and foreign material from the construction area and maholes.

END OF SECTION

# NON-POTABLE IRRIGATION DISTRIBUTION SYSTEM

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## **DIVISION 2-SITE WORK**

### **SECTION 02623-NON-POTABLE IRRIGATION DISTRIBUTION SYSTEM**

#### **PART 1: GENERAL**

##### **1.01 SCOPE:**

Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete installation of the non-potable irrigation distribution system, and guarantee/warranty as shown on the drawings, the installation details, and as specified herein. Items of work specifically included are:

- A. Procurement of all applicable licenses, permits, and fees
- B. Coordination of Utility Locates ("Call Before You Dig").
- C. Installation of complete non-potable irrigation distribution system including piping, isolation gate valves, blow-off valves, air-vacuum relief valves, manual drain valves, copper tracer wire, thrust blocks, restraining devices, all fittings, jointing materials, necessary appurtenances, excavation, dewatering, bedding, backfill, and compaction.
- D. Installation of non-potable irrigation stub-outs and point-of-connections, including service taps, meter, irrigation valve, piping, and necessary appurtenances for each location as indicated on drawings.
- E. Testing.
- F. Maintenance period.

##### **1.02 SUBMITTALS:**

- A. Deliver four (4) copies of all submittals to the Owner's Representative within 10 working days from the date of Notice to Proceed. Provide information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed for different components and labeled with the specification section number and the name of the component. Submittals must be made for all the components on the material list. Indicate which items are being supplied on the catalog cut sheets when multiple items are shown on one sheet. Submittal package must be complete prior to being reviewed by the Owner's Representative. Incomplete submittals will be returned without review.
- B. Materials List: Include pipe, fittings, distribution mainline components, air-vacuum relief valve, blow-off valve, manual drain valve, shop drawings and all other components shown on the drawings and installation details or described herein. Components such as pipe gaskets, restraint devices, wire, etc. must be included. Quantities of materials need not be included.

- C. Manufacturers' Data: Submit manufacturers' catalog cuts, specifications, and operating instructions for equipment shown on the materials list.
- D. Shop Drawings: Submit shop drawings called for in the installation details. Show products required for proper installation, their relative locations, and critical dimensions. Note modifications to the installation detail.

#### 1.03 RULES AND REGULATIONS:

- A. Work and materials shall be in accordance with the latest edition of the National Electric Code, the Uniform Plumbing Code as published by the Western Plumbing Officials Association, and applicable laws and regulations of the governing authorities.
- B. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.
- C. If quantities are provided either in these specifications or on the drawings, these quantities are provided for information only. It is the Contractor's responsibility to determine the actual quantities of all material, equipment, and supplies required by the project and to complete an independent estimate of quantities and wastage.

#### 1.04 TESTING:

- A. Notify the Owner's Representative three days (72 hours) in advance of testing.
- B. Pipelines jointed with rubber gaskets or threaded connections may be subjected to a pressure test at any time after partial completion of backfill. Pipelines jointed with solvent-welded PVC joints shall be allowed to cure at least 24 hours before testing.
- C. Subsections of mainline pipe may be tested independently, subject to the review of the Owner's Representative.
- D. Furnish clean, clear water, pumps, labor, fittings, and equipment necessary to conduct tests or retests.
- E. Where permanent air release vents are not available, the Contractor shall install corporation stops at high points in the distribution line in order to evacuate trapped air.
  - 1. All corporation stops installed to facilitate evacuation of air from the distribution line shall be removed and plugged with a "cc" threaded brass plug after the water main is filled, and prior to pressure testing.
- F. Volumetric Leakage Test:
  - 1. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.

2. Purge air from pipeline before test.
3. Subject mainline pipe to 140 PSI for two hours. Maintain constant pressure.
4. Provide all necessary pumps, bypass piping, storage tanks, meters, 3-inch test gauge, supply piping, and fittings in order to properly perform testing.
5. Testing pump must provide a continuous 140-PSI pressure to the mainline pipe. Allowable deviation in test pressure is 5-PSI during test period. Restore test pressure to 140-PSI at end of test.
6. Water added to the mainline pipe must be measured volumetrically to the nearest 0.10 gallons.
7. Use the following table to determine the maximum allowable volume lost during the test:

Leakage Allowable (Gallons per (100 Joints) / Hour)

PIPE SIZE (INCHES)	Test Pressure (PSI)								
	60	70	80	90	100	110	120	130	140
3"	0.48	0.51	0.55	0.58	0.62	0.65	0.68	0.70	0.73
4"	0.62	0.66	0.71	0.75	0.80	0.84	0.87	0.91	0.94
6"	0.90	0.97	1.04	1.11	1.18	1.23	1.29	1.34	1.40
8"	1.17	1.26	1.35	1.44	1.53	1.60	1.67	1.74	1.81
10"	1.47	1.59	1.70	1.82	1.93	2.02	2.10	2.19	2.27
12"	1.72	1.85	1.99	2.12	2.25	2.35	2.46	2.56	2.67

8. If the distribution line section being tested includes various diameter pipe, the allowable leakage will be the sum of the computed leakage for each size.
9. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat test until pipe passes test.
10. Repair all visible leaks, regardless of maximum allowable leakage.
11. Contractor may sub-contract testing to an Owner approved pipeline testing company.
12. Cement or caulking to seal leaks is prohibited.

G. Tracer Wire Test:

1. Pass current through wire and demonstrate that wire is capable of locating the pipe.
2. If wire will not pass current, locate break in circuit and test until tracer wire works in accordance with its intended use.

H. Valve Test:

1. All valves shall be operated by the Contractor in the presence of the Owner's Representative prior to requesting system acceptance.

1.05 CONSTRUCTION REVIEW:

The purpose of on-site reviews by the Owner's Representative is to periodically observe the work in progress, the Contractor's interpretation of the construction documents, and to address questions with regard to the installation.

- A. Scheduled reviews such as those for distribution system layout or testing must be scheduled with the Owner's Representative as required by these specifications.
- B. Impromptu reviews may occur at any time during the project.
- C. A review will occur at the completion of the irrigation distribution system installation and Project Record (As-Built) Drawing submittal.

1.06 GUARANTEE/WARRANTY AND REPLACEMENT:

The purpose of this guarantee/warranty is to insure that the Owner receives non-potable irrigation distribution system materials of prime quality, installed and maintained in a thorough and careful manner.

- A. For a period of one year from commencement of the formal maintenance period, guarantee/warranty irrigation distribution system materials, equipment, and workmanship against defects. Fill and repair depressions. Restore landscape or structural features damaged by the settlement of pipe trenches or excavations. Repair damage to the premises caused by a defective item. Make repairs within seven days of notification from the Owner's Representative.
- B. Contract documents govern replacements identically as with new work. Make replacements at no additional cost to the contract price.
- C. Guarantee/warranty applies to originally installed materials and equipment and replacements made during the guarantee/warranty period.

## PART 2: MATERIALS

### 2.01 QUALITY:

Use materials which are new and without flaws or defects of any type, and which are the best of their class and kind.

### 2.02 SUBSTITUTIONS:

- A. Alternative equipment must be approved by the Engineer prior to bidding. The Contractor is responsible for making any changes to the design to accommodate alternative equipment.
- B. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at the option of the Contractor.

### 2.03 PIPE:

#### A. Non-Potable Distribution Pipe:

1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end.
2. Use Pressure Class 150 (DR-18), C900 PVC pipe, rated at 150 PSI, conforming to the dimensions and tolerances established by AWWA Standard C900. Use purple pipe. Use laying lengths of 20-ft.
3. Use rubber-gasketed pipe equipped with factory installed reinforced gaskets for pipe with a nominal diameter greater than or equal to 3-inches. Gasketed pipe joints must conform to the "Laboratory Qualifying Tests" section of ASTM D3139. Gasket material must conform to ASTM F477. Use rubber-gasketed deep bell ductile iron fittings conforming to ASTM A-536 and ASTM F-477 or mechanical joint ductile iron fittings conforming to ANSI/AWWA C153/A21.53 and C111/A21.11. Use lubricant approved by the pipe manufacturer.

#### B. Thrust Blocks:

1. Use thrust blocks for fittings on pipe greater than or equal to 3-inch diameter or any diameter rubber gasketed pipe.
2. Use 3,000 PSI concrete.
3. Use 2 mil plastic.
4. Use No. 4 Rebar wrapped or painted with asphalt tar based mastic coating.

C. Mechanical Joint Pipe Restraints:

1. Use a mechanical joint restraint wherever joints are not positively restrained by flanged fittings, threaded fittings, and/or thrust blocks.
2. Use a mechanical joint restraint with transition fittings between metal and PVC pipe, where weak trench banks do not allow the use of thrust blocks, or where extra support is required to retain a fitting or joint.
3. Use a mechanical joint restraint at all valves and fittings.
4. All mechanical joint pipe restraints shall be incorporated in a follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Twist-off nuts, sized same as tee-head bolts, shall be used to ensure proper actuating of restraining devices.
5. Glands shall be manufactured of ductile iron conforming to ASTM A536-80, grade 60-42-10. Restraining devices shall be of ductile iron heated to a minimum hardness of 370 bhn. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI/AWWA C153/A21.53.
6. Use bolts, nuts, retaining clamps, all-thread, or other joint restraint materials which are zinc plated or galvanized.
7. Mechanical joint restraint devices shall have a minimum working pressure of 350 PSI.
8. Acceptable manufacturers and styles:
  - a. EBAA Iron, Inc. – MEGALUG, Series 2000 PV
  - b. Uni-Flange Corp. – Series 1500

2.04 PIPE MARKING TAPE:

- A. Use detectable warning purple tape, 12" wide, located 12" above the top of the pipe and labeled as "NON-POTABLE WATER" to allow for future pipe location.

2.05 COPPER TRACER WIRE:

- A. Use 12-gauge stranded or solid copper, water-tight insulation for direct bury.
- B. Use 3M Direct Bury splice kit or approved equal for solderless connector.

2.06 DISTRIBUTION PIPE COMPONENTS:

- A. Fittings:
  1. All fittings shall be manufactured in accordance with AWWA C104, C110, and C111.
  2. Use fittings with either flanged joint or mechanical joint connections.

3. Use ductile iron fittings with a minimum working pressure rating of 250 psi.
4. Furnish all ductile iron fittings with a cement-mortar lining of standard thickness as defined in referenced standards and given a seal coat of bituminous material.

B. Isolation Gate Valve Assembly: as presented in the installation details.

1. AWWA C509, iron body, bronze trim, two O-ring stem seals, non-rising stem with square nut, single wedge, resilient seat, mechanical joint ends, control rod, extension box and valve key.
2. Rotate:clockwise to open
3. Acceptable manufacturers are Waterous, Mueller, Kennedy Valve, Dresser, Clow, or approved equal.

C. Air-Vacuum Relief Valve Assembly: as presented in the details.

1. Furnish assembly in accordance with AWWA C512.
2. Provide a continuous acting combination air vacuum relief valve with a working pressure of 150 PSI and a minimum hydrostatic pressure of 250 PSI
3. Valve shall have stainless steel float and all working parts and seats shall be brass, stainless steel, or other non-corroding material.
4. Acceptable manufacturers are Bermad, Crispin, or approved equal.

D. Blow-off Assembly: as presented in the details.

1. Blow off assemblies shall be as shown in the standard details

## 2.07 VALVE BOXES:

- A. Valve boxes for all buried valves shall be cast or ductile iron, buffalo type, two piece boxes with round bases, depth as required for valve:
  - 1. Minimum diameter: 5 ¼”
  - 2. Minimum thickness: 3/16-inch
  - 3. Screw type shaft suitable for depth of cover as required and capable of future adjustment for street overlays.
  - 4. Box, cover, and base coated by dipping in asphalt varnish
  - 5. Cover marked “Non-Potable Water” and manufactured by Trumbull Industries or approved equal
  - 6. Manufactured by Tyler Pipe, or approved equal

## 2.08 OTHER COMPONENTS:

- A. Tools and Spare Parts: Provide operating keys, servicing tools, test equipment, spare parts and other items indicated in the General Notes of the drawings.
- B. Other Materials: Provide other materials or equipment shown on the drawings or installation details that are part of the irrigation distribution system, even though such items may not have been referenced in these specifications.

## PART 3: EXECUTION

### 3.01 INSPECTIONS AND REVIEWS:

- A. Site Inspections:
  - 1. Verify construction site conditions and note irregularities affecting work of this section. Report irregularities to the Engineer prior to beginning work.
  - 2. Beginning work of this section implies acceptance of existing conditions.
- B. Utility Locates ("Call Before You Dig"):
  - 1. Arrange for and coordinate with local authorities the location of all underground utilities.
  - 2. Repair any underground utilities damaged during construction. Make repairs at no additional cost to the contract price.
  - 3. Coordinate with proposed utility plans for development.
- C. Non-Potable Distribution System Layout Review: System layout review will occur after the staking has been completed. Notify Owner's Representative one week

in advance of review. Modifications will be identified by the Owner's Representative at this review.

### 3.02 LAYOUT OF WORK:

- A. Stake out the irrigation distribution system. Items staked include: pipe, point of connections, manual drains, air-vacuum relief valves, blow-off valves, mainline fittings, and isolation valves.
- B. Install all mainline pipe and mainline components inside of project property lines.

### 3.03 EXCAVATION, TRENCHING, AND BACKFILLING:

- A. Excavate, trench, and backfill in accordance with Specification Section 02300 for this project.
- B. Excavate to permit the pipes to be laid at the intended elevations and to permit work space for installing connections and fittings.
- C. Backfill only after lines have been reviewed and tested.
- D. Enclose pipe and wiring beneath roadways, walks, curbs, etc., in sleeves. Minimum compaction of backfill for sleeves shall be 95% Standard Proctor Density, ASTM D698-78. Conduct one compaction test for each sleeved crossing less than 50 feet long. Conduct two compaction tests for each sleeved crossing greater than 50 feet long. Costs for such testing and any necessary retesting shall be borne by the Contractor. Use of water for compaction around sleeves, "puddling", will not be permitted.
- E. Where non-potable distribution pipe crosses potable water lines, the non-potable pipe shall be installed under the potable line. Provide 45 degree fittings, thrust blocks, and joint restraints per details and these specifications.

### 3.04 ASSEMBLING PIPE AND FITTINGS:

- A. General:
  - 1. Keep pipe free from dirt and pipe scale. Cut pipe ends smooth, straight, and at right angles to the pipe axis with saws or pipe cutters designed specifically for the material. Debur and clean pipe ends. Bevel the cut end in accordance with manufacturer's recommendations.
  - 2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.
  - 3. Trenches may be curved to change direction or avoid obstructions within the limits of the curvature of the pipe. Minimum radius of curvature and offset per 20-foot length of pipe by pipe size are shown in the following table. All curvature results from the bending of the pipe lengths. No deflection will be allowed at a pipe joint.

4. Do not lay pipe in water. Do not lay pipe under unsuitable weather or trench conditions.
5. Protect piping from entry of foreign materials by using temporary covers, completing discrete sections of work, and isolating completed sections of pipe.

SIZE	RADIUS	OFFSET PER 20' LENGTH
3"	100'	1'-11"
4"	100'	1'-11"
6"	150'	1'-4"
8"	200'	1'-0"
10"	250'	9"
12"	300'	8"

B. Non-Potable Distribution Pipe and Fittings:

1. PVC Rubber-Gasketed Pipe:
  - a. Use pipe lubricant. Join pipe in the manner recommended by manufacturer and in accordance with accepted industry practices.
  - b. All joints shall be watertight and free from leaks.
  - c. Ductile iron fittings shall not be struck with a metallic tool. Cushion blows with a wood block or similar shock absorber.
2. Field Joints:
  - a. Use push-on joints for buried pipe except where indicated otherwise.
  - b. Remove foreign material from the inside of the bell and outside of the spigot.
  - c. Apply a thin film of lubricant to the inside surface of the gasket and the spigot end of the pipe, per the manufacturer's recommendations.
  - d. Keep lubricated joint surface clean until joined.

C. Thrust Blocks:

1. Use cast-in-place concrete bearing against undisturbed soil in a manner to allow access to joints.
2. Size, orientation and placement shall be as shown on the installation details.
3. Wrap fitting with plastic to protect bolts, joint, and fitting from concrete.
4. Install rebar with mastic coating as shown on the installation details.

D. Joint Restraint:

1. Install harness in the manner recommended by the manufacturer and in accordance with accepted industry practices.

3.05 INSTALLATION OF PIPE MARKING TAPE:

- A. Install detectable warning tape flat, 12-inches above flow-fill in pipe trench, centered over pipe and as shown in the detail.

3.06 INSTALLATION OF COPPER TRACER WIRE:

- A. Install tracer wire as shown in the details.
- B. Tape to top centerline of pipe every 5-feet with adhesive tape or plastic tie straps so that the wire remains in place during embedding and backfilling.
- C. Bring tracer wire to the surface on the inside of the upper valve box section of a test station where shown in the drawings and located adjacent to fittings when possible.
- D. Install test stations flush with grade, complete with insulated terminal block having 4 terminals.
- E. Test station section shall be 4-inch diameter, 18-inches long plastic shaft with a flared end to prevent removal. Cover shall be lockable, cast-iron, and have "CP Test" cast in the cover.

### 3.07 INSTALLATION OF NON-POTABLE DISTRIBUTION PIPE COMPONENTS:

- A. Valves:
  - 1. Do not bury flanged valves.
  - 2. Install valves with operating nut perpendicular to the pipe.
  - 3. Install valves as shown in the details.
- B. Isolation Gate Valve Assembly: Install where indicated on the drawings.
- C. Air-Vacuum Relief Valve Assembly: Install where indicated on drawings or nearest high point, not closer than 2.25-feet from nearest fitting.
- D. Blow-off Assembly: Install where indicated on the drawings and at other low points in the mainline piping.
- E. Stub-outs: Install where indicated on the drawings and at other low points in the mainline piping.

### 3.08 INSTALLATION OF OTHER COMPONENTS:

- A. Tools and Spare Parts:
  - 1. Prior to completion of construction, supply to the Owner operating keys, servicing tools, spare parts, test equipment, and any other items indicated in the General Notes on the drawings.
- B. Other Materials: Install other materials or equipment shown on the drawings or installation details which are part of the irrigation distribution system, even though such items may not have been referenced in these specifications.

### 3.09 PROJECT RECORD (AS-BUILT) DRAWINGS:

- A. The Contractor is responsible for documenting changes to the design. Maintain on-site and separate from documents used for construction, one complete set of contract documents as Project Documents. Keep documents current. Do not permanently cover work until as-built information is recorded.
- B. Record pipe and wiring network alterations. Record work which is installed differently than shown on the construction drawings. Record accurate reference dimensions, measured from at least two permanent reference points, of each irrigation distribution system valve, stub-out, and other irrigation components enclosed within a valve box.
- C. Prior to construction completion, obtain from the Owner's Representative a reproducible mylar copy of the drawings. Mylars or CAD data files compatible with AutoCAD software, can be purchased from the Engineer. Cost of mylar reproducible drawings is \$25 per sheet and the cost of AutoCAD data files on diskette is \$100 per project set. Using technical drafting pen or CAD, duplicate

information contained on the project drawings maintained on site. Label each sheet "Record Drawing".

- D. Turn over the "Record Drawings" to the Owner's Representative. Completion of the Record Drawings will be a prerequisite for the Review at the completion of the irrigation system installation.

### 3.10 MAINTENANCE:

- A. Upon completion of construction and Review by Owner's Representative, maintain non-potable irrigation distribution system for a duration of 30 calendar days. Make periodic examinations and adjustments to system components so as to achieve the most desirable application of water.
- B. Following completion of the Contractor's maintenance period, the Owner will be responsible for maintaining the system in working order during the remainder of the guarantee/warranty period, for performing necessary minor maintenance, for protecting against vandalism, and for preventing damage after the landscape maintenance operation.

### 3.11 CLEANUP:

- A. Upon completion of work, remove from the site all machinery, tools, excess materials, and rubbish.

END OF SECTION

# PUMP BUILDING SPECIFICATIONS

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## **DIVISION 2-SITE WORK**

### **SECTION 02820-PRECAST CONCRETE BUILDING**

#### **PART 1: GENERAL**

##### **1.01 SCOPE OF WORK:**

Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete installation of the pump building, and guarantee/warranty as shown on the drawings, the installation details, and as specified herein. Items of work specifically included are:

- A. Procurement of all applicable licenses, permits, and fees.
- B. Construction and backfill of precast concrete pump building.
- C. Provision and installation of electrical and mechanical components in pump building as described herein.
- D. Restoration of finish grade to area disturbed by construction.
- E. Maintenance period.

##### **1.02 DISCREPANCIES:**

It is the intent of these plans and specification that the all equipment installed in the pump building be complete and workable. It is the Contractor's responsibility to make sure that the equipment furnished is compatible and adheres to all regulations. Any discrepancies should be noted immediately and should be reported to the Engineer for clarification.

##### **1.03 SUBMITTALS:**

- A. Deliver four (4) copies of all submittals to the Engineer within 15 days from the date of Notice to Proceed.
- B. Materials List: Include pipe, fittings, mechanical, and electrical components. Quantities of materials need not be included.
- C. Manufacturers' Data: Submit manufacturers' catalog cuts, specifications, and operating instructions for all equipment supplied.
- D. Shop Drawings: Submit shop drawings of building and other drawings called for in the installation details or specifications. Show products required for proper installation, their relative locations, and critical dimensions. Note modifications to the installation detail.

1.04 RULES AND REGULATIONS:

- A. Work and materials shall be in accordance with the latest edition of the National Electric Code, the Uniform Plumbing Code as published by the Western Plumbing Officials Association, and applicable laws and regulations of the governing authorities.
- B. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.
- C. If quantities are provided either in specifications or on these drawings, these quantities are provided for information only. It is the contractor's responsibility to determine the actual quantities of all material, equipment, and supplies required by the project and to complete an independent estimate of quantities and wastage.

1.05 TESTING:

- A. Notify the Owner's Representative three days (72 hours) in advance of testing.
- B. Operate pumps, control circuits, ventilators, outlets, and building lights.
- C. Adjust or move system components to correct deficiencies. Repeat the test until the Owner's Representative approves the test results.
- D. Cement or caulking to seal piping leaks is prohibited.

1.06 GUARANTEE/WARRANTY AND REPLACEMENT:

The purpose of this guarantee/warranty is to insure that the Owner receives fountain and plumbing materials of prime quality, installed and maintained in a thorough and careful manner.

- A. For a period of one year from commencement of the formal maintenance period, guarantee/warranty materials, equipment, and workmanship against defects. Fill and repair depressions. Restore landscape or irrigation components damaged by the settlement of trenches or excavations. Repair damage to the premises caused by a defective item. Make repairs within seven days of notification from the Owner's Representative.
- B. Contract documents govern replacements identically as with new work. Make replacements at no additional cost to the contract price.
- C. Guarantee/warranty applies to originally installed materials and equipment and replacements made during the guarantee/warranty period.

## PART 2: MATERIALS

### 2.01 QUALITY:

Materials used in the system shall be new and without flaws or defects of any type, and shall be the best of their class and kind.

### 2.02 SUBSTITUTIONS:

- A. Make complete submittals of all manufacturer's data showing compliance with the Contract Documents.
- B. In making a request for a substitution, the Contractor represents that he:
  - 1. Has investigated the proposed substitution and found that it is the same or better quality, level, capacity, function, or appearance than the specified product, and can demonstrate that to the Engineer.
  - 2. Will coordinate the installation and make all modifications to the work which may be required for complete installation and operation of the system.
- C. The Engineer will determine acceptability of the proposed substitution and will notify Contractor of acceptance or rejection.
- D. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at the option of the Contractor.

### 2.03 PRECAST CONCRETE BUILDING AND COMPONENTS:

- A. Provide materials required by local codes for installation of the pump building and associated piping.
- B. Precast Concrete Exposed Aggregate pump building:
  - 1. Minimum inside dimensions as shown on the drawings.
  - 2. Sealed exposed aggregate PSI concrete finish, clear coated with graffiti guard, with 72-inch steel entry door and welding plates for construction of building.
  - 3. Precast concrete roof and walls with cast out openings for vents and piping as shown in details. Thicken roof slab at seam and slope roof slab away from the seam.
  - 4. Furnish building manufactured by Colorado Precast Concrete, Loveland, CO. or approved equal.
  - 5. Furnish shop drawings for approval.

#### 2.04 PIPING COMPONENTS:

##### A. Wall Penetration Seal:

1. Use Link Seal, as manufactured by PSI Thunderline Corporation, Wayne, MI 48184 (313.728.2290). Toll Free 1.800.288.0404.
2. Size seal as recommended by manufacturer to fit pipe and wall opening.

#### 2.05 ELECTRICAL COMPONENTS:

##### A. Transformer and Load Center:

1. Refer to electrical drawings and specifications.

##### B. Ventilation Fan:

1. Furnish ventilation fan per drawings.

#### 2.06 OTHER COMPONENTS:

- ##### A. Tools: Provide operating keys, servicing tools, test equipment, and other items indicated in the General Notes of the drawings and other incidental hardware and fixtures as required.

### PART 3: EXECUTION

#### 3.01 INSPECTIONS AND REVIEWS:

##### A. Site Inspections: Verify locations of underground utilities.

1. Verify site conditions and note irregularities affecting work of this section. Report irregularities to the Owner's Representative prior to beginning work.
2. Beginning work of this section implies acceptance of existing conditions.

#### 3.02 EXCAVATION, TRENCHING, AND BACKFILLING:

- ##### A.
- Excavate to permit the concrete pump building and pipes to be laid at the intended elevations and to permit work space for installing connections and fittings.
- ##### B.
- Excavated material is generally satisfactory for backfill. Backfill shall be free from rubbish, vegetable matter, frozen materials, and stones larger than 2-inches in maximum dimension. Remove material not suitable for backfill. Backfill placed next to pipe shall be free of sharp objects which may damage the pipe.

- C. Backfill excavated areas in either of the following manners:
  - 1. Backfill and puddle the lower half of the trench. Allow to dry 24 hours. Backfill the remainder of the trench in 6-inch layers. Compact to density of surrounding soil.
  - 2. Backfill the trench by depositing the backfill material equally on both sides of the pipe in 6-inch layers and compacting to the density of surrounding soil.
- D. Dress backfilled areas to original grade.

### 3.03 PRECAST CONCRETE BUILDING AND COMPONENTS:

- A. Precast Concrete Building: Construct precast building as shown in detail. Submit shop drawings of proposed building prior to construction.
  - 1. Install 6-inch gravel base over compacted subgrade. Install conduit prior to building floor installation. Coordinate pump mounting pedestal with cast-in-place floor.
  - 2. Install building per manufacturer's instructions. Grout and seal all joints and penetrations. Use caulking consisting of 1 part urethane sealant.
  - 3. Install galvanized vandal proof screens for all louvers. Paint screens to match building exterior.
  - 4. Install threshold and weather stripping at entry door. (City of Greeley)
- B. Concrete Building Floor: Construct cast-in-place concrete building floor.
  - 1. Use 3,000 PSI concrete for concrete floor. Install No. 4 rebar on 12-inch centers both directions to form a grid in concrete floor.
  - 2. Coordinate location and installation of building welding plates with building manufacturer prior to construction.

### 3.04 INSTALLATION OF PIPING COMPONENTS:

- A. Wall Penetration Seal:
  - 1. Install where indicated on drawings.
  - 2. Install per manufacturer's recommendations.

### 3.05 INSTALLATION OF ELECTRICAL:

- A. All installation of electrical components shall be performed by a licensed electrician, and conform to the National Electric Code and all local building codes.
- B. Main Disconnect Control Panel:
  - 1. Refer to electrical drawings and specifications
- C. Ventilation Fan:
  - 1. Install per drawing and per manufacturer recommendation

### 3.06 INSTALLATION OF OTHER COMPONENTS:

- A. Tools: Prior to the Pre-Maintenance Review, supply to the Owner operating keys, servicing tools, test equipment, and any other items indicated on the drawings.
- B. Paint all unfinished steel surfaces with at least two (2) coats of Sherwin-Williams Polane textured epoxy. Prepare metal surfaces and prime per manufacturer's instructions. Color will be determined by the Owner's Representative
- C. Other Materials: Install other materials or equipment shown on the drawings or installation details to be part of the pump building and mechanical system, even though such items may not have been referenced in these specifications.

### 3.07 PROJECT RECORD (AS-BUILT) DRAWINGS:

- A. Maintain on-site and separate from documents used for construction, one complete set of contract documents as Project Documents. Keep documents current. Do not permanently cover work until as-built information is recorded.
- B. Record pipe and wiring network alterations. Record work which is installed differently than shown on the construction drawings. Record accurate reference dimensions, measured from at least two permanent reference points.
- C. Prior to project completion, obtain from the Engineer a reproducible mylar copy of the drawings. Using technical drafting pen, duplicate information contained on the project drawings maintained on site. Label each sheet "Record Drawing". Completion of the Record Drawings will be a prerequisite for the Final Review.

### 3.08 MAINTENANCE:

- A. Upon completion of project, maintain the pump building mechanical system for a duration of 30 calendar days. Make periodic examinations and adjustments to the system components so as to achieve the most desirable operating conditions.

3.09 CLEANUP:

- A. Upon completion of work, remove from the site all machinery, tools, excess materials, and rubbish.
- B. Remove all debris and foreign material from the construction area and pump building prior to operating the system.

END OF SECTION

## PUMP SYSTEM INTAKE SPECIFICATIONS

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## **DIVISION 2-SITE WORK**

### **SECTION 02840-PUMP SYSTEM INTAKE**

#### **PART 1: GENERAL**

##### **1.01 SCOPE:**

Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete installation of the pump system intake, and guarantee/warranty as shown on the drawings, the installation details, and as specified herein. Items of work specifically included are:

- A. Procurement of all applicable licenses, permits, and fees.
- B. Provision, excavation, installation, and backfill of a round pre-cast wet well as shown in the detail drawings.
- C. Provision, excavation, installation, and backfill of a precast concrete intake structure with headwall, canal gate, and trash rack.
- D. Provision, excavation, installation, and backfill of intake pipe, line gate valve, and filter backwash pipe.
- E. Coordination with site work, grading, pump system installation, and pump house construction.

##### **1.02 DISCREPANCIES:**

It is the intent of these plans and specification that the pump system intake be complete and workable. It is the Contractor's responsibility to make sure that the equipment furnished is compatible and adheres to all regulations. Any discrepancies should be noted immediately and should be reported to the Owner's Representative for clarification.

##### **1.03 SUBMITTALS:**

- A. Materials List: Include pipe, fittings, and valves. Quantities of materials need not be included.
- B. Manufacturers' Data: Submit manufacturers' catalog cuts, specifications, and operating instructions for all equipment supplied.
- C. Shop Drawings: Submit shop drawings called for in the installation details or specifications. Show products required for proper installation, their relative locations, and critical dimensions. Note modifications to the installation detail.

#### 1.04 RULES AND REGULATIONS:

- A. Work and materials shall be in accordance with the latest edition of the Uniform Plumbing Code as published by the Western Plumbing Officials Association, and applicable laws and regulations of the governing authorities.
- B. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.
- C. If quantities are provided either in specifications or on these drawings, these quantities are provided for information only. It is the contractor's responsibility to determine the actual quantities of all material, equipment, and supplies required by the project and to complete an independent estimate of quantities and wastage.

#### 1.05 GUARANTEE/WARRANTY AND REPLACEMENT:

The purpose of this guarantee/warranty is to insure that the Owner receives concrete and plumbing materials of prime quality, installed and maintained in a thorough and careful manner.

- A. For a period of one year from commencement of the formal maintenance period, guarantee/warranty pump system intake materials, equipment, and workmanship against defects. Fill and repair depressions. Restore landscape or structural features damaged by the settlement of trenches or excavations. Repair damage to the premises caused by a defective item. Make repairs within seven days of notification from the Owner's Representative.
- B. Contract documents govern replacements identically as with new work. Make replacements at no additional cost to the contract price.
- C. Guarantee/warranty applies to originally installed materials and equipment and replacements made during the guarantee/warranty period.

### PART 2: MATERIALS

#### 2.01 QUALITY:

Materials used in the system shall be new and without flaws or defects of any type, and shall be the best of their class and kind.

#### 2.02 SUBSTITUTIONS:

Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at the option of the Contractor.

### 2.03 PRECAST CONCRETE WET WELL AND INTAKE STRUCTURE:

- A. Provide shop drawings showing complete information for the fabrication and installation of the precast concrete sections. Include special reinforcement and lifting devices necessary for handling and erection.
- B. Provide layout dimensions, and identification of each precast unit. Detail inserts, connections, blockouts, joints, accessories and openings.
- C. Manufacturer of precast concrete units is responsible for design of reinforcement and its placement. Fabricate units with concrete having minimum compressive strength of 4000 PSI at 28 days using Type I-II cement.
  - 1. Furnish test reports of concrete indicating compressive strength.
  - 2. Certify that the concrete units fabricated and installed will support the required design loads.
- D. Fabricate precast sections in conformance with to ASTM C-478 designation for manufacturing, testing, and quality control.
- E. Furnish precast units with concrete finish equal to smooth steel formed as-cast concrete. Small surface holes caused by air bubbles, normal form joint marks, minor cracking, chips and spalls, and normal color variations will be permitted.
- F. Furnish wet well as shown on drawings.
  - 1. Insert type plastic coated steel access steps installed on 12-inch centers.
  - 2. Cast out gasketed openings for intake pipe as shown in details.
- G. Furnish precast concrete sections manufactured with tongue and groove joints installed with a joint sealant.
- H. Furnish precast intake structure
  - 1. Cast out opening for pipe as shown in details.

### 2.04 PIPE AND FITTINGS:

- A. PVC Pipe and Fittings:
  - 1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end suitable for solvent welding.

2. Use SDR-32.5 conforming to the dimensions and tolerances established by ASTM Standard D2241.
3. Use rubber-gasketed pipe for intake pipe with a nominal diameter greater than or equal to 4-inches and rubber-gasketed fittings with lubricant approved by the pipe manufacturer.

2.05 TRASH RACK:

- A. Provide intake structure trash rack as shown in the installation details.

2.06 CANAL GATE:

- A. Furnish canal gate on intake structure as shown in the details.

2.07 OTHER COMPONENTS:

Provide any special tools, operating keys for isolation valves, servicing tools for screen as required.

PART 3: EXECUTION

3.01 INSPECTIONS AND REVIEWS:

A. Site Inspections:

1. Verify site conditions and note irregularities affecting work of this section. Report irregularities to the Owner's Representative prior to beginning work.
2. Beginning work of this section implies acceptance of existing conditions.

- B. Verify locations of underground utilities.

3.02 EXCAVATION, TRENCHING, AND BACKFILLING:

- A. Excavate to permit the pipes and the precast wet well to be set at the intended elevations and to permit work space for installing connections and fittings.
- B. Minimum cover (distance from top of pipe to finish grade) is 24-inch over filter system backwash pipe.
- C. Excavated material is generally satisfactory for backfill. Backfill shall be free from rubbish, vegetable matter, frozen materials, and stones larger than 2-inches in maximum dimension. Remove material not suitable for backfill. Backfill placed next to pipe shall be free of sharp objects which may damage the pipe.

- D. Backfill pipe in either of the following manners:
  - 1. Backfill and puddle the lower half of the trench. Allow to dry 24 hours. Backfill the remainder of the trench in 6-inch layers. Compact to density of surrounding soil.
  - 2. Backfill the trench by depositing the backfill material equally on both sides of the pipe in 6-inch layers and compacting to the density of surrounding soil.
- E. Backfill pre-cast concrete wet well in following manner:
  - 1. Backfill the area around the wet well by depositing the backfill material equally around the circumference / perimeter of the pre-cast wet well in 6-inch lifts and compacting to 90-95% Standard Proctor Density (SPD).
- F. Dress backfilled areas to original grade. Incorporate excess backfill into existing site grades.
- G. Where utilities conflict with irrigation trenching and pipe work, contact the Owner's Representative for trench depth adjustments.

### 3.03 PRECAST CONCRETE:

- A. Coordinate exact location of fixtures with Architect prior to installation.
- B. Install units on a 6-inch gravel subbase over compacted subgrade in accordance with manufacturer's instructions.
- C. Lift, place, and secure units in accordance with manufacturer's instructions and final shop drawings. Do not install units until supporting members are in place and secured.
  - 1. Lift only at lifting points provided and install temporary shoring and bracing as necessary.
  - 2. Level units accurately and in acceptable condition to allow installation of subsequent work.
  - 3. Grout all joints and repair damaged exposed surfaces as required.
- D. Steel trowel finish all concrete, smooth surfaces, and round all corners.

### 3.04 ASSEMBLING PIPE AND FITTINGS:

- A. General:
  - 1. Keep pipe free from dirt and pipe scale. Cut pipe ends square and debur. Clean pipe ends.

2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.
3. Join pipe according to industry standards and manufacturer's recommendation.

B. Pipe and Fittings:

1. PVC Rubber-Gasketed Pipe:
  - a. Use pipe lubricant. Join pipe in the manner recommended by manufacturer and in accordance with accepted industry practices.
2. Install intake pipe and fittings as recommended by the manufacturer.

3.05 INSTALLATION OF ISOLATION VALVE:

- A. Install where indicated on drawings.
- B. Install per manufacturer's recommendations.
- C. Install operating extension, valve box and cover as shown in installation details and as recommended by the manufacturer.

3.06 INSTALLATION OF TRASH RACK:

- A. Install as shown in drawings.
- B. Install to permit removal of trash rack for maintenance.

3.07 INSTALLATION OF CANAL GATE:

- A. Install as shown in drawings

3.08 INSTALLATION OF OTHER COMPONENTS:

- A. Tools: Prior to the Final Review, supply to the Owner, operating keys, servicing tools, and any other items indicated on the drawings.
- B. Other Materials: Install other materials or equipment shown on the drawings or installation details to be part of the pump intake system, even though such items may not have been referenced in these specifications.

3.09 PROJECT RECORD (AS-BUILT) DRAWINGS:

- A. Maintain on-site and separate from documents used for construction, one complete set of contract documents as Project Documents. Keep documents current. Do not permanently cover work until as-built information is recorded.

- B. Record pipe alterations. Record work which is installed differently than shown on the construction drawings. Record accurate reference dimensions, measured from at least two permanent reference points.
- C. Prior to project completion, obtain from the Engineer a reproducible mylar copy of the drawings. Using technical drafting pen, duplicate information contained on the project drawings maintained on site. Label each sheet "Record Drawing". Completion of the Record Drawings will be a prerequisite for the Final Review.

3.10 CLEANUP:

- A. Upon completion of work, remove from the site all machinery, tools, excess materials, and rubbish.
- B. Remove all debris and foreign material from the construction area and wet well.

END OF SECTION

## CAST-IN-PLACE CONCRETE

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## SECTION 03300 - CAST-IN-PLACE CONCRETE

### PART 1: GENERAL

#### 1.01 DESCRIPTION:

- A. This Section covers cast-in-place concrete, including furnishing materials, transporting, placing, finishing, curing and other appurtenant items of construction.
- B. Inform Owner at least 48 hours in advance of time and places at which Contractor intends to place concrete, exclusive of weekends and holidays.

#### 1.02 QUALITY ASSURANCE:

##### A. Reference Standards:

- 1. Except as noted or modified in this Section all concrete materials, transporting, placing, finishing and curing shall conform to the requirements of MAG and the following standard specifications:
  - a. American Concrete Institute Standards (ACI).
    - (1) 301 Specifications for Structural Concrete for Buildings.
    - (2) 304 Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.
    - (3) Committee 304 Placing Concrete by Pumping Methods.
    - (4) 305 Recommended Practice for Hot Weather Concreting.
    - (5) 306 Recommended Practice for Cold Weather Concreting.
    - (6) 309 Recommended Practice for Consolidation of Concrete.
    - (7) 318 Building Code Requirements for Reinforced Concrete.

- B. Contractor shall keep at least one copy of above listed ACI publications, latest edition, in project field office at all times.

#### 1.03 SUBMITTALS:

##### A. Test Results:

- 1. Perform and submit test reports for the following products in accordance with above general reference standards and specific standards of these Specifications.

##### B. Proposed Mix Design:

- 1. Prior to commencing concrete Work, submit and obtain Owner's approval of certified test reports describing proposed concrete mix design, including:

- a. Fine aggregates - source, type, gradation, deleterious substances and bulk specific gravity on basis of weight of saturated surface - dry aggregate, ASTM C128.
- b. Coarse aggregate - source, type, gradation, deleterious substances and bulk specific gravity on basis of weight of saturated surface -dry aggregate, ASTM C127.
- c. Ratio of fine to total aggregates.
- d. Weight (surface dry) of each aggregate per cubic yard.
- e. Total water content in gallons per cubic yard and proposed source.
- f. Slump on which design is based.
- g. Brand, type, and quantity of cement.
- h. Brand, type, descriptive data, and quantity of admixtures.
- i. Air content.
- j. Two sets of trial mix test cylinders, two cylinders per set, shall be made for each proposed mix or provide field experience basis for evaluation per ACI 301. Test one set of two cylinders at age 7 days and other set at 28 days.

C. Cylinder Compression Test Reports:

1. Submit 2 copies of certified test reports to Owner's Representative for 1.3 B.1.j. and 2 copies of each of test results required under 3.9A.

D. Ready-Mix Delivery Tickets:

1. Submit delivery tickets for each load at time of delivery indicating following:
  - a. Quantity delivered.
  - b. Quantity of each material in batch.
  - c. Outdoor temperature in shade.
  - d. Time at which water was added.
  - e. Elapsed time between when water was added and concrete load was in place.
  - f. Amounts of initial and supplemental water added.

- g. Name of individual authorizing supplemental water.
  - h. Numerical sequence of delivery by indicating cumulative yardage delivered on each ticket.
- E. Concrete Construction Jointing Plan:
- 1. Provide Construction Jointing Plan showing proposed location of wall, footing and slab locations prior to submitting reinforcing shop drawings.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Cement:

- 1. Store in weather tight enclosures and protect against dampness, contamination and warehouse set.
- 2. Do not use cement that has become caked or lumpy.

B. Aggregates:

- 1. Stockpile to prevent excessive segregation, or contamination with other materials or other sizes of aggregates.
- 2. Use only one supply source for each aggregate stock pile.
- 3. The bottom 6 inches of all aggregate piles in contact with ground shall not be used.

C. Admixtures:

- 1. Store to prevent contamination, evaporation, or damage.
- 2. Protect liquid admixtures from freezing or harmful temperature ranges.
- 3. Agitate emulsions prior to use.

D. Rubber and Plastic Materials:

- 1. Store in cool place away from direct sunlight.

E. Mixing and Transporting Ready-mixed Concrete:

- 1. Maximum elapsed time; from time water is added to mix until concrete is in place; shall not exceed 1 and 1/2 hours when concrete is transported in revolving drum truck bodies.

1.05 JOB CONDITIONS:

A. Environmental Requirements:

1. Do not place concrete during rain, sleet or snow unless adequate protection is provided and Owner's Representative's approval is obtained.
2. Do not allow rain-water to increase mixing water or damage surface finish.

B. Cold Weather Concreting - Conform to ACI 306, "Recommended Practice for Cold Weather Concreting":

1. Temperature of concrete when placed shall not be less than following:

Air Temp. ° F.	Minimum Concrete Temp. °F.	
	Under 12"	12" and Over
30° to 45°	60° <sup>□</sup>	50° <sup>□</sup>
0° to 30°	65° <sup>□</sup>	55°
Below 0°	70°	60° <sup>□</sup>

2. When placed, heated concrete shall not be warmer than 80°<sup>□</sup>F.
3. Prior to placing concrete, all ice, snow, surface and subsurface frost shall be removed, and temperature of surfaces to be in contact with new concrete shall be raised to temperature specified for placing.
4. Protect concrete from freezing during specified curing period.
5. Heated enclosures shall be strong and windproof to insure adequate protection of corners, edges and thin sections.
6. Do not permit heating units to locally heat or dry concrete.
7. Do not use combustion heaters during first 24 hours unless concrete is protected from exposure to exhaust gases which contain carbon dioxide.
8. Refer to ACI 306 for further requirements.

C. Hot Weather Concreting - Conform to ACI 305, "Recommended Practice for Hot Weather Concreting":

1. Take precautions when ambient air temperature is 80°F. or above.
2. Temperature of concrete when placed shall not exceed 85°<sup>□</sup>F.
3. Cool forms and reinforcing to a maximum of 90°F. by spraying with water prior to placing concrete.
4. Do not use cement which has reached a temperature of 170°F. or more.

5. Prevent plastic shrinkage cracking due to rapid evaporation of moisture.
6. Do not place concrete when evaporation rate (actual or anticipated) equals or exceeds 0.20 pounds per square foot per hour, as determined by Figure 2.1.4 of ACI 305.
7. Set-retarding and water-reducing admixtures may be used to offset accelerating effects of high temperatures (with Owner's Representative's approval) when ambient air temperature is 90°F. or above.
8. Refer to ACI 305 for further requirements.

D. Construction Joints:

1. Divide tank bottom slabs and wall pours into sections by construction joints (including contraction and expansion joints) shown on Drawings.
2. If all construction joints are not shown on Drawings, limit all concrete pours as follows:
  - a. Bottom slabs to a maximum of 30 feet in any direction. Do not break slabs parallel with walls in thickened sections.
  - b. Limit wall pours to a maximum length of 60 feet.
  - c. Do not end wall pours at a corner.
  - d. Vertical wall construction joints shall be at least one-half the wall height in each direction from any corner.
  - e. Pour suspended slab and beam arrangements monolithic.
  - f. Request for change in location of construction joints shown or called for, or the addition of such joints, shall be made by Contractor to Owner before detailed reinforcing drawings have been prepared by the steel fabricators.
3. Contraction and expansion joints as shown, detailed or called for on the Drawings.

- E. Contractor is solely responsible for the proper size and location of anchors, chases, recesses, openings, and embedded items required for the work.

1.06 ALTERNATIVES:

- A. Horizontal construction joints located in all walls over 16 feet high at midheight of wall shall be provided unless the Contractor complies with the following minimum requirements:
1. Submit experience statement identifying projects on which the Contractor has constructed walls of this height. Include references of Owner's Representative for the projects.
  2. Provide standby equipment including vibrators, and a crane and bucket or standby pump to insure the pouring operations will not be interrupted.
  3. Submit pouring schedules indicating maximum rate of vertical rise taking into consideration form strength and the lateral pressures on the forms as affected by concrete and ambient temperature, concrete slump and the use of water reducing and retarding agents.

PART 2: PRODUCTS

2.01 CONCRETE MATERIALS:

- A. Cement: ASTM 150, Type II, except tricalcium aluminate content shall not exceed 5%.
- B. Aggregates:
1. Fine aggregate - ASTM C33.
  2. Course aggregate - ASTM C33 except that air-cooled blast furnace slag will not be allowed.
    - a. Nominal maximum size of coarse aggregate shall not be larger than:
      - (1) 1/5 narrowest dimension between sides of forms, nor
      - (2) 3/4 minimum clear spacing between reinforcing bars, bundles or bars, minimum cover on form work for columns, beams, girders and walls.
- C. Water:
1. Clean, fresh and free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances that may be deleterious to concrete reinforcement.
- D. Admixtures:
1. Use only as specified or approved in writing by Owner's Representative.
  2. Do not use admixtures which cause accelerated setting of cement.

3. Calcium chloride is not permitted.
4. Air-entraining Agent: ASTM C260.
5. Water-Reducing & Retarding: ASTM C494, Type D.
6. Water Reducing: ASTM C494, Type A.

## 2.02 CONCRETE PRODUCTION:

### A. Ready-Mixed Concrete:

1. Mixed and delivered, ASTM C94.

### B. Batching and Mixing Equipment:

1. "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete", ACI 304.

### C. Concrete Classes:

1. Class A:
  - a. 4000 psi structural concrete mix.
  - b. To be used in all areas of project.

### D. Proportioning:

1. Proportion ingredients for Class A, B and C to produce a well-graded mix of high density and maximum workability consistent with approved mix designs as follows:
  - a. Minimum 28-day Compressive Strength: 4,000 psi
  - b. Minimum 7-day Compressive Strength: 2,300 psi
  - c. Avg. 28-day strength if Production Plant does not have 30 consecutive strength tests for concrete proportions: 5,200 psi
  - d. Minimum cement content: 564 pounds/cubic yard
  - e. Maximum water/cement ratio: 0.40
  - f. Fine to total aggregate ratio:

-3/4 inch coarse	0.35-0.50
-larger than 3/4 inch	0.35-0.46

2. Entrained Air:
  - a. Air content: 5% to 7% as tested in accordance with ASTM C231.
3. Slump:
  - a. Slump of concrete shall be 3 inches  $\pm$  1 inch as tested in accordance with ASTM C39.
4. Mixing - Minimum time:
  - a. Central mixed concrete, 1 minute for mixer capacities of one cubic yard or less, plus 15 seconds for each cubic yard or fraction thereof of additional capacity.
  - b. Truck mixed concrete, 100 revolutions after introduction of all ingredients. Maximum 300 revolutions.
  - c. Do not place concrete until Resident has had the opportunity to check the load for air entrainment and slump requirements. He may exercise this right for any load he so chooses.

#### 2.03 CONCRETE ACCESSORY MATERIALS:

##### A. Curing Materials:

1. Sheet material: ASTM C171.
2. Liquid membrane: ASTM C309.

##### B. Expansion Joint Filler:

1. Bituminous type: ASTM D994. (Preformed mastic)
2. Cork type: ASTM D1752, Type 2 or 3.
3. Fiber type: ASTM D1751.
4. Sponge rubber type: ASTM D1752, Type I.

##### C. Bond Break Material:

1. Felt: ASTM D2475.
2. Plastic: polyethylene sheet, Product Standard 17, 8 mil, use only where shown on Drawings.

##### D. Joint Sealers:

1. Cold - application type: ASTM D1850.

2. Hot-poured elastic type: ASTM D1190.
3. Hydrostatic pressure resistant sealant: Sikaflex 427, or 405/406, or equal.

E. Sealant Backer Rod:

1. Backer rod shall be closed cell, compatible with sealant.
2. Manufacturers.
  - a. Bostick Construction Products Division.
  - b. Chem-Calk - Backer Rod.
  - c. Dow Chemical Company - Ethafoam.
  - d. Hercules Foam Backer Rod.
  - e. Sonneborn Building Products - Sonofoam.
  - f. W.R. Meadows - Sealtight Backer Rod.

F. Vapor Barrier Material:

1. Polyethylene sheet: Product Standard PS1769, 10 mil.

G. Curing and Sealing Compounds:

1. Liquid membrane-forming: ASTM C309.
2. Manufacturers:
  - a. Protex "Triple Seal,"
  - b. Castle Chemical Corp., "Klearseal,"
  - c. Or equal.

H. Water Stops:

1. Material:
  - a. Polyvinyl chloride, (PVC); Corps of Engineers, CRD-C-572.
  - b. Butyl Rubber and Bentonite waterstop with Primer.

2. Type:
  - a. Ribbed with center bulb.
  - b. Butyl rubber and bentonite with primer.
3. Location:
  - a. For all locations unless otherwise indicated or specified.  
(1) Greenstreak Plastic Products: Greenstreak Style 732.
4. Manufacturers:
  - a. Greenstreak Plastic Products: Greenstreak Style 702, or equal.
  - b. America Colloid Company: Waterstop Rx, 3/4 "x 3/4" with primer.

### PART 3: EXECUTION

#### 3.01 INSPECTION:

##### A. General:

1. Assure that excavations and form work are completed.
2. Check that fill under slabs are of the type, depth and degree of compaction specified.
3. Assure that dirt, mud, encrusted concrete, debris and excess water has been removed.
4. Check that reinforcement is properly positioned and secured in place.
5. Verify that expansion joint material, anchors, waterstops and other embedded items are secured in proper position. Waterstop Rx that has been wetted shall be removed and replaced with dry. Prime all concrete at waterstop Rx locations. Provide cut nails as necessary for secure installation.
6. Verify that all required tests for pipes under slabs have been completed.
7. Keyways are to be continuous and formed. No free hand keyways permitted.

#### 3.02 PREPARATION:

##### A. General:

1. Remove any hardened concrete and foreign material from inner surface of conveying equipment.

2. Prepare slab subgrades in accordance with ACI 301, Chapter 11.
3. Moisten subgrade prior to placement, but do not cause water to pond, nor muddy or soft spots to appear.
4. Provide vapor barrier material under all floor slabs on grade. Lap edges and ends 4 inches and seal with 2 inch pressure-sensitive tape. Seal edges with pressure-sensitive tape at vertical surfaces.
5. Designate limits of each placement and obtain Owner's approval of entire installation prior to proceeding.

B. Concrete Placed Against Gravel or Crushed Stone:

1. Cover with 10 mil polyethylene film all surfaces that do not contain at least 25 percent material passing a No. 4 sieve to protect concrete from loss of water.
2. Lap joints at least 4 inches and seal with 2 inch pressure-sensitive tape. Seal edges with pressure-sensitive tape at vertical surfaces.

C. Concrete Placed Against Rock:

1. Remove all loose pieces of rock.
2. Clean exposed rock surface with high pressure water hosing followed by high air pressure hosing.

D. Concrete Placed Against Hardened or Existing Concrete:

1. Prior to placing fresh concrete against surface of hardened concrete, complete the following:
  - a. Roughen, air clean, and thoroughly wet hardened surface to sound concrete.
  - b. Remove all laitance, foreign substances (including curing compound), wash with clean water, and thoroughly wet hardened surface before placing fresh concrete.
  - c. If hardened concrete is in roughened condition, clean all loose material by high pressure water hosing in combination with stiff brooming.

2. Omit coarse aggregate from mix when placing first batch or batches of fresh concrete against hardened horizontal concrete surfaces.
  - a. Cover hardened concrete with a mortar puddle to a depth of 2-3 inches at every point before continuing with normal mix of concrete.

### 3.03 PLACEMENT BASE SLABS/WALLS:

A. Placing sequence - To reduce the effect of shrinkage cracks, concrete for bottom and walls shall be placed as follows:

1. Slabs:

- a. Place outer thickened slab sections.
- b. Place inner sections alternately, first on one side and then on other side of previously poured sections.
- c. Schedule pours so that two adjacent sides of each section are free, except at closure.

2. Walls:

- a. Divide walls into sections by construction joints or expansion joints shown on Drawings or as noted in Joint Submittal.
- b. Place section near center of each wall first.
- c. Place sections alternately, first on one side and then on other side of previously placed section.
- d. Schedule pours so that one end of each section is free, except at closures.

3. Do not place two abutting sections within 48 hours, unless otherwise authorized by Owner's Representative.

4. Changes in construction joint locations from that shown on Drawings must have Owner's Representative's written approval.

B. Conveying:

1. Convey concrete from mixer to final position as rapidly as practicable without segregation or loss of material.
2. Use only metal or metal lined chutes with maximum length of 20 feet, having a maximum slope of 1 vertical to 2 horizontal, and a minimum slope of 1 vertical to 3 horizontal.

3. Provide a hopper at the end of long belt conveyors and chutes not meeting the requirements in 2 above.
4. Conveying by pumping methods shall conform to ACI 304, Chapter 9.
  - a. Maximum loss of slump, 2 inches.
  - b. Do not pump concrete having a slump of less than 2 inches.
  - c. Do not use aluminum or aluminum alloy pipe to convey concrete.

C. Depositing:

1. Deposit concrete in a continuous operation until section is completed.
2. Regulate rate of placement so concrete remains plastic and flows into position.
3. Place concrete in approximately horizontal layers 18 inches maximum thickness for liquid containing structures and 24 inches for all other structures.
4. Each layer of concrete shall be plastic when covered with following layer.
5. Rate of vertical rise not less than 2 ft per hour.
6. Provide vertical joints as necessary to comply with these requirements.
7. Maximum height of concrete free fall, 4 feet.
8. Use a tremie for placing concrete in drilled piers and walls to prevent free fall of more than 4 feet. Do not allow concrete to fall on reinforcement or other objects that would cause segregation.
9. Tremies shall have varying lengths to limit free fall of concrete to 4 feet at all times.
10. Place and compact concrete in wall or column forms before any reinforcing steel is placed in the system to be supported by such wall or column.
11. Do not exceed 6 feet of vertical height for any portion of wall or column placed monolithically with floor or roof slabs.
12. Concrete in walls or columns shall settle at least 2 hours before concrete is placed in structural systems to be supported by such walls or piers.

13. Allow concrete to thoroughly settle before top is finished.
  - a. Remove all laitance, debris, and surplus water from surfaces at tops of forms by screeding, scraping, or other effective means.
14. Overfill forms wherever top of a wall will be exposed and screed off excess concrete after settlement has occurred. Forms may be extended above top of wall by 2 feet provided work conforms to the requirements of the preceding paragraph 13.

D. Consolidation:

1. During and immediately after placement, thoroughly vibrate and work around all reinforcements, embedments, and corners of forms.
2. Use mechanical vibrators that will maintain at least 9000 cycles per minute when immersed in concrete.
3. Minimum horsepower per vibrator shall be 1 1/2.
4. Number and type of vibrators shall be acceptable to Owner's Representative.
5. Do not use vibrators to transport concrete laterally in forms.
6. Vertically insert vibrators at points approximately 18 inches apart and to a depth to penetrate 6 inches into the preceding layer.
7. Vibrate each location for a length of time to obtain adequate consolidation (generally 5 to 15 seconds).

3.04 JOINTS:

A. Watertight Joints:

1. Provide waterstops at locations shown on Drawings.

B. Expansion and Contraction Joints:

1. At all locations shown on Drawings.
2. Do not extend reinforcement continuously through joint unless specifically shown on Drawings.
3. Form joint with felt, ASTM D2475, extending full depth, where "break bond" or "isolation" joint is indicated.
4. Use sponge rubber type filler where in contact with liquid.
5. Provide expansion joints where walls abut structures.

C. Construction Joints:

1. Where shown on Drawings.
2. Obtain Owner's approval for location of construction joints not shown on Drawings.
3. Locate joints as follows:
  - a. Columns and walls.
    - (1) At underside of beams, girders, haunches, drop panels.
    - (2) Column bases will not be required to be monolithic with floor beneath.
  - b. Beams and girders.
    - (1) Construction joints will not be allowed.
  - c. Suspended slabs.
    - (1) At or near center of span in flat slab or T-beam construction or centered over wall.
    - (2) No joint will be permitted between a slab and a concrete beam or girder unless specifically shown on Drawings.
  - d. Construction joints in walls and slabs shall be perpendicular to planes of their surfaces.

D. Key Joints:

1. Install key joint where vertical wall meets the floor slab.

3.05 EMBEDDED ITEMS:

A. Waterstops:

1. Place in construction and expansion joints as indicated on Drawings.
2. Waterstops shall be continuous in each joint.
  - a. Splice as recommended by manufacturer.
  - b. Splices shall be watertight.
  - c. Thoroughly clean water stops of foreign material before splicing or placing concrete.
  - d. Splices shall be neat with the ends of the joined materials in true alignment.
3. Install with an approximately equal width of material embedded in concrete on each side of the joint.

4. Provide suitable guards to protect exposed projecting edges and ends of partially embedded water stops for mechanical damage when concrete placement has been discontinued.
5. Carefully place and vibrate concrete around waterstops to ensure the following: maximum concrete imperviousness and density, the complete filling of the forms in the vicinity of the waterstop, and complete contact between the concrete and all surfaces of the waterstop.
6. Make adequate provision to support and completely protect the waterstops in proper position during the progress of the work and take particular care for their protection during form removal. Waterstops shall be wired to reinforcing when possible to maintain alignment.
7. Replace or repair punctured or otherwise damaged waterstops.
8. Waterstops are to be in center of keyway unless detailed otherwise.

### 3.06 FINISHING EXPOSED SURFACES:

#### A. Finishing Unformed Surfaces:

1. Slabs, floors, stairs, pavements, sidewalks, driveways, curbs and gutters, and similar structures.
  - a. Provide surface conforming to proper elevation and contour with all aggregates completely embedded in mortar by screeding.
    - (1) Screeded surfaces shall be free of surface irregularities.
    - (2) Maximum variation from level in any 10 feet section,  $\pm$  1/4 inch.
  - b. Provide an initial float finish as soon as concrete has stiffened sufficiently for proper working.
    - (1) Remove any piece of coarse aggregate which is disturbed by float or which causes a surface irregularity and replace with mortar.
    - (2) Produce a surface of uniform texture and appearance with initial floating, without unnecessary working of surface.
  - c. Provide a second floating at time of initial set.
    - (1) Produce a finish of uniform texture and color with second floating.
    - (2) Float finish produced by second floating shall be completed finish unless additional finishing is specifically required and specified.
    - (3) Perform floating with hand floats or suitable mechanical compactor- floats.

- d. In areas where concrete is to remain exposed, follow second floating with a broomed treatment to surface to provide a uniform abrasive texture of constant color.
  - (1) Broom at right angles to normal traffic direction.
  - (2) Broom exterior concrete stairs, sidewalks, driveways, curbs and gutters, pavements and exterior decks and slabs.

B. Troweling:

- 1. Steel trowel finish following surfaces:
  - a. Exposed interior floor surfaces after construction is completed.
  - b. Surfaces to be covered with resilient floor covering or thinset terrazzo.
  - c. Exposed portion of top of equipment bases.
  - d. Top of interior curbs.
  - e. Other surfaces that may be designated on Drawings.
  - f. Steel trowel finish will not be required for slabs normally submerged.
- 2. Perform steel troweling after second floating when surface has hardened sufficiently to prevent excess of fines being drawn to surface.
  - a. Produce a dense, smooth, uniform surface free from blemishes and trowel marks.
  - b. Power or hand steel trowel surface to smooth finish with a tolerance of  $\pm 1/4$  inch in 10 feet.
  - c. Hand trowel areas inaccessible to power trowel.

C. Finishing Surfaces for Bonding:

- 1. Float finish all surfaces to be covered with concrete topping.
- 2. Remove by brushing or air blasting at time of initial set, all laitance, surface mortar, and unsound material.
- 3. Surfaces shall be rough, clean, and sound.

D. Edging:

- 1. Edge exposed edges of floated or troweled surfaces with a tool having 1/4 inch corner radius, unless these edges are specified to be beveled.

### 3.07 CURING:

#### A. General:

1. Keep concrete continuously moist for at least 7 days after placement by use of:
  - a. Ponding or continuous sprinkling.
    - (1) Begin as quickly as possible after initial set.
    - (2) Provide complete coverage with minimum of runoff by regulating rate of water application.
    - (3) Interrupt application of water to wall for grout cleaning only over areas being cleaned.
    - (4) Do not permit wall areas to become dry which are not being grout cleaned.
  - b. Wet burlap, wet absorptive mats, wet sand, polyethylene sheeting, or membrane curing compound.

#### B. Membrane Curing Compound:

1. May be used in lieu of water curing on concrete which will not be covered later with topping, mortars, additional concrete, paint, or adhesive attached flooring.
2. Spray apply at coverages recommended by manufacturer.
3. Cover unformed surfaces with curing compound within 30 minutes after final finishing.
4. Apply curing compound immediately to formed surfaces if forms are removed before end of specified curing period.
5. Protect compound against abrasion during curing period.
6. Do not place curing compound when ambient air temperature is respectively measured as being higher or lower than the maximum or minimum air temperature allowed by manufacturer.
7. Do not place curing compound when ambient air temperature is forecasted to exceed or fall below the maximum or minimum air temperature allowed by manufacturer, respectively.

#### C. Film Curing:

1. Film curing with polyethylene sheeting may be used in lieu of water curing on concrete which will be covered later with mortar or additional concrete, or will otherwise be covered or hidden from view.
2. Begin as quickly as possible after initial set of concrete.

3. Cover surfaces completely with polyethylene sheeting.
4. Overlap edges for proper sealing and anchorage.
5. Seal joints between sheets.
6. Promptly repair all tears, holes and other damage.
7. Anchor continuously all edges and anchor surface as necessary to prevent billowing.

### 3.08 FINISHING FORMED SURFACES:

#### A. Repair of Defective Concrete:

1. Repair, to satisfaction of Owner, within 24 hours after removal of forms, all defects in concrete surfaces.
2. Replace, to satisfaction of Owner, within 48 hours after adjacent forms have been removed, all defective concrete.
3. Cut out and remove to sound concrete, with edges square cut to avoid feathering, all honeycombed or otherwise defective concrete.
4. Repair work shall conform to Chapter 9, ACI 301.
5. Perform in a manner that will not interfere with thorough curing of surrounding concrete.
6. Adequately cure all repair work.

#### B. Finishing:

1. Rough form finish - All concrete surfaces not exposed to view and in contact with earth from 1 foot below finish grade. Finish is accomplished by the following:
  - a. Remove all fins and other surface projections when dampproofing is specified.
  - b. Provide a flush surface and use a power grinder, if necessary, to remove fins and projections.
  - c. Fill all tie holes with patching mortar.
  - d. Tar contraction cracks, construction joints and tie holes below finish grade on the side exposed to earth.

2. Smooth form finish - Use smooth form on all surfaces except rough form areas described above. Finish to be accomplished by the following:
  - a. Use form facing to produce a smooth, hard, uniform surface.
  - b. Keep number of seams to a minimum.
  - c. Remove all fins and projections.
  - d. Clean, wet, and fill all tie holes with patching mortar.
  - e. Repair and patch all defects including honeycombs.
3. Smooth form finish can be substituted for rough form.
4. Basin floors.
  - a. Accurately finish to a uniform slope.
  - b. Conform to ACI Committee 117 tolerance  $F_F25$  (approximate variation from level in any 10 foot section,  $\pm 1/4"$ ).
5. Floor sealer.
  - a. Provide two coats of clear floor sealer in addition to any membrane curing compound to all floors subject to foot traffic and which are not required to be covered with any type of final floor covering.
  - b. Apply first coat at end of curing period and before any traffic is permitted.
  - c. Apply second coat after floor has been cleaned in preparation for final inspection.
  - d. Apply in strict accordance with manufacturer's recommendations.

### 3.09 QUALITY CONTROL:

#### A. Concrete Tests:

1. Shall be in accordance with requirements of ACI 301, Chapter 16 - Testing, except as noted or modified in this Section.
  - a. Strength test.
    - (1) Mold and cure three cylinders from each sample.
    - (2) Test one at 7-days for information and two at 28-days for acceptance.

- b. Minimum samples.
  - (1) Collect the following minimum samples for each 28-day strength concrete used in the Work for each days placing:

<u>Quantity</u>	<u>Number of Samples</u>
50 cubic yards or less	two
50 to 100 cubic yards	four
100 cubic yards or more	four plus one sample for each additional 50 cubic yards

- c. Sample marking.
  - (1) Mark or tag each sample of compression test cylinders with date and time of day cylinders were made.
  - (2) Identify location in Work where concrete represented by cylinders was placed.
  - (3) Identify delivery truck or batch number, air content, and slump.
- d. Slump test.
  - (1) Conduct test for each strength test sample and whenever consistency of concrete appears to vary.
- e. Air content.
  - (1) Conduct test from one of first three batches mixed each day and for each strength test sample.

B. Acceptance of Concrete:

- 1. Strength level of concrete will be considered satisfactory so long as average of all sets of three consecutive strength test results equals or exceeds specified 28-day strength and no individual strength test result falls below specified strength by more than 500 psi.
- 2. Concrete will be rejected based on air content as specified in ASTM C94.

C. Failure of Test Cylinder Results:

- 1. Upon failure of test cylinder results, Owner may require Contractor, at his expense, to obtain and test at least three 2-inch diameter cored samples from area in question.
  - a. Conform to ASTM C42.
- 2. Concrete will be considered adequate if average of three cores is at least 85% of, and if no single core is less than 75% of specified 28-day strength.

3. Upon failure of core test results, Owner may require Contractor, at his expense, to perform load tests as specified in ACI 318, Chapter 20.
4. Fill all core holes as specified for repairing defective concrete.

END OF SECTION

**IRRIGATION PUMP SYSTEM SPECIFICATIONS  
VERTICAL TURBINE**

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## **DIVISION 15-MECHANICAL**

### **SECTION 15140-IRRIGATION PUMP SYSTEM**

#### **PART 1: GENERAL**

##### **1.01 SCOPE:**

Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete manufacturing of the pumping system, and guarantee/warranty as shown on the drawings, the installation details, and as specified herein. Items of work specifically included are:

- A. Procurement of all applicable licenses, permits, and fees as required by local utilities and regulations.
- B. Services of a factory field service person to supervise the assembly, installation, and start-up of the pumping system, and the training of maintenance staff.
- C. Furnishing and installing a prefabricated, vertical turbine type pumping system including pumps, motors, electrical controls, and other items as specified.
- D. Maintenance period.

##### **1.02 WORK NOT INCLUDED:**

Items of work specifically excluded or covered under other sections are:

- A. Provision and installation of electrical transformer on site.

##### **1.03 SUBMITTALS:**

- A. Deliver four (4) copies of all submittals to the Owners Representative within 21 days from the date of Notice to Proceed. Deliver Maintenance Manual prior to start-up.
- B. Materials List: Include pipe, valve, fittings, pumps and motors, control system components, and electrical equipment. Quantities of materials need not be included.
- C. Manufacturers' Data: Submit manufacturers' catalog cuts, performance curves, specifications, and operating instructions for equipment shown on the materials list. Submit complete instructions for installation, operation, and recommended maintenance of the pump system.
- D. Maintenance Manual: Submit four copies of a bound maintenance manual that includes all manufacturer's data listed above and recommended operating procedures and preventive maintenance procedures. Include guide for

troubleshooting operational problems with the pump station and complete documentation for programming, recommended settings and adjustments.

- E. Shop Drawings: Submit shop drawings of proposed pump system. Show products required for proper installation, their relative locations, and critical dimensions. Submit technical data sheets, electrical schematics, sequence of operation, UL listing authorization form. Note modifications to the installation drawings.

The construction documents show a typical layout, elevation view, and critical dimensions for the pump system, building, wet well, etc. Pump system manufacturer is responsible for layout and design of the pump system supplied, and any special coordination issues that affect the critical dimensions, layout, or orientation of the pump system.

#### 1.04 RULES AND REGULATIONS:

- A. Work and materials shall be in accordance with the latest edition of the National Electric Code, the Uniform Plumbing Code as published by the Western Plumbing Officials Association, and applicable laws and regulations of the governing authorities.
- B. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.
- C. All electrical control panels with controls shall be built in accordance to N.E.C., U.L. and E.T.L. standards. The electrical components and enclosure shall be labeled as a complete U.L. listed assembly with manufacturer's U.L. label applied to the door. All equipment and wiring shall be mounted within the enclosure and labeled for proper identification.

#### 1.05 TESTING:

- A. Notify the Owner's Representative three days (72 hours) in advance of testing.
- B. On completion of assembly of the pumping station, all discharge pipe and valves shall be hydrostatically tested at 150% of the maximum pump shutoff head.
- C. Bump manual motor starter controls to prove correct rotation and secure local inspection/approval.
- D. Test, verify, and demonstrate to the Owner's Representative the proper operation of all control and safety shut off devices.
- E. Verify flow and discharge pressure from the pump system and demonstrate to the Owner's Representative system performance based on the specified values.

- F. All costs, including travel expenses and site visits by the Engineer, for any additional reviews that may be required due to non-compliance with the Construction Documents shall be the sole responsibility of the Contractor.
- G. Coordinate availability of water with the Owner.

1.06 REVIEWS:

The purpose of on-site reviews by the Owner's Representative is to observe the Contractor's interpretation of the construction documents and to address questions with regards to the pump installation.

- A. Scheduled reviews such as those for testing should be scheduled with the Owner's Representative as required by these specifications.
- B. Impromptu reviews may occur at any time during the project.
- C. Final review will occur at the completion of the pumping system installation and Record Drawings.

1.07 GUARANTEE/WARRANTY AND REPLACEMENT:

The purpose of this guarantee/warranty is to insure that the Owner receives materials of prime quality, installed and maintained in a thorough and careful manner.

- A. The manufacturer shall warrant the pumping system to be free of defects and product malfunctions for a period of one year from date of start up or eighteen months after shipment, whichever occurs first.
- B. The programmable controller shall be unconditionally warranted for 5 years from the date of shipment. The pumping system manufacturer shall be responsible for all warranties, pass through warranties are not acceptable.
- C. Failures caused by lightning strikes, power surges, vandalism, flooding, operator abuse, or acts of God are excluded from warranty coverage.
- D. Repair damage to the premises caused by a defective item. Make repairs within seven days of notification from the Owner's Representative.
- E. Contract documents govern replacements identically as with new work. Make replacements at no additional cost to the contract price.

PART 2: MATERIALS

2.01 QUALITY:

Materials used in the system shall be new and without flaws or defects of any type, and shall be the best of their class and kind.

## 2.02 SUBSTITUTIONS:

- A. Make complete submittals of all manufacturer's data showing compliance with the Contract Documents.
- B. In making a request for a substitution, the Contractor represents that he:
  - 1. Has investigated the proposed substitution and found that it is the same or better quality, level, capacity, function, or appearance than the specified product, and can demonstrate that to the Owner and the Engineer.
  - 2. Will coordinate the installation and make all modifications to the work, which are required for the complete installation and operation of the system.
- C. The Engineer and the Owner's Representative will determine acceptability of the proposed substitution and will notify Contractor of acceptance or rejection.
- D. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at the option of the Contractor.

## 2.03 GENERAL REQUIREMENTS:

- A. The prefabricated pumping station shall have a capacity as shown on the drawings and a station discharge pressure downstream of all pump system components as shown on the drawings, using equally sized main pumps. Provide a submersible pump as a pressure maintenance pump. The station shall be completely piped, wired, hydraulically and electrically tested on a structural steel skid before shipment to the job site.
- B. All components of the pumping system shall be designed to function in an outdoor environment exposed to all of the elements. Furnish protective enclosures and covers as required for proper operation of the system.
- C. Use a static lift of 8.0 feet when calculating the total dynamic head (TDH) requirements of the pump system.
- D. Construction shall include skid assembly to support all components during shipping and to serve as the installed mounting base. Base shall be of sufficient size and strength to resist twisting and bending from hydraulic forces and support the full weight of pumps and motors.
- E. The pump station and related equipment shall meet all the general and technical specifications; shall be designed, fabricated and installed in a workmanlike manner; and shall be delivered within the negotiated schedule.
- F. Provide a factory-trained technician to supervise the installation of the pump station, pumps, and motors.

In addition to the time required for installation supervision, the technician shall provide a **minimum of 1 day of training** for the Owner's staff in the operation, maintenance, and programming of the pumping system.

- G. All pump station components shall be supplied by and be the responsibility of one manufacturer, even though others manufactured some components.
- H. Acceptable Manufacturers:
  - 1. **METRON**, 1505 West 3<sup>rd</sup> Avenue, Denver, Colorado 80223, (303) 592-1903, FAX (303) 534-1947.
  - 2. **FLOWTRONEX PSI Ltd.**, 10717 Harry Lines Blvd., Dallas, Texas 75220, (214) 357-1320. Local Representative: Jay Folk, Arapahoe Pumping Systems, P.O. Box 3482, Littleton, Colorado 80161.
  - 3. **SYNCHROFLO**, 6700 Best Friend Rd., Norcross, Georgia, 30071, (770) 447-4443. Local Representative: John MacIntyre, Munro Supply, 1271 Elmwood Court, Colorado 80020, (303) 439-2600.
  - 4. **WATERTRONICS**, 525 Industrial Drive, Hartland, Wisconsin 53029, (800)356-6686, (414)367-5000, F: (414) 367-5551.

#### 2.04 PUMPS:

- A. Furnish main vertical turbine type pumps, electric motor driven, 1800 nominal rpm, complete with the required length of threaded column assembly, galvanized steel basket type suction strainer, and cast iron discharge head.
- B. Bowl assemblies including the suction, intermediate, and discharge bowls shall be furnished in cast iron, enamel lined with flanged connections. Furnish bronze statically balanced impellers that are adjustable vertically by an adjusting nut located at the top of the hollowshaft motor.
- C. Pump efficiency shall be minimum 80 % at the specified operating point. The performance curve of each pump selected shall be continuously rising as the shutoff condition is approached. The impeller diameter selected shall be less than the maximum diameter available.
- D. Furnish each pump with a flanged, cast iron or fabricated steel discharge head complete with a cast iron adjustable packing gland, gland plate, grease seal, packing bushing, packing and water slinger. Provide a continuous bypass flush line from the stuffing box of each pump to the wet well.
- E. All bowl bearings shall be constructed of bronze, all column bearings shall be fluted rubber. Each pump shaft, column line shaft, and pump motor shaft shall be turned, ground and polished 416 stainless steel sized to transmit full nameplate HP of the motor. Minimum acceptable shaft size is 1-inch.

- F. All shaft couplings shall be threaded and machined from 300 series stainless steel. Furnish two piece headshaft assembly. Each motor shaft shall be removable and couple to the pump head shaft between the bottom of the motor and the packing gland with sufficient clearance to allow removal of the packing gland assembly without motor removal.
- G. Furnish an overall pump length to within **12-inches of the bottom** of the wet well.
- H. Furnish a pressure maintenance pump, a multistage, submersible type, well pump. Pump shall be equipped with a motor shroud for proper cooling of submersible motor and stainless steel suction screen.

Furnish a pump with a Franklin submersible motor and Subtrol motor protection controls. Pump furnished shall be a Goulds, Grundfos or engineer approved equal.

#### 2.05 MOTORS:

- A. Each main pump motor shall be 1800-RPM nominal, squirrel cage induction vertical hollow shaft type with a WP-1 enclosure and a 1.15 service factor. The temperature rise of the motor shall be to NEMA Standard MG-1-12.42 for Class B or Class F insulation.
- B. For less than 40 HP motors, furnish "High Efficiency / Energy Efficient" US Electric motors Type AUE that are rated for continuous inverter duty with variable frequency drive.
- C. Furnish motors of proper size to drive the pump at any point on its operation curve without exceeding motor horsepower nameplate rating.
- D. Furnish motor thrust bearings of ample capacity to accommodate the weight of all rotating parts plus the hydraulic thrust of the pump at shutoff conditions. Furnish motor bearings rated for a minimum service life not less than five years continuous operation at the design rating point.
- E. The pump shaft shall be connected to the motor by a bolted down coupling at the top of each motor. All couplings shall be equipped with non-reversing ratchets.
- F. Furnish motors manufactured in the U.S.A.

#### 2.06 PIPING:

- A. Fabricated Piping: All fabricated piping shall conform to ASTM specifications A53 for Grade B welded or seamless pipe. Piping 16" and smaller shall be Schedule 40. All welding flanges shall be forged steel with slip-on or welding neck type. All welding fittings shall be seamless, conforming to ASTM

Specification A234, with pressure rating not less than 150 psi. All pressurized tube fittings shall be copper or brass.

- B. Winterization Connection: Provide 2-inch ball valve and capped threaded nipple in pump system discharge manifold for compressed air winterization of the irrigation system.

## 2.07 VALVES:

- A. Air/Vacuum Release Valve:

1. Provide a continuous-acting, combination air release/vacuum valve to release excess air from the pump discharge manifold. The valve must be capable of releasing air during filling and pump operation and also open in a vacuum condition to allow air to enter the manifold when piping is drained. Valve shall have a cast iron body rated for 300 PSI, stainless steel trim and float ball, Buna N and viton seats.
2. In lieu of an air/vacuum release valve, provide an Engineer approved equal device to release air from the system.

- B. Drain Valves: Drains are to be provided from any possible low point in the system and are to consist of 1/4" brass angle valves unless otherwise noted. Drain piping is to be furnished so that no drain water runs out on top of the deck plate, but either under deck plate, or directly into the trench drain or wet well. They include, but are not limited to, the following:

1. Provide drain in the pump discharge manifold between pump check valves and control valve.
2. Provide 3/4" brass hose bib in the discharge piping to function as a washdown connection and also function as a drain.

- C. Check Valves: Pump check valves shall be of the silent operating, non-slam type, cast iron bodied with bronze and stainless steel trim. Sealing surfaces shall utilize resilient Buna N rubber. The valve design shall incorporate a center guided, spring, loaded poppet, guided at opposite ends and having a short linear stroke that generates a flow area equal to the pipe diameter. Valves shall be sized to permit full pump capacity to discharge through them without exceeding a pressure drop of 2.5 PSI. Furnish check valves on the discharge of each pump.

- D. Isolation Valves: Valves shall be butterfly type with the position lever or gear hand wheels and rated at 200 psi WOG working pressure. Trim shall include stainless steel stem, bronze streamlined disc, and full faced resilient seat. Isolation valves shall be installed on the discharge side of each pump. The pump system shall also be furnished with a main station isolation valve located in the discharge manifold.

- E. Pressure Relief Valve: Furnish pressure relief valve and bypass piping to wet well installed on the discharge piping upstream of the pressure regulating valve. Size pressure relief valve to bypass sufficient water to avoid operating pumps at or near shut off head conditions.

## 2.08 GAUGES:

Gauges and switch gauges shall be isolated from all electrical switch gear and control panels. Gauges shall be provided at appropriate locations to read inlet pressure and discharge manifold pressure. Switch gauges shall be 4" diameter vibration/pulsation dampened. Pressure gauges shall be 2.5" diameter, glycerin filled, with ANSI Class B accuracy. Install ball valves to provide total isolation of all pressure gauges.

## 2.09 ELECTRICAL:

- A. Electrical Supply: The power supply to the station shall be three phase, 460 volt, 60 hertz, for full voltage across the line motor starting.

- B. Enclosures:

1. The pumping station electrical controls shall be mounted in a self contained NEMA 3S (minimum NEMA rating) enclosure with a drip lip fabricated from not less than 14 gauge steel. Door gasket seals shall be neoprene sponge, sufficient to protect interior components from weather and dust. The electrical panel doors shall be constructed from 12-gauge steel with integral locking screws and latches.
2. Provide operating handle for the main station power disconnect on the front of the panel. Furnish weatherproof and dust proof external operating devices.
3. All internal components of the enclosures shall be mounted on removable back panels. Mounting screws for components shall not be tapped in the panel enclosure.
4. All internal wiring within, and interconnecting between, the panels shall be complete and no field wiring within the panels shall be required. Wiring troughs and cable raceways shall be self-contained within the enclosures and no external cable trays or wiring troughs are permitted.
5. No pressure gauges, pressure switches, water activated devices, or water lines of any sort shall be installed in any electrical control panel. All adjustments and maintenance shall be able to be done from the front of the control enclosure. A complete wiring circuit and legend with all terminals, components, and wiring identification shall be provided. Main disconnect shall be interlocked with door.

6. All electrical starter and control panels shall be assembled from components that are U.L. listed and each completed panel shall be U.L. listed as an Industrial Control Panel.
7. A closed type cooling system shall be included to cool the enclosure and reject heat from the VFD. Open type cooling systems allowing outside ambient air to enter the panel are not acceptable.

C. Pump Motor Starters, Disconnect, and Electrical Switch Gear:

1. The pump motor starters shall be contained within a single NEMA 12 enclosure with a single access door and main disconnect. Each starter shall be protected on each power leg by a time delay fuse of the appropriate amperage. Motor starter coils shall be 120 volt operated.
2. Overload relays shall be ambient-compensating type installed on each power leg and shall be set to trip at 105% of motor full-load current rating.

D. Variable Speed Master Controls and Display:

Provide complete instrumentation and controls to automatically start, stop and modulate pump speed(s) to smoothly, efficiently and reliably pump variable flow rates at a constant discharge pressure. Provide full alarms and safety features needed to protect the equipment and irrigation piping system.

1. Variable Frequency Drive: Provide a digital, pulse width modulation (PWM) variable frequency drive (VFD) with IGBT transistors.
  - a. Provide VFD with a minimum wire to wire efficiency of 98.5%, and shall be rated up to 550-volt operation in order to eliminate nuisance tripping at marginally high voltage conditions.
  - b. Provide VFD with the front end protected by fast acting semiconductor fuses. Any VFD error messages shall be displayed on a 40-character LCD readout in English or any one of 8 other languages.
  - c. Include the following fault protection circuits: Over-current (200%), over-voltage (130%), under-voltage (60%), over-temperature (70° C), ground fault, and motor overload.
  - d. Provide VFD capable of starting into a rotating load and accelerate or decelerate to setpoint without safety tripping.
  - e. Provide VFD with an automatic extended power loss ride through circuit, which will utilize the inertia of the pump to keep the drive powered. The minimum power loss ride-through shall be one cycle based on full load and no inertia.

- f. Provide VFD optimized for a 3 kHz carrier frequency to reduce motor noise and employing three current limit circuits to provide "tripless" operation.
  - g. The following operating information shall be displayed on the VFD LCD: KWH, elapsed time, Output frequency (Hz), motor speed (RPM), motor current (amps), and voltage. Line reactor will be installed on input of VFD to protect against voltage transients.
  - h. Provide VFD as manufactured by Allen Bradley, ABB, Toshiba, Siemens, or engineer approved equal.
2. Pressure Transducer: Pressure transducer shall be utilized for providing all pressure signals for the control logic.
- a. Provide a solid-state bonded strain gauge type pressure transducer with an accuracy of plus/minus 0.20%. Housing shall be stainless steel NEMA 4X with 304L stainless steel wetted parts. Plastic transducer housings are not acceptable.
  - b. Furnish a transducer rated for station discharge pressure as shown on technical data sheet, that will provide gauge pressure output, rather than an absolute.
3. Controls: All control logic shall be handled by an industrial grade programmable logic controller (PLC) with a 40 character LED industrial operator interface providing data entry and read-out capabilities.
- a. Provide PLC with LED indicators for input, output, and four (4) diagnostic read-outs showing PC Run, CPU Fault, I/O Fault, and communication. Provide an LED visual status light for each I/O to indicate on/off status.
  - b. Provide PLC with a built in EEPROM, capacitor, and battery for memory backup. A surge suppressor shall be mounted on input of PLC for power transient suppression.
  - c. All logic for system control, timing, and control of VFD speed shall be handled by the PLC. No external relay logic and/or timers are permitted. A separate set point controller is not acceptable.
  - d. PLC shall have a built in clock calendar. The PLC shall be of the type manufactured by Toshiba, Siemens, Allen Bradley, Mitsubishi, or Engineer approved equal.
4. Alarms and shutdowns:
- a. Low discharge pressure (with override switch)\*

- b. High discharge pressure
- c. Low lake level (Attempts restart)\*
- d. Phase loss (Attempts restart)\*
- e. Low voltage (Attempts restart)\*
- f. Phase unbalance (Attempts restart)\*
- g. Individual motor overload/phase loss (indicates which individual motor was shut down)
- h. VFD fault (shutdown VFD pump only and attempts restart).\*

\*Three failed restarts in 15-minute period will give hard shutdown.

A red general alarm light will indicate all alarms. Specific alarm conditions along with procedures for correction will be displayed in English on the operator interface display (OID).

5. Panel face switches and lights:

- a. Individual pump run lights and pump on/off switches
- b. System Hand/Off/Automatic switch
- c. Mode Select switch -- allows automatic bypass mode of operation that can be used if VFD should fail.
- d. VFD selector switch -- in manual mode, allows user to select which pump will be run off the VFD.
- e. Reset -- Acknowledges pump station alarms
- f. Speed potentiometer -- in manual mode allows user to adjust VFD pump speed
- g. Low discharge pressure override switch -- disables low discharge pressure alarm
- h. PLC bypass switch mounted inside panel allows user to manually operate pumps should PLC fail.

6. Software:

- a. Software will be included to automatically and gradually ramp up irrigation system pressure to the desired operating pressure (i.e., 1 PSI every 3 seconds) without overshooting design pressure.

This feature operates whenever pressure drops below set point pressure. This ramp up time is fully adjustable by the operator. This control feature is based on an increase in pressure over a pre-defined time period. The acceleration control on the VFD is **NOT** an acceptable means of adjusting pressure ramp up speed.

- b. Software will be included for optionally maintaining a lower irrigation system pressure when not irrigating. Reduced pressure values will be shown in the technical data sheet. Controls will cycle the PM pump at these reduced pressures during non-irrigation times and pressure will gradually increase to design pressure when the irrigation periods begin.
- c. Neither flow meter nor VFD output frequency shall be used for shutting down last VFD driven pump. Controls and software shall incorporate a method to eliminate excessive cycling of VFD pump at very low flow conditions, yet not run the pump excessively at no flow conditions.
- d. Provide automatic alternation of VFD driven pumps accomplished by incorporating dual mechanically and electrically interlocked contactors allowing alternation of the VFD between pumps.
- e. Real time clock calendar allows PLC to internally provide all date and time functions used above.
- f. Two separately adjustable PID control loops for both low flow and high flow pressure stability.
- g. Provide system that allows user to field select either two modes of VFD operation. Auto switch VFD option allows VFD to sequentially start each pump. The standard mode of operation starts the first main pump on the VFD and the remaining pump starts across the line as required.
- h. Shutoff algorithm for fixed speed pumps to minimize pump cycling while also remaining responsive to sudden flow reductions. Minimum run timers alone for minimizing fixed speed pump cycling is not acceptable. Discharging through relief valve during pump transitions is not acceptable.
- i. Full manual operation capability with panel face mounted speed potentiometer for manually adjusting VFD speed.
- j. System can be immediately and directly switched from manual to automatic mode of operation. This allows for manual pressurization and immediate switching capability to automatic.

- k. Light test sequence. Pressing the reset button for 5 seconds illuminates all lights.
- l. Rate of pressure change algorithm to rapidly determine if there is an irrigation demand and immediately cycle on the VFD pump, in lieu of waiting for pressure to drop to a predetermined start pressure.
- m. All pump station shutdowns shall be of the controlled type which sequentially phase pumps off at user selectable internals to reduce water hammer within the irrigation system.

7. Operator Interface Device (OID):

- a. The pump station shall include a NEMA 4, 40 character LED display and keypad mounted on the control panel door. This device will allow the operator to view and selectively modify all registers in the PLC. The unit shall store its messages in non-volatile memory. The operator interface device shall incorporate password protection for protecting data integrity. The device will allow for display and modification of all timers, set points, lockout times, etc. The device shall communicate with the PLC through the programming port, and shall include an RS232 communications port allowing a printer to be attached for real time station status logging.
- b. The OID shall be an information system only and not required for pump station operation. No switches, reset buttons, general alarm light, run lights or speed potentiometers are included within this unit. This pump station will be fully functional in the event the OID unit should fail.
- c. In addition to normal data entry keys, the device shall include a minimum of the following function keys labeled:
  - (1) **Event.** Displays one of three data logging functions.
    - (a) Operator can scroll through the historical pump station flows and pressures for up to the last 7 days. The operator can change sampling time periods (from 1 to 60 minutes). Averages are taken over the sample period and the average recorded with time stamp.
    - (b) The last 128 sequential pump station events with time of occurrence. Events shall include but not be limited to: all alarms, starting of individual pumps, stopping of individual pumps and changing of selector switches.

- (c) Station flow and pressure are shown every second for the previous 60 seconds and every minute for the previous 30 minutes. If a shutdown occurs, the flow and pressure tables are locked in so that the operator may view how the pump station was performing immediately before the shutdown occurred.
- (2) **Status.** Will display the current operating status. When the station is running, the display will show the setpoint pressure, actual pressure, flow, and pump rpm.
- (3) **Alarm Info.** It will display detailed information on the alarm, time of occurrence, pumps operating at time of alarm and how to correct the alarm condition.
- (4) **Daily Log.** It will display the following: Last time of log reset, individual pump run times, run times since last reset, pump starts, pump starts since last reset, total flow, total flow since last reset, highest flow rate with time of occurrence, alarm conditions, and times since last reset.
- (5) **Scroll Key.** Used to scroll up and down through data.

8. Operation:

- a. During non-irrigation times, the pressure maintenance pump (PM) will cycle on and off as required to maintain irrigation system pressure. The cycling pressures can be user selected and can be set substantially below normal set point pressure, if desired. If the PM pump cannot maintain the desired pressure, then the VFD will start the first pump and will gradually ramp the pressure up to desired irrigation pressure.
- b. The pump speed will be modulated to hold a constant discharge pressure regardless of flow. As the flow rate increases and the VFD pump can no longer maintain pressure while at maximum speed, the next sequential pump will be started and the VFD driven pump will accordingly reduce its speed and modulate.
- c. An algorithm shall be included for accurately reducing the VFD pump speed as the next sequential pump is started so that no pressure surges are generated during the transition (even with across the line starting). If the user prefers to switch the VFD from pump to pump for sequential starting, he can select this option with the OID.

- d. As the flow continues to increase, pumps will sequentially be started until all pumps are operating. As the flow begins to decrease, pumps will be sequentially turned off until only a single VFD driven pump is operating. When a no flow condition occurs, the VFD pump shall be turned off.

E. Skid Wiring:

1. All wiring from control panels to motors shall be in liquid-tight conduit with copper conductors rated not less than 600 volts AC and of proper size to carry the full load amperage of the motors without exceeding 70% capacity of the conductor. A grounding cable shall be included in the liquid-tight conduit. There shall be no splices between the motor starters and the motor connection boxes.
2. Wiring to flow sensors and pressure transducers shall be multi-conductor shielded cable suitable for Class II low voltage controls.

F. Lightning Arrestor:

The main power supply feeding the pumping station shall be equipped with a 3 phase secondary lightning arrestor having a breakdown current rating of not less than 60,000 amps at 14,000 volts discharge. Power supplies, 300 volts and less, shall use 300 volt rated arrestor with an 800 volt spark-over voltage. Power supplies 301-600 volts shall use 600 volt rated arrestors with a 1,000-volt spark-over voltage.

G. Misc. Electrical Components:

1. Main Station Disconnect:

A three-pole main station disconnect shall be mounted in a separate NEMA 3S enclosure to completely isolate the electrical system from incoming power. The disconnect shall conform to the requirements of the NEC and applicable local codes. The main station disconnect shall have an operating handle on the front of the panel.

2. Secondary Control Circuit Fuses:

Single-pole secondary distribution fuses with appropriate ratings shall supply power to each pump starter coil circuit, the control system, and to other circuits as required.

3. Phase Failure - Low Voltage Safety Shutdown:

A phase failure - low voltage system dropout relay shall be provided to de-energize the individual pump controls and motor sequencing control in case of either low voltage or phase failure after a 5.0 second time delay. The resetting shall be automatic after full power is restored for 5.0

seconds, with pumps sequentially restarting. The phase failure - low Voltage indicator light is to remain illuminated until manually reset.

4. Low System Pressure Safety Shutdown:

Low discharge pressure is to be sensed by the pump starting set point. When the station discharge pressure decreases to this point and maintains a start signal for a preset time, the pumps will be de-energized and remains so until the circuit is manually reset. An indicator light shall illuminate to indicate a low discharge pressure shutdown has occurred.

5. Low Water Level Safety Shutdown:

Furnish liquid level probes and controls to prevent operation of the pumps when water levels in the wet well are insufficient. Furnish shutdown with automatic restart after an adjustable delay. Low water level indicator lamp shall remain lit until manually reset.

6. Corrosion Inhibiting Modules:

Corrosion inhibiting modules shall be installed in all electrical enclosures in accordance with the manufacturer's recommendations.

H. Standards:

1. All wiring shall conform to the National Electrical Code Standards. Flexible conduit sections shall be under 5 feet in length. All conduit to devices shall be attached securely to avoid trip hazards.
2. The manufacturer shall provide a wiring schematic. The schematic shall show all devices, connections and wire numbers.
3. All controls and electrical equipment shall be thoroughly inspected and tested before shipment.

2.10 PIPE SUPPORT STAND:

- A. Furnish manufactured steel pipe support stand as shown on the drawings and details. Support must be capable of supporting 500 lbs. dead load and be adjustable within the range shown on the pump piping detail.
- B. Furnish Standon Model S89 or S92 as required, with red oxide primer, as manufactured by Material Resources, Hillsboro, Oregon, (503) 693-0727 or approved equal.

2.11 FLOW SENSOR:

- A. Provide magnetic flow meter as shown in the drawings.

2.12 AUTOMATIC BACKWASHING SCREEN FILTER:

- A. Provide Amiad SAF with 300-micron screens and 1/4 HP 480 volt motorized suction scanner. Filter must be capable of an automatic backwash cycle based on pressure differential and time interval.

2.13 ACCESS HATCH:

- A. Provide aluminum hatch as a hinged component of the pump-mounting skid for access to wet well.

2.14 PAINTING:

- A. Painting of the entire unit shall consist of a multi-step coating system which includes metal preparation, rust inhibitive prime coat, and a two part polyurethane finish having a total dry film thickness of not less than 4 mils.
- B. Pump station components shall be painted the manufacturer's standard color. All electrical enclosures, tank, and accessory panels shall be painted to a minimum thickness of 3 mils and baked at 160-180 F.
- C. Provide a 1-quart can of the finish paint with the system for job site touch up use.

PART 3: EXECUTION

3.01 INSPECTIONS AND REVIEWS:

- A. Site Inspections:
  - 1. Verify site conditions and note irregularities affecting work of this section. Report irregularities to the Owner's Representative prior to beginning work.
  - 2. Beginning work of this section implies acceptance of existing conditions.

3.02 PUMPS AND MOTORS:

- A. Shipping, off-loading and the technical start up shall be furnished by the pump station manufacturer. The pump station manufacturer shall furnish location and mounting details to Owner's Representative.
- B. Anchor pump system to concrete mounting pad and complete all piping connections prior to startup and operation of the pump system.
- C. Electrical connection shall consist of a single conduit from 3 phase 460 volt 200 ampere disconnect to the pump station main disconnect.

- D. Technical start up procedures by the pump station manufacturer shall include the following:
  - 1. Station start up and pressurization
  - 2. Pressure, flow, and programming adjustments
  - 3. Monitoring of irrigation cycle when possible. Technician will instruct operations personnel as to the operation, adjustment and maintenance of the pump station.

### 3.03 OPERATION AND MAINTENANCE MANUALS:

- A. Furnish four (4) copies of the bound Pump System Operation and Maintenance manuals as described in the specifications to the Owner's Representative prior to the start up.
- B. Tools and Spare Parts: Prior to the project completion, supply to the Owner operating keys, servicing tools, test equipment, and any other items indicated on the drawings.
- C. Other Materials: Install other materials or equipment shown on the drawings or installation details to be part of the pumping system, even though such items may not have been referenced in these specifications.

### 3.04 PROJECT RECORD DRAWINGS:

- A. The Contractor is responsible for documenting changes to the design. Maintain on-site and separate from documents used for construction, one complete set of contract documents as Project Documents. Keep documents current. Do not permanently cover work until as-built information is recorded.
- B. Record pumping system alterations. Record work, which is installed differently than shown on the construction drawings. Record accurate reference dimensions.
- C. Prior to project completion, obtain from the Engineer a reproducible mylar copy of the drawings. Mylars or CAD data files compatible with AutoCAD software, can be purchased from the Engineer. Cost of mylar reproducible drawings is \$50 per set and the cost of AutoCAD data files on diskette is \$50 per project set. Using technical drafting pen, duplicate information contained on the project drawings maintained on site. Label each sheet "Record Drawing". Completion of the Record Drawings will be a prerequisite for the Final Review.

### 3.05 MAINTENANCE:

- A. Upon completion of project, maintain system for a duration of 30 calendar days. Make periodic examinations and adjustments to irrigation system components as necessary.

- B. Following completion of the Contractor's maintenance period, the Owner will be responsible for maintaining the system in working order during the remainder of the guarantee/warranty period, and for performing necessary minor maintenance.

3.06 CLEANUP:

- A. Upon completion of work, remove from the site all machinery, tools, excess materials, and rubbish.
- B. Manufacturer's Representative shall clean all surfaces and touch up scratches with factory paint to match original.

END OF SECTION

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SECT.  
NO.                    SECTION TITLE

DIVISION 16 - ELECTRICAL

16050	BASIC ELECTRICAL MATERIALS AND METHODS
16060	GROUNDING AND BONDING
16140	WIRING DEVICES
16410	ENCLOSED SWITCHES
16442	PANELBOARDS
16461	DRY-TYPE TRANSFORMERS (1000 V AND LESS)
16491	FUSES
16511	INTERIOR LIGHTING
16856	UNIT HEATERS

# CITY OF EVANS PARKER MEADOWS PUMP STATION

## SECTION 16050 - BASIC ELECTRICAL MATERIALS AND METHODS

### 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:
  - 1. Raceways.
  - 2. Building wire and connectors.
  - 3. Supporting devices for electrical components.
  - 4. Electrical identification.
  - 5. Electricity-metering components.
  - 6. Cutting and patching for electrical construction.
  - 7. Touchup painting.

#### 1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. LFMC: Liquidtight flexible metal conduit.
- D. RNC: Rigid nonmetallic conduit.

#### 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.
- B. Comply with NFPA 70.

#### 1.5 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

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1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work.
- C. Coordinate electrical service connections to components furnished by utility companies.
  1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
  2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
- D. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

## PART 2 - PRODUCTS

### 2.1 RACEWAYS

- A. EMT: ANSI C80.3, zinc-coated steel, with set-screw or compression fittings.
- B. FMC: Zinc-coated steel.
- C. LFMC: Zinc-coated steel with sunlight-resistant and mineral-oil-resistant plastic jacket.
- D. RNC: NEMA TC 2, Schedule 40 PVC, with NEMA TC3 fittings.
- E. Raceway Fittings: Specifically designed for the raceway type with which used.

### 2.2 CONDUCTORS

- A. Conductors, No. 10 AWG and Smaller: Solid or stranded copper.
- B. Conductors, Larger Than No. 10 AWG: Stranded copper.
- C. Insulation: Thermoplastic, rated at 75 deg C minimum.
- D. Wire Connectors and Splices: Units of size, ampacity rating, material, type, and class suitable for service indicated.

### 2.3 SUPPORTING DEVICES

- A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.

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- C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- (14-mm-) diameter slotted holes at a maximum of 2 inches (50 mm) o.c., in webs.
- D. Raceway Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- E. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- F. Expansion Anchors: Carbon-steel wedge or sleeve type.
- G. Toggle Bolts: All-steel springhead type.
- H. Powder-Driven Threaded Studs: Heat-treated steel.

### 2.4 ELECTRICAL IDENTIFICATION

- A. Identification Devices: A single type of identification product for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. Underground Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:
  - 1. Not less than 6 inches wide by 4 mils thick (150 mm wide by 0.102 mm thick).
  - 2. Compounded for permanent direct-burial service.
  - 3. Embedded continuous metallic strip or core.
  - 4. Printed legend that indicates type of underground line.
- C. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- D. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suit coding scheme.
- E. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch (1.6-mm) minimum thickness for signs up to 20 sq. in. (129 sq. cm) and 1/8-inch (3.2-mm) minimum thickness for larger sizes. Engraved legend in black letters on white background.
- F. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

### 2.5 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING

- A. Meter Sockets: Comply with requirements of electrical power utility company.

### 2.6 TOUCHUP PAINT

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

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### PART 3 - EXECUTION

#### 3.1 ELECTRICAL EQUIPMENT INSTALLATION

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- D. Right of Way: Give to raceways and piping systems installed at a required slope.

#### 3.2 RACEWAY APPLICATION

- A. Use the following raceways for outdoor installations:
  - 1. Exposed: RGS. PVC coated RGS for underground sweeps.
  - 2. Concealed: EMT.
  - 3. Underground, Single Run: RNC.
  - 4. Underground, Grouped: RNC.
  - 5. Connection to Vibrating Equipment: LFMC.
  - 6. Boxes and Enclosures: NEMA 250, Type 3R or Type 4.
- B. Use the following raceways for indoor installations:
  - 1. Exposed: EMT.
  - 2. Concealed: EMT.
  - 3. Connection to Vibrating Equipment: LFMC.
  - 4. Damp or Wet Locations: EMT.
  - 5. Boxes and Enclosures: NEMA 250, Type 4, unless otherwise indicated.

#### 3.3 RACEWAY AND CABLE INSTALLATION

- A. Conceal raceways and cables, unless otherwise indicated, within finished walls, ceilings, and floors.
- B. Locate horizontal raceway runs above water piping.
- C. Use temporary raceway caps to prevent foreign matter from entering.
- D. Make conduit bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
- E. Use raceway and cable fittings compatible with raceways and cables and suitable for use and location.

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- F. Connect motors and equipment subject to vibration, noise transmission, or movement with a maximum of **72-inch (1830-mm)** flexible conduit. Install LFMC in wet or damp locations. Install separate ground conductor across flexible connections.

### 3.4 WIRING METHODS FOR POWER, LIGHTING, AND CONTROL CIRCUITS

- A. Feeders: Type THHN/THWN insulated conductors in raceway.
- B. Underground Feeders and Branch Circuits: Type THWN or single-wire in raceway.
- C. Branch Circuits: Type THHN/THWN insulated conductors in raceway.
- D. Remote-Control Signaling and Power-Limited Circuits: Type THHN/THWN insulated conductors in raceway for Classes 1, 2, and 3, unless otherwise indicated.

### 3.5 WIRING INSTALLATION

- A. Install splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- B. Install wiring at outlets with at least **12 inches (300 mm)** of slack conductor at each outlet.
- C. Connect outlet and component connections to wiring systems and to ground. 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.

### 3.6 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
- B. Dry Locations: Steel materials.
- C. Selection of Supports: Comply with manufacturer's written instructions.
- D. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of **200-lb (90-kg)** design load.

### 3.7 SUPPORT INSTALLATION

- A. Install support devices to securely and permanently fasten and support electrical components.
- B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

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- D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.
- E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- F. Install **1/4-inch- (6-mm-)** diameter or larger threaded steel hanger rods, unless otherwise indicated.
- G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for **1-1/2-inch (38-mm)** and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.
- H. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than **24 inches (610 mm)** from the box.
- I. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
- J. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- K. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
  - 1. Wood: Fasten with wood screws or screw-type nails.
  - 2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
  - 3. New Concrete: Concrete inserts with machine screws and bolts.
  - 4. Existing Concrete: Expansion bolts.
  - 5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
  - 6. Steel: Welded threaded studs or spring-tension clamps on steel.
    - a. Field Welding: Comply with AWS D1.1.
  - 7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
  - 8. Light Steel: Sheet-metal screws.
  - 9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

### 3.8 IDENTIFICATION MATERIALS AND DEVICES

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- A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.
- C. Self-Adhesive Identification Products: Clean surfaces before applying.
- D. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.
- E. Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate **6 to 8 inches (150 to 200 mm)** below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed **16 inches (400 mm)**, overall, use a single line marker.
- F. Color-code 240/120-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:
  - 1. Phase A: Black.
  - 2. Phase B: Red.
- G. Color-code 480/277-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:
  - 1. Phase A: Yellow.
  - 2. Phase B: Brown.
  - 3. Phase C: Orange.

### 3.9 UTILITY COMPANY ELECTRICITY-METERING EQUIPMENT

- A. Install equipment according to utility company's written requirements. Provide grounding and empty conduits as required by utility company.

### 3.10 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

### 3.11 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:

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1. Raceways.
2. Building wire and connectors.
3. Supporting devices for electrical components.
4. Electrical identification.
5. Electricity-metering components.
6. Cutting and patching for electrical construction.
7. Touchup painting.

### 3.12 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint. Paint materials and application requirements are specified in Division 9 Section "Painting."
  1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
  2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
  3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

### 3.13 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 16050

# CITY OF EVANS PARKER MEADOWS PUMP STATION

## SECTION 16060 - 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 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 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.

### 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. Boggs, Inc.
    - c. Chance/Hubbell.
    - d. Copperweld Corp.
    - e. Dossert Corp.
    - f. Erico Inc.; Electrical Products Group.
    - g. Framatome Connectors/Burndy Electrical.
    - h. Galvan Industries, Inc.
    - i. Harger Lightning Protection, Inc.
    - j. Hastings Fiber Glass Products, Inc.
    - k. Heary Brothers Lightning Protection Co.
    - l. Ideal Industries, Inc.
    - m. ILSCO.

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- n. Kearney/Cooper Power Systems.
- o. Korns: C. C. Korns Co.; Division of Robroy Industries.
- p. Lightning Master Corp.
- q. Lyncole XIT Grounding.
- r. O-Z/Gedney Co.; a business of the EGS Electrical Group.
- s. Raco, Inc.; Division of Hubbell.
- t. Robbins Lightning, Inc.
- u. Salisbury: W. H. Salisbury & Co.
- v. Superior Grounding Systems, Inc.
- w. Thomas & Betts, Electrical.

### 2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 16 Section "Basic Electrical Materials and Methods."
- B. Material: Copper.
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.
- D. Grounding Electrode Conductors: Stranded cable.
- E. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- F. Bare Copper Conductors: Comply with the following:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Assembly of Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
- G. Copper Bonding Conductors: As follows:
  - 1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, **1/4 inch (6.4 mm)** 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 (42 mm)** wide and **1/16 inch (1.5 mm)** thick.
- H. 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.

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### 2.4 GROUNDING ELECTRODES

- A. Ground Rods: Sectional type; copper-clad steel.
  - 1. Size: **3/4 by 120 inches (19 by 3000 mm)** in diameter.

## 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.
- D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

### 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.
- C. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by NEC:
  - 1. Feeders and branch circuits.
  - 2. Lighting circuits.
  - 3. Receptacle circuits.
  - 4. Single-phase motor and appliance branch circuits.
  - 5. Three-phase motor and appliance branch circuits.
  - 6. Flexible raceway runs.
- D. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- E. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including heaters. Bond conductor to each unit and to air duct.

### 3.3 INSTALLATION

- A. Ground Rods: Install at least one rods.

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1. Drive ground rod until top is 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
  2. Interconnect ground rod with grounding electrode conductors. Use exothermic welds, 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 Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water 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. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, and electric heaters. Use braided-type bonding straps.
- F. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, Paragraph 250-81(c), using a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within the base of the foundation. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.

### 3.4 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. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
  5. 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.

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- 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 noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- E. 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 and UL 486B.
- F. 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.
- G. 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.

### 3.5 FIELD QUALITY CONTROL

- A. 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.
    - a. Equipment Rated 500 kVA and Less: 10 ohms.
  - 2. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 16060

# CITY OF EVANS PARKER MEADOWS PUMP STATION

## SECTION 16140 - WIRING DEVICES

### 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 various types of receptacles, connectors, switches, and finish plates.

#### 1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70 "National Electrical Code" for devices and installation.
- B. Listing and Labeling: Provide products that are listed and labeled for their applications and installation conditions and for the environments in which installed.
  - 1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.
  - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Wiring Devices:
    - a. Arrow Hart Div., Cooper Industries.
    - b. Bryant Electric, Inc.
    - c. Challenger Electrical Equipment Co.
    - d. Eagle Electric Mfg. Co., Inc.
    - e. General Electric Co.
    - f. Hubbell Inc.
    - g. Killark Electrical Mfg. Co.
    - h. Leviton Mfg. Co., Inc.
    - i. Pass & Seymour/Legrand.
    - j. Pyle-National Co.
    - k. Slater Electric, Inc.

#### 2.2 WIRING DEVICES

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- A. Straight-Blade Receptacles: Heavy-Duty, specification grade. Meets all requirements of Federal Specification WC-596.
- B. Enclosures: NEMA 3R equivalent.
- C. Color: Brown except as required by Code.
- D. Receptacles, Straight-Blade Type: Comply with UL Standard 498, "Electrical Attachment Plugs and Receptacles," heavy-duty grade except as otherwise indicated.
- E. Receptacles, Straight-Blade, Special Features: Comply with the basic requirements specified above for straight-blade receptacles of the class and type indicated, and with the following additional requirements:
  - 1. Ground-Fault Circuit Interrupter (GFCI) Receptacles: UL Standard 943, "Ground Fault Circuit Interrupters," feed-through type, with integral NEMA 5-20R duplex receptacle arranged to protect connected downstream receptacles on the same circuit. Design units for installation in a 2-3/4-inch (70-mm) deep outlet box without an adapter.
- F. Snap Switches: Quiet-type a.c. switches, heavy duty specification grade. NRTL listed and labeled as complying with UL Standard 20 "General Use Snap Switches," and with Federal Specification W-S-896.
- G. Wall Plates: Single and combination types that mate and match with corresponding wiring devices. Features include the following:
  - 1. Plate-Securing Screws: Metal with heads colored to match plate finish.
  - 2. Material for Finished Spaces: 0.04-inch-thick (1-mm-thick), type 302, satin-finished stainless steel, except as otherwise indicated. Weatherproof when noted on plans.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install devices and assemblies plumb and secure.
- B. Install wall plates when painting is complete.
- C. Arrangement of Devices: Except as otherwise indicated, mount surface, with long dimension vertical, and grounding terminal of receptacles on top.
- D. Protect devices and assemblies during painting.

### 3.2 FIELD QUALITY CONTROL

- A. Testing: Test wiring devices for proper polarity and ground continuity. Operate each operable device at least 6 times.
- B. Test ground-fault circuit interrupter operation with both local and remote fault simulations

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according to manufacturer recommendations.

- C. Replace damaged or defective components.

3.3 CLEANING

- A. General: Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION 16140

# CITY OF EVANS PARKER MEADOWS PUMP STATION

## SECTION 16410 - ENCLOSED SWITCHES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
  - 1. Fusible switches.

#### 1.3 DEFINITIONS

- A. GD: General duty.
- B. GFCI: Ground-fault circuit interrupter.
- C. HD: Heavy duty.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of enclosed switch, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current rating.
  - 4. UL listing for series rating of installed devices.
  - 5. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

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### 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 NFPA 70.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
  - 1. Ambient Temperature: Not less than **minus 22 deg F (minus 30 deg C)** and not exceeding **104 deg F (40 deg C)**.
  - 2. Altitude: Not exceeding **6600 feet (2010 m)**.

### 1.7 COORDINATION

- A. Coordinate layout and installation of switches, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### 2.2 FUSIBLE SWITCHES

- A. Manufacturers:
  - 1. Eaton Corporation; Cutler-Hammer Products.
  - 2. General Electric Co.; Electrical Distribution & Control Division.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D/Group Schneider.

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- B. Fusible Switch, 200 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper neutral conductors.

### 0.1 TRANSIENT VOLTAGE SURGE SUPPRESSORS (480 VOLT SERVICE SWITCH)

- A. Description: IEEE C62.41, selected to meet requirements for category indicated.
  - 1. Exposure: High.
- B. Impulse sparkover voltage coordinated with system circuit voltage.
- C. Factory mounted with UL-recognized mounting device.

### 2.3 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
  - 1. Outdoor Locations: NEMA 250, Type 3R.
  - 2. Pump Room: NEMA 250, **Type 12, no exceptions.**

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches.
- B. Mount individual wall-mounting switches with tops at uniform height, unless otherwise indicated.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

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### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Basic Electrical Materials and Methods."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 16 Section "Basic Electrical Materials and Methods."

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches. 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.

### 3.5 CLEANING

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 16410

# CITY OF EVANS PARKER MEADOWS PUMP STATION

## SECTION 16442 - PANELBOARDS

### 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:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit 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.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated.

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- C. 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.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
  - 1. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
  - 2. Altitude: Not exceeding 6600 feet (2000 m).

### 1.7 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.

### 1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Keys: Six spares for each type of panelboard cabinet lock.

## 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 Corporation; Cutler-Hammer Products.
    - b. General Electric Co.; Electrical Distribution & Protection Div.
    - c. Siemens Energy & Automation, Inc.
    - d. Square D.

### 2.2 MANUFACTURED UNITS

- A. Enclosures: Surface-mounted cabinets.

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1. Rated for environmental conditions at installed location.
  - a. Indoor Locations: NEMA 250, Type **12, no exceptions.**
2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions.
3. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
4. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door.

### B. Phase and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.

### C. Conductor Connectors: Suitable for use with conductor material.

1. Main and Neutral Lugs: Mechanical type.
2. Ground Lugs and Bus Configured Terminators: Compression type.

### D. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.

### E. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

## 2.3 PANELBOARD SHORT-CIRCUIT RATING

- A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

## 2.4 DISTRIBUTION PANELBOARDS

- A. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

### B. Branch Overcurrent Protective Devices:

1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in or 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.

## 2.5 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Branch Overcurrent Protective Devices: Plug-in or Bolt-on circuit breakers, replaceable without disturbing adjacent units.

- B. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

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### 2.6 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: UL 489, with series-connected rating 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.
- 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 conductor materials.
  - 2. Multipole units enclosed in a single housing or factory-assembled to operate as a single unit.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Mount top of trim **74 inches (1880 mm)** above finished floor, unless otherwise indicated.
- C. Mount plumb and rigid without distortion of box.
- D. Install overcurrent protective devices and controllers.
- E. Install filler plates in unused spaces.
- F. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

### 3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components.
- B. Create a directory to indicate installed circuit loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories in pencil are acceptable.
- C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

### 3.3 CONNECTIONS

- A. Ground equipment according to Division 16 Section "Grounding and Bonding."
- B. Connect wiring according to Division 16 Section "Basic Electrical Materials and Methods."

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### 3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, 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.

### 3.5 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 16442

# CITY OF EVANS PARKER MEADOWS PUMP STATION

## SECTION 16461 - DRY-TYPE TRANSFORMERS (600 V AND LESS)

### 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 dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
  - 1. Distribution transformers.

#### 1.3 SUBMITTALS

- A. Product Data Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

#### 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.
- B. Comply with IEEE C 57.12.91.
- C. Energy-Efficient Transformers Rated 15 kVA and Larger: Certified as meeting NEMA TP 1, Class 1 efficiency levels when tested according to NEMA TP 2.

#### 1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

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## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Acme Electric Corporation; Power Distribution Products Division.
  - 2. Challenger Electrical Equipment Corp.; a division of Eaton Corp.
  - 3. Computer Power Inc.
  - 4. Controlled Power Co.
  - 5. Cutler-Hammer.
  - 6. Federal Pacific Transformer Company; Division of Electro-Mechanical Corp.
  - 7. GE Electrical Distribution & Control.
  - 8. Hammond Co.; Matra Electric, Inc.
  - 9. Jefferson Electric, Inc.
  - 10. Micron Industries Corp.
  - 11. Siemens Energy & Automation, Inc.
  - 12. Sola/Hevi-Duty Electric.
  - 13. Square D/Groupe Schneider NA.

### 2.2 MATERIALS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices, except for taps.
  - 1. Internal Coil Connections: Brazed or pressure type.
  - 2. Coil Material: Copper.

### 2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Cores: One leg per phase.
- C. Enclosure: Ventilated, dripproof, NEMA 250, Type 2.
- D. Indoor Transformer Enclosure Finish: Comply with NEMA 250 for "Indoor, Corrosion Protection."
  - 1. Finish Color: Gray.
- E. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.

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- F. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- G. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

### 2.4 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.91.
- B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls and floors for suitable mounting conditions where transformers will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install floor-mounting transformers level on concrete bases. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit and 4 inches (100 mm) high.
  - 1. Anchor transformers to concrete bases according to manufacturer's written instructions.

### 3.3 CONNECTIONS

- A. Ground equipment according to Division 16 Section "Grounding and Bonding."
- B. Connect wiring according to Division 16 Section "Basic Electrical Materials and Methods."
- C. 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.

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3.4 ADJUSTING

- A. Output Settings Report: Prepare a written report recording output voltages and tap settings.

END OF SECTION 16461

# CITY OF EVANS PARKER MEADOWS PUMP STATION

## SECTION 16491 - FUSES

### 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:
  - 1. Cartridge fuses rated 600 V and less for use in switches.

#### 1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses from a single manufacturer.
- B. 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.
- C. Comply with NEMA FU 1.
- D. Comply with NFPA 70.

#### 1.4 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

#### 1.5 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

#### 1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fuses: Quantity equal to 10 percent of each fuse type and size, but no fewer than 3 of each type and size.

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### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper Bussman, Inc.
  - 2. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.
  - 3. Ferraz Shawmut, Inc.
  - 4. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

#### 2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 FUSE APPLICATIONS

- A. Service Entrance: Class RK1, time delay.
- B. Motor Branch Circuits: Class RK5, time delay.
- C. Other Branch Circuits: Class RK5, time delay.

#### 3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

#### 3.4 IDENTIFICATION

- A. Install labels indicating fuse replacement information on inside door of each fused switch.

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END OF SECTION 16491

# CITY OF EVANS PARKER MEADOWS PUMP STATION

## SECTION 16511 - INTERIOR LIGHTING

### 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:
  - 1. Interior lighting fixtures with lamps and ballasts.
  - 2. Lighting fixtures mounted on exterior building surfaces.

#### 1.3 DEFINITIONS

- A. BF: Ballast factor. Ratio of light output of a given lamp(s) operated by the subject ballast to the light output of the same lamp(s) when operated on an ANSI reference circuit.
- B. CRI: Color rendering index.
- C. CU: Coefficient of utilization.
- D. LER: Luminaire efficiency rating, which is calculated according to NEMA LE 5. This value can be estimated from photometric data using the following formula:
  - 1. LER is equal to the product of total rated lamp lumens times BF times luminaire efficiency, divided by input watts.
- E. RCR: Room cavity ratio.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of lighting fixture scheduled, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
  - 1. Physical description of fixture, including dimensions and verification of indicated parameters.
  - 2. Fluorescent and high-intensity-discharge ballasts.
  - 3. Lamps.

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### 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 NFPA 70.

### 1.6 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, and partition assemblies.

### 1.7 WARRANTY

- A. Special Warranty for Fluorescent Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Electronic Ballasts: Five years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for T8 Fluorescent Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
  - 1. Warranty Period: One year from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Products: Subject to compliance with requirements, provide one of the products specified.

### 2.2 FIXTURES AND COMPONENTS, GENERAL

- A. Fluorescent Fixtures: Comply with UL [1570] [1598]. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- B. HID Fixtures: Comply with UL [1572] [1598]. Where LER is specified, test according to NEMA LE 5B.

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- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- F. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
- G. Plastic Diffusers, Covers, and Globes:
  - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
    - a. Lens Thickness: At least [0.125 inch (3.175 mm)] minimum unless different thickness is scheduled.
    - b. UV stabilized.
  - 2. Glass: Annealed crystal glass, unless otherwise indicated.

### 2.3 LIGHTING FIXTURES

- A. As Specified on the plans.

### 2.4 FLUORESCENT LAMP BALLASTS

- A. Description: Include the following features, unless otherwise indicated:
  - 1. Designed for type and quantity of lamps indicated at full light output.
- B. Electronic ballasts for linear lamps shall include the following features, unless otherwise indicated:
  - 1. Comply with NEMA C82.11.
  - 2. Ballast Type: Instant start, unless otherwise indicated.
  - 3. Programmed Start: Ballasts with two-step lamp starting to extend life of frequently started lamps.
  - 4. Sound Rating: A.
  - 5. Total harmonic distortion rating of less than 10 percent according to NEMA C82.11.
  - 6. Transient Voltage Protection: IEEE C62.41, Category A.
  - 7. Operating Frequency: 20 kHz or higher.
  - 8. Lamp Current Crest Factor: Less than 1.7.

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### 2.5 HIGH-INTENSITY-DISCHARGE LAMP BALLASTS

- A. General: Comply with NEMA C82.4 and UL 1029. Shall include the following features, unless otherwise indicated.
  - 1. Type: Constant-wattage autotransformer or regulating high-power-factor type.
  - 2. Minimum Starting Temperature: Minus 22 deg F/Minus 30 deg C for single-lamp ballasts.
  - 3. Normal Ambient Operating Temperature: 104 deg F/40 deg C.
  - 4. Open-circuit operation that will not reduce average life.
- B. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.

### 2.6 FLUORESCENT LAMPS

- A. T8 rapid-start low-mercury lamps, rated 32 W maximum, 2800 initial lumens (minimum), CRI of 75 (minimum), color temperature of 3500 K, and average rated life of 20,000 hours, unless otherwise indicated.

### 2.7 HIGH-INTENSITY-DISCHARGE LAMPS

- A. High-Pressure-Sodium Lamps: NEMA C78.42, wattage and burning position as scheduled, CRI 21 (minimum), color temperature 1900 and average rated life of 24,000 hours.

### 2.8 FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 16 Section "Basic Electrical Materials and Methods" for channel- and angle-iron supports and nonmetallic channel and angle supports.

### 2.9 FINISHES

- A. Fixtures: Manufacturers' standard, unless otherwise indicated.
  - 1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
  - 2. Metallic Finish: Corrosion resistant.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

## CITY OF EVANS PARKER MEADOWS PUMP STATION

### 3.2 CONNECTIONS

- A. 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.

### 3.3 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Verify normal operation of each fixture after installation.
- C. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.

END OF SECTION 16511

# CITY OF EVANS PARKER MEADOWS PUMP STATION

## PART 1 – GENERAL – UNIT HEATERS

### 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 unit heaters.

### 1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each type of product specified.
- C. Wiring diagrams detailing power and control wiring and differentiating clearly between manufacturer-installed wiring and field-installed wiring.

### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Firm experienced in manufacturing unit heaters similar to those indicated for this Project and that have a record of successful in-service performance.
- B. Comply with NFPA 70 for components and installation.
- C. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
  - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
  - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide unit heaters by one of the following:
  - 1. Berko.
  - 2. Brasch Manufacturing Co., Inc.

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3. Cadet Manufacturing Company.
4. Carrier Corp.
5. Emerson Electric Co.; Wiegand Division.
6. Dunham-Bush, Inc.
7. Edwards Engineering Corporation.
8. Hydrotherm Corporation, (The); A Mestek Co.
9. Lennox Industries Inc.
10. Markel Products Company.
11. Marley Electric Heating Company; Berko Division.
12. Reed National Corp.; L.J. Wing Division.
13. Sterling Radiator Division/Mestek, Inc.
14. Trane Co.

### 2.2 ELECTRICAL UNIT HEATERS

- A. Heating Elements: Nickel-chromium heating wire element; free from expansion noise and 60-Hz hum; embedded in magnesium oxide, insulating refractory; and sealed in high-mass steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch (4 mm). Element ends are enclosed in terminal box. Fin surface temperature does not exceed 550 deg F (288 deg C) at any point during normal operation.
- B. Heater Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for overtemperature protection of heaters.
- C. Fan and Motor: Direct-drive propeller fan and manufacturer's standard motor. Motors sized 1 hp and less include motor overload protection.
- D. Wiring Terminations: Match conductor materials and sizes indicated.
- E. Discharge Configuration: Horizontal discharge with horizontal, adjustable louvers.
- F. Optional Accessories: Include the following:
  1. Fan-delay relay.
  2. Enclosure suitable for damp locations.
  3. Integral unit mounted thermostat.
  4. Mounting bracket.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and supports to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of units. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

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- A. Install unit heaters as indicated, according to manufacturer's written instructions and NFPA 90A.
- B. Connect unit heaters and components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.

### 3.3 FIELD QUALITY CONTROL

- A. Testing: After installing unit heaters and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
- B. Remove and replace malfunctioning units with new units and retest.

END OF SECTION 16856