CONTRACT DOCUMENTS

FOR THE CONSTRUCTION OF THE

ROSECREST PIPELINE CAPACITY UPGRADES

SCHEDULE A - ROSECREST PIPELINE CAPACITY UPGRADES
SCHEDULE B - ROSECREST ROADWAY IMPROVEMENTS

Volume 1 of 2
TECHNICAL SPECIFICATIONS

Jordan Valley Water Conservancy District

JORDAN VALLEY WATER
CONSERVANCY DISTRICT

For Information Regarding this Project Contact:
Lindsay Minck, P.E.
154 E. 147075 S.
Draper, Utah 84020
801-495-2224

BOWEN COLLINS & ASSOCIATES

November 2025

SECTION 00 01 07
SEALS PAGE



10/29/2025

SCHEDULE A
[CIVIL/MECHANICAL]



11/7/2025

SCHEDULE B
[CIVIL/ROADWAY]



10/28/2025

[TRAFFIC CONTROL]



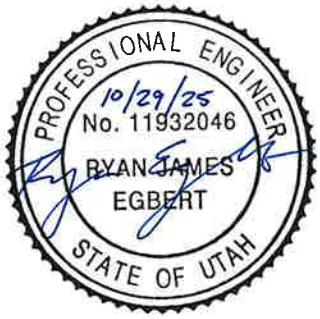
10/29/2025

[STRUCTURAL]



10/29/25

[ELECTRICAL]



[CATHODIC PROTECTION]

END OF SECTION

CONTRACT DOCUMENTS FOR

Rosecrest Pipeline Capacity Upgrades

JVWCD PROJECT #: 4350

NOVEMBER 2025

OWNER

Jordan Valley Water Conservancy District
8215 South 1300 West
West Jordan, Utah 84088
801-565-4300

ENGINEER

Bowen Collins & Associates
154 East 14075 South
Draper, Utah 84020
801-495-2224
Project Manager: Lindsay Minck, P.E.

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VOLUME 2 OF 2 - DRAWINGS

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NOTICE INVITING BIDS

PROJECT NAME: Rosecrest Pipeline Capacity Upgrades

DESCRIPTION OF WORK: The work to be performed under this Contract consists of furnishing all facilities, tools, equipment, materials, supplies, and manufactured articles, and furnishing all labor, transportation, and services including fuel, power, water, essential communications, permits and performing all Work, or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The Work includes installation of a new 24" welded steel pipeline to parallel an existing line which will increase capacity and reliability to the existing system and assist the District in meeting future water demands. The **w**ork also includes various vaults, valves, and other appurtenances to help bring the new pipeline into full working order.

SITE OF WORK: The project begins at 13400 South Rosecrest Road in Riverton, follows the alignment of the existing pipeline along Rosecrest Road in Herriman headed south, and ends at JVWCD's reservoir site at 5601 West Emmaline Drive, Herriman via Crown Rose Drive.

OBTAINING CONTRACT DOCUMENTS: Documents may be obtained by electronic download from the District's Website www.jvwcd.org beginning on November XX, 2025.

PRE-BID MEETING: A non-mandatory pre-bid meeting will be held at the office of the owner, 8215 South 1300 West, on Tuesday December 2th, 2025, at 1:30 pm.

RECEIPT OF BIDS: Sealed bids will be received at the office of the Jordan Valley Water Conservancy District, Owner of the Work, located at 8215 South 1300 West, West Jordan, Utah 84088, until **2:00 pm, on December 16, 2025**, for construction of the Rosecrest Pipeline Capacity Upgrades. Electronic bids may also be submitted in adobe .pdf format to ellisad@jvwcd.gov. JVWCD requests that electronic bids be submitted 15 minutes prior to the bid opening deadline.

AWARD OF CONTRACT: An Award of Contract, if it were awarded, will be made within 60 calendar days of the opening of bids.

NOTICE TO PROCEED: A Notice to Proceed, if it were issued, will be made within 60 calendar days of the Notice of Award.

COMPLETION OF WORK: All work shall be completed within 825 calendar days from the date of the Notice to Proceed. Work shall be sequenced and scheduled as listed in Section 01 14 40 – Construction and Schedule Restraints.

DISTRICT WEB SITE AND PLANHOLDERS LIST: Prospective bidders must register at the District's web site (www.jvwcd.org) under "Engineering Projects". Prospective bidders are required to check the District's web site for any addenda prior to submitting a responsive bid. The District's web site will be used to publish updated information relative

to the project, including a planholders list.

BID SECURITY: Each bid shall be accompanied by a certified or cashier's check, money order or bid bond in the amount of five percent of the total bid price payable to the Jordan Valley Water Conservancy District as a guarantee that the bidder, if its bid is accepted, will promptly execute the contract, provide evidence of worker's compensation insurance, and furnish a satisfactory faithful performance bond in the amount of 100 percent of the total bid price and a payment bond in the amount of 100 percent of the total bid price.

ADDRESS AND MARKING OF BID: The envelope enclosing the bid shall be sealed and addressed to the Jordan Valley Water Conservancy District and delivered or mailed to 8215 South 1300 West, West Jordan, Utah 84088. The envelope shall be plainly marked in the upper left-hand corner with the name and address of the bidder and shall bear the words "Bid for," followed by the title of the Contract Documents for the work and the date and hour of opening of bids. The certified or cashier's check, money order, or bidder's bond shall be enclosed in the same envelope with the bid.

PROJECT ADMINISTRATION: All questions relative to this project prior to the opening of bids shall be directed to the Engineer for the project. It shall be understood, however, that no interpretations of the specifications will be made by telephone, nor will any "or equal" products be considered for approval prior to award of contract.

Engineer
Bowen Collins & Associates
154 East 14075 South
Draper, Utah 84020
801-495-2224
Project Manager: Lindsay Minck, P.E.
Email: lminck@bowencollins.com

OWNER'S RIGHTS RESERVED: The Owner reserves the right to reject any or all bids, to waive any informality in a bid, and to make awards in the interest of the Owner.

Owner
Jordan Valley Water Conservancy District
8215 South 1300 West
West Jordan, Utah 84088
Project Manager: Conor Tyson, P.E.
Telephone: (801) 565-4300
Email: conort@jvwcd.gov

JORDAN VALLEY WATER CONSERVANCY DISTRICT

INSTRUCTIONS TO BIDDERS

FORM OF BID: The bid shall be made on the bidding schedule(s) bound herein. The bid shall be enclosed in a sealed envelope bearing the name of the bidder and name of the project. In the event there is more than one bidding schedule, the bidder may bid on any individual schedule or on any combination of schedules.

BID APPURTANCES: Bidders must provide bid appurtenances including Information required of bidder and experience reference projects. Bids not including the required information may be deemed non-responsive.

DELIVERY OF BID: The bid shall be delivered by the time and to the place stipulated in the Notice Inviting Bids. Alternately electronic bids will be accepted in adobe acrobat (.pdf) format. Electronic bids must be sent to ellisad@jvwcd.org. It is the bidder's sole responsibility to see that the respective bid is received in proper time.

WITHDRAWAL OF BIDS: Bids shall be unconditionally accepted without alteration or correction, excepting that bidder may by means of written request, signed by the bidder or his properly authorized representative withdraw his bid. Such written request must be delivered to the place stipulated in the Notice Inviting Bids for receipt of bids prior to the scheduled closing time for receipt of bids.

OPENING OF BIDS: The bids will be publicly opened and read at the time and place stipulated in the Notice Inviting Bids. According to state law, total bid amounts for each bidder will be posted to the District’s website within 24 hours following receipt of the bids.

MODIFICATIONS AND ALTERNATIVE BIDS: Unauthorized conditions, limitations, or provisions attached to a bid may render it non-responsive and may cause its rejection. The completed bid forms shall be without interlineations, alterations, or erasures. Alternative bids will not be considered unless called for. Oral, telegraphic, or telephonic bids or modifications will not be considered.

DISCREPANCIES IN BIDS: In the event there is more than one bid item in a bidding schedule, the bidder shall furnish a price for all bid items in the schedule; failure to do so may render the bid non-responsive and subject to rejection. In the event there are unit price bid items in a bidding schedule and the "amount" indicated for a unit price bid item does not equal the product of the unit price and quantity, the unit price shall govern and the "amount" will be corrected accordingly, and the Contractor shall be bound by said Correction. In the event there is more than one bid item in a bidding schedule and the total indicated for the schedule does not agree with the sum of the prices bid on the individual items, the prices bid on the individual items shall govern and the total for the schedule will be corrected accordingly, and the Contractor shall be bound by said correction.

INSTRUCTIONS TO BIDDERS

BID SECURITY: Each bid shall be accompanied by a certified or cashier's check or approved bid bond in the amount stated in the Notice Inviting Bids. Said check or bond shall be made payable to the Owner and shall be given as a guarantee that the bidder, if awarded the work, will enter into a contract within 10 calendar days after receipt of the contract from the Owner, and will furnish the necessary insurance certificates, Payment Bond, and Performance Bond; each of said bonds to be in the amount stated in the Notice Inviting Bids. In case the apparent low bidder refuses or fails to enter into such contract or fails to provide the required insurance and insurance certificates, the check or bid bond, as the case may be, shall be forfeited to the Owner. If the bidder elects to furnish a bid bond as his bid guarantee, he shall use the bid bond bound herein, or one conforming substantially to it in form.

BIDDER'S EXAMINATION OF CONTRACT DOCUMENTS AND SITE

It is the responsibility of each Bidder before submitting a Bid to:

1. Examine Contract Documents thoroughly.

2. Visit the site to become familiar with local conditions that may affect cost, progress, performance, or furnishing of the work.

3. Consider federal, state and local laws and regulations that may affect cost, progress, and performance of furnishing of the work.

4. Study and carefully correlate the Bidder's observations with the Contract Documents.

5. Notify the Engineer of all conflicts, errors, or discrepancies in the Contract Documents.

Reference is made to the Supplemental General Conditions for identification of:

1. Those reports of exploration and tests of subsurface conditions at the site, which have been utilized by the Engineer in the preparation of the Contract Documents.

2. Those drawings of physical conditions in or relating to existing surface and subsurface conditions (except underground utilities as defined in Article 1 of the General Conditions) which are at or contiguous to the site and which were utilized by the Engineer in the preparation of the Contract Documents. Copies of such reports and drawings are available for inspection at the office of the Owner.

INSTRUCTIONS TO BIDDERS

Information and data reflected in the Contract Documents with respect to underground facilities at/or contiguous to the site are based upon information and data furnished to the Owner and the Engineer by the owners of such underground facilities or others, and the Owner does not assume any responsibility for the accuracy or completeness thereof including any damages whatsoever that may be incurred by the Bidder or the Contractor through his reliance thereon unless it is expressly provided otherwise in the Supplemental General Conditions and/or the Technical Specifications.

Before submitting a bid, the bidder shall conduct such examination, investigations, studies and tests as are necessary to satisfy himself as to: the nature and location of the physical conditions (surface, subsurface and underground facilities), the general and local conditions particularly those bearing upon transportation, disposal, handling and storage of materials, availability of labor, availability of utilities, local weather conditions, the character of equipment and facilities required preliminary to and during the prosecution of the work; any and all other conditions that may in any way affect the cost, progress, performance or furnishing of materials in accordance with the Contract Documents. All such examination, investigation, studies, tests and the like shall be at the Bidder's expense.

Upon reasonable request in advance, the Owner shall provide each Bidder access to the site to conduct such explorations, examination, investigation and tests as each Bidder may determine necessary for the submission of a Bid. The Bidder shall fill all holes, clean and restore the site to its former condition upon the completion of such activities.

The submission of a bid hereunder shall be considered prima facie evidence that the Bidder has made such examination as is set forth in the above paragraph and is knowledgeable as to the location and site conditions surrounding the work and the conditions to be encountered in performing the work and as to the requirements, conditions and terms of the Contract and Contract Documents.

The Owner assumes no responsibility for any understanding or representations made by any of its officers or agents during or prior to the execution of this Contract, for information contained in any reports, subsurface studies, or other information which may be made available for the Contractor's information and which are not included as Contract Documents, for any understanding or representations by the Owner or by others which are not expressly stated in the Contract Documents which liability is not expressly assumed by the Owner or its representatives or Engineer in the Contract Documents. Such information shall be deemed to be for the information of the Contractor and the Contractor shall have the obligation of evaluating any such information as to its accuracy and effect the Owner will not be liable or responsible for any such information or any conclusions that may be drawn there from by the Contractor.

The lands upon which the work is to be performed, right-of-ways and easements for access thereto together with other lands designated for use by the Contractor in performing the work are identified in the Contract Documents. All additional lands and access thereto that are required for temporary construction facilities or storage of materials and equipment are to be provided by the Contractor. Easements for permanent structures or permanent changes in existing structures are to be obtained and paid for by the Owner unless otherwise provided in the Contract Documents.

The submission of a Bid shall constitute an incontrovertible representation by the Bidder that the Bidder has complied with every requirement of this Article, and that without exception the Bid is premised upon performing and furnishing the work required by the Contract Documents in compliance with such means, methods, techniques, sequences, or procedures of construction as may be indicated in or required by the Contract Documents; and that such means, methods, techniques, sequences or procedures described in the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance and furnishing the work.

QUANTITIES OF WORK

The quantities of work or material stated in the Bid Schedule are supplied only to give an indication of the general scope of the work; the Owner does not expressly or by implication agree that the actual amount of work or material will correspond therewith. The Owner reserves the right after award of the Contract to increase or decrease the quantities of any unit price item of the work by an amount up to and including 25 percent of the quantity of any bid item, or to omit portions of such work as may be deemed necessary or expedient by the Engineer or Owner, without a change in the unit price. Such right to revise and omit shall include the right to delete any bid item in its entirety, or to add additional bid items in quantities up to and including an aggregate total amount not to exceed 25 percent of the total amount of the Contract.

The Bidders nor the ultimate Contractor on the Project shall at any time after the submittal of a bid make or have any claim for damages or anticipated profits or loss of profit or otherwise because of any difference between the quantities of work actually done and material furnished and those stated in said unit price items of the Bid.

INSTRUCTIONS TO BIDDERS

COMPETENCY OF BIDDERS: In selecting the lowest responsible Bidder, consideration will be given to the general competency of the Bidder for the performance of the work covered by the Bid. To this end, each bid shall be supported by a statement of the bidder's experience as of recent date on the form entitled "Information Required of Bidder," bound herein. No bid for the work will be accepted from a contractor who does not hold an active Contractor's license in good standing applicable to the type of work bid upon at the time of opening bids.

After an award of the contract no substitution of the Project Manager or Project Superintendent will be allowed without the written approval by the Owner.

DISQUALIFICATION OF BIDDERS: More than one bid from an individual, firm partnership, corporation, or association under the same or different names will not be considered. Reasonable grounds for believing that any bidder is interested in more than one bid for the work contemplated will cause the rejection of all bids in which such bidder is interested. If there is reason for believing that collusion exists among the bidders, all bids will be rejected.

RETURN OF BID GUARANTEE: Within 10 calendar days after award of the contract, the Owner will return the bid guarantees accompanying such of the bids as are not considered in making the award. All other bid guarantees will be held until a Notice to Proceed has been issued and accepted. They will then be returned to the respective bidders whose bids they accompany.

AWARD OF CONTRACT: Award of the Contract, if it be awarded, will be based primarily on the lowest overall cost to the Owner, and will be made to a responsive and responsible bidder whose bid complies with all the requirements prescribed. Any such award will be made by written notice and within 60 calendar days after opening of the bids, unless a different waiting period is expressly allowed in the Notice Inviting Bids. Unless otherwise indicated, an award will not be made for less than all the bid items in an individual bidding schedule. In the event the entire work is contained in more than one bidding schedule, the Owner may award schedules individually or in combination. In the case of two bidding schedules which are alternate to each other, only one of such alternate schedules will be awarded.

INSTRUCTIONS TO BIDDERS

EXECUTION OF CONTRACT: The Bidder to whom the award is made shall secure all insurance and shall furnish all certificates and bonds required by the specifications within ten calendar days after receipt of the Notice of Award from the Owner. The Bidder to whom the award is made shall execute a written contract with the Owner on the form of agreement provided within ten calendar days after receipt of the Agreement from the Owner. Failure or refusal to enter into a contract as herein provided or to conform to any of the stipulated requirements in connection therewith shall be just cause for annulment of the award and forfeiture of the bid guarantee. If the successful bidder refuses or fails to execute the contract, the Owner may award the contract to the second lowest responsible bidder, or reject all bids and re-advertise the project for rebidding. If the second lowest responsible bidder refuses or fails to execute the contract, the Owner may award the contract to the third lowest responsible bidder. On the failure or refusal of such second or third lowest bidder to execute the contract, each such bidder's guarantees shall be likewise forfeited to the Owner.

ISSUANCE OF NOTICE TO PROCEED: The Owner intends to execute the Agreement and issue the Notice to Proceed specifying the Project start date within ten calendar days after its receipt of the executed Agreement, Purchase Order Assignment(s), (if applicable), bonds and insurance certificates from the successful bidder. If the Contract Time is expressed as a specific completion date in the Notice Inviting Bids and paragraph 3.1 of the Agreement rather than a specific number of successive days following the start date identified in the Notice to Proceed, then any delay by the Owner beyond the ten days in issuing the Notice to Proceed shall extend the completion date by the number of days of the delay.

LICENSES: Contractor must be licensed as a business qualified to do business within the state of Utah prior to issuance of a Notice of Award. Contractor must hold a current contractor’s license with classifications appropriate to the work being contracted.

BID

BID TO: JORDAN VALLEY WATER CONSERVANCY DISTRICT

The undersigned Bidder hereby proposes to furnish all plant machinery, labor, services, materials, equipment, tools, supplies, transportation, utilities, and all other items and facilities necessary to perform all work required under the Bidding Schedule of the Owner's Contract Documents entitled “Rosecrest Pipeline Capacity Upgrades” drawings and all addenda issued by said Owner prior to opening of the bids.

Addenda, if issued, are only delivered by e-mail and on Owner’s website (jvwcd.gov).

The undersigned bidder acknowledges receipt of the following addenda:

No.	Date Received	No.	Date Received

Bidder agrees that, within 10 calendar days after receipt of Notice of Award from Owner, he will execute the Agreement in the required form, of which the Notice Inviting Bids, Instructions to Bidders, Bid, Information Required of Bidder, Technical Specifications, Drawings, and all addenda issued by Owner prior to the opening of bids, are a part, and will secure the required insurance and bonds and furnish the required insurance certificates; and that upon failure to do so within said time, then the bid guarantee furnished by Bidder shall be forfeited to Owner as liquidated damages for such failure; provided, that if Bidder shall execute the Agreement, secure the required insurance and bonds, and furnish the required insurance certificates within said time, his check, if furnished, shall be returned to him within five days thereafter, and the bid bond, if furnished, shall become void. It is further understood that this bid may not be withdrawn for a period of 45 days after the date set for the opening thereof, unless otherwise required by law.

Dated: _____ Bidder: _____

By: _____
(Signature)

Title: _____

Bidder further agrees to complete all work required within the time stipulated in the Contract Documents, and to accept in full payment therefore the price(s) named in the above-mentioned Bidding Schedule(s).

BID

BID SCHEDULE

PART 1 – GENERAL

1.1 CONSTRUCTION CONTRACT

A. Name of Project: Rosecrest Pipeline Capacity Upgrades

B. Owner's Project Number: 4350

1.2 SCHEDULES TO BE ADDED TO THE AGREEMENT

A. Bid Schedule contains the schedules of prices which will be incorporated into the Agreement (Section F) by reference.

1.3 SCHEDULES OF PRICES

A. The Contract has been divided into separate Bid Schedules for purposes of award. The Owner reserves the right to award a single Contract based upon the lowest overall project cost, or any combination of the individual bid schedules as described herein.

B. Schedule A: Generally includes all Work associated with Rosecrest Pipeline from the connection at 13400 South to the connection at the Rosecrest Reservoir and connections to the Herriman City system and Riverton City system. Work includes construction of the Interconnect Vault, Rosecrest Reservoir Vault, Rocky Point Drive Mainline Valve Vault, air valve vaults and drain structures, restoration and cathodic protection work.

C. Schedule B: Generally includes all Work for the Rosecrest Roadway Improvements beginning and including 13400 South and extending to Crown Rose Drive for the full width of Rosecrest Road, including replacement of waterway, ADA ramps, curb and gutter, and striping, for full roadway reconstruction and for mill and overlay.

D. The Contract, if awarded, will be on the basis of materials and equipment specified or described in the bidding documents without consideration of possible substitution of "or equal" items.

BID

Bid Schedule – Unit Prices:

E. BID SCHEDULE A – ROSECREST PIPELINE CAPACITY UPGRADES

Base Bid Items				
Item No.	**Classification of Unit Price Work**	**Quantity Unit**	**Unit Price**	**Amount**
1A	Mobilization, Demobilization, Temporary Facilities and Administrative Items (not to exceed 10% of Total Base Bid Sch A)	1 Lump Sum	$	$
2A	Traffic Control	1 Lump Sum	$	$
3	Public Information and Engagement	1 Lump Sum	$	$
4A	30-inch, 5/16” thickness, Welded Steel Pipe, 13400 South Pipeline	160 Linear Feet	$	$
4B	24-inch, Welded Steel Pipe, Rosecrest Pipeline and 5600 West Pipeline	7,713 Linear Feet	$	$
4C	16-inch and 20-inch, Welded Steel Pipe, Rosecrest Pipeline (Replacement) and 5600 West Pipeline	349 Linear Feet	$	$
5	Turnout to Herriman City Pump Station	1 Lump Sum	$	$
6	Foothill Service Area Connection to Herriman City at 13680 South and Rocky Point Drive	2 Each	$	$
7	12" DIP, Herriman City and Riverton city Metering Pipeline and Connection to Existing Pipeline	119 Linear Feet	$	$
8A	Herriman City Metering at Interconnect Vault	1 Lump Sum	$	$
8B	Riverton City Metering at Interconnect Vault	1 Lump Sum	$	$
10A	Rosecrest Pipeline Connection	5 Each	$	$
11	Rosecrest Reservoir Vault & Sampling Manhole-Mechanical and Structural, Site Restoration, and Storm Drain Relocation	1 Lump Sum	$	$
12	Rosecrest Reservoir Vault - Electrical Work and Site Instrumentation, Complete	1 Lump Sum	$	$
14	Demolition of Existing JVWCD Reservoir Vault	1 Lump Sum	$	$
16	Rocky Point Mainline Valve Vault, Complete	1 Lump Sum	$	$

BID

Base Bid Items				
Item No.	**Classification of Unit Price Work**	**Quantity Unit**	**Unit Price**	**Amount**
17	13400 South Interconnect Vault - Mechanical and Structural, and Site Restoration	1 Lump Sum	$	$
18	13400 South Interconnect Vault - Electrical Work	1 Lump Sum	$	$
19	Demolition of Existing Interconnect Vault, Riverton Metering Vault and Herriman Metering Vault	1 Lump Sum	$	$
21	Air Valve Structure	3 Each	$	$
22	Drain and Blowoff Structure	2 Each	$	$
23	Storm Drain Relocation at Reservoir Site	1 Lump Sum	$	$
24	Fire Hydrant Relocation, Complete	5 Each	$	$
25	Trench Stabilization Material, Only as Directed by Engineer	1,850 Cubic Yards	$	$
26	Cathodic Protection, Complete	1 Lump Sum	$	$
27A	Culinary Main Line Loop (Under) – 16" DIP, CL-52, Complete	6 Each	$	$
27B	Pressurized Irrigation Loop (Under) – 20" PVC, C900 or C909, Complete	1 Each	$	$
28A	Culinary Water Service Loop – 1", IPS polyethylene pipe	9 Each	$	$
28B	Irrigation Service Loop – 1", IPS polyethylene pipe	9 Each	$	$
29A	Curb and Gutter Replacement	260 Linear Feet	$	$
30	Sidewalk Replacement	375 Sq Feet	$	$
31A	Driveway Approach, Reservoir Driveway	1 Each	$	$
32	Enbridge Gas Relocation Coordination	1 Lump Sum	$	$
33	Permit Allowance	Allowance	$ 100,000	$ 100,000
34	UTBC	6,665 Tons	$	$

BID

Base Bid Items				
Item No.	**Classification of Unit Price Work**	**Quantity Unit**	**Unit Price**	**Amount**
35	Temporary Asphalt, 2-inch Thickness	1,350 Tons	$	$
36A	Asphalt Restoration (T-Patch) at Emmeline Drive, Crown Rose Drive, 13680 South, Rocky Point Drive, Reservoir Driveway, and Site Asphalt Restoration: 5-inch Thickness, PG 58-28 SP-1/2 75Nd	1,200 Tons	$	$
36B	Asphalt Restoration (T-Patch) at Rosecrest Road from Rocky Point Drive to Crown Rose Drive and at 134000 South: 6-inch Thickness, PG 64-34 SP-1/2 75Nd	2,200 Tons	$	$
39A	2” Mill & Overlay – Emmeline Drive, Crown Rose Drive and Rocky Point Drive	350 Tons	$	$
TOTAL BID SCHEDULE A:			$	

Bid Adjustment – Rosecrest Pipeline Capacity Upgrades

The bid adjustment allows the Bidder to adjust their base bid just prior to bid opening without the need to adjust individual bid item amounts. The sum of the extended total shall be increased or (decreased) by this Bid Adjustment amount. Indicate decrease in parenthesis (___). For payment purposes, this correction amount will be applied to Bid Items No. 4 proportionally to the amount bid for those items.

Bid Adjustment $_____

Total adjusted BID Schedule A $_____

F. BID SCHEDULE B – ROSECREST ROADWAY IMPROVEMENTS

Base Bid Items				
Item No.	**Classification of Unit Price Work**	**Quantity Unit**	**Unit Price**	**Amount**
1B	Mobilization, Demobilization, Temporary Facilities, and Administrative Items (not to exceed 10% of Total Base Bid Sch B)	1 Lump Sum	$	$
2B	Traffic Control	1 Lump Sum	$	$
29B	Curb and Gutter Replacement	190 Linear Feet	$	$
31B	Driveway Replacement	1 Lump Sum	$	$
34D	UTBC, 8” Thickness - Rosecrest Road from 13400 South to Rocky Point Drive with Material Testing	3,067 Cubic Yards	$	$
38	6” Asphalt Pavement – Rosecrest Roadway, 13400 South to Rocky Point Drive	13,800 Sq Yards	$	$
40	Rosecrest Roadway Asphalt and Base Course Removal and Subgrade Preparation	13,800 Sq Yards	$	$
41A	3” Mill & Overlay – Rosecrest Road from Rocky Point Drive to Crown Rose Drive	19,500 Sq Yards	$	$
41B	3” Mill & Overlay – Rosecrest Road and 13400 South Intersection	1,200 Sq Yards	$	$
42	Concrete Waterway Replacement	35 Linear Feet	$	$
43	ADA Ramp Replacement	26 Each	$	$
44A	Collars for Manhole	29 Each	$	$
44B	Collars for Water Valves	47 Each	$	$
45	Monument Relocation	12 Each	$	$
TOTAL BID SCHEDULE B:			$	

Bid Adjustment – Rosecrest Roadway Improvements

Bid Adjustment $_____

Total adjusted BID Schedule A $_____

G. BID TOTAL – BID SCHEDULES A & B

Bid Total	
BID TOTAL– Bid Schedule A *Including Bid Adjustment* and Bid Schedule B *Including Bid Adjustment*:	$

1. Bidder agrees to accept as full payment for Work proposed with the Bidding Documents, based upon the undersigned's own estimate of quantities and costs and including sales, consumer, use, other taxes, and overhead and profit.

2. Based upon Bidder's own estimate of quantities and costs, the Bidder, if awarded the contract, payment shall be made for the items as outlined in Section 01 20 00 – Measurement and Payment.

3. Bidder acknowledges that estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

4. Identify Steel Pipe Supplier, **Circle One*:***

   a. Northwest Pipe Company

   b. Thompson Pipe Group

   c. Other, _____ (Name Supplier)

BID

Bidder (Company name): _____

By: _____ Dated: _____
(Signature)

Name: _____ Title: _____

ATTACHMENTS TO THIS BID

The following documents are attached to and made a condition of this Bid:

1. Required Bid security in the form of Bid Bond.
2. Information Required of Bidder.

BID BOND

KNOW ALL MEN BY THESE PRESENTS,

That _____
as Principal, and _____
as Surety, are held and firmly bound unto the Jordan Valley Water Conservancy District (hereinafter called "Owner") in the sum of _____ dollars, (not less than five percent of the total amount of the bid) for the payment of which sum, will and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, Principal has submitted a bid to Owner to perform all work required under the bidding Schedule of the Owner's Contract Documents entitled Rosecrest Pipeline Capacity Upgrades, (hereafter called the “Project”).

NOW THEREFORE, if Principal is awarded Contract by Owner for the Construction of the Project and, within the time and in the manner required under the heading "Instructions to Bidders" enters into the written contract entitled "Agreement" bound with said Contract Documents, furnishes the required certificates of insurance, and furnishes the required Performance Bond and Payment Bond within 10 calendar days after receipt of such contract from Owner, then this obligation shall be null and void, otherwise it shall remain in full force and effect. In the event suit is brought upon this bond by Owner and judgment is recovered, Surety shall pay all costs incurred by Owner in such suit, including a reasonable attorney's fee to be fixed by the court.

SIGNED AND SEALED, this _____ day of _____, 20___.

_____ _____

By: _____ By: _____

Its: _____ Its: _____

(SEAL) (SEAL)

INFORMATION REQUIRED OF BIDDER

The Bidder shall furnish the following information. Failure to comply with this requirement may render the Bid non-responsive and subject to rejection. Additional sheets shall be attached as required.

1. Contractor firm information:

Contractor's name: _____

Contractor's address: _____

_____

_____

Contractor's Primary Contact: _____

Email address of Contractor's primary contact: _____

Contractor's telephone number: _____

2. Contractor must be qualified and licensed to do business in Utah.

Utah Department of Commerce Information

Business Entity Number: _____

Delinquent Date: _____

3. Contractor must hold a current contractor's license, classification E100.

Contractor's Utah License Number: _____

Expiration Date: _____

Primary Classification: _____

Supplemental Classification held, if any: _____

INFORMATION REQUIRED OF BIDDER

5. **Key Personnel Qualifications and Experience**

List key personnel here and provide detailed information in Attachments A, B and D. More than one Project Manager and/or Project Superintendent may be proposed. Only personnel approved by the Owner will be allowed in the key positions.

Project Manager A: _____

Project Manager shall have:

- At least five (5) years' experience as a Project Manager.
- Have successfully performed as Project Manager on the construction of at least two (2) welded steel pressure pipeline projects with a diameter of at least 24-inches.
- The demonstrated pipeline projects shall have:
    - A minimum length of at least 1,000 linear feet.
    - A combined total of at least 5,000 linear feet,
    - A combined total of at least 2,500 linear feet of pipeline construction within the public right-of-way, and
    - A combined total of at least three (3) cast-in-place concrete vaults.

Project Superintendent A: _____

Project Superintendent shall have:

- At least ten (10) years' construction experience
- Have successfully performed as Superintendent on the construction of at least three (3) welded steel pressure pipeline projects with a diameter of at least 24-inches.
- The demonstrated pipeline projects shall have:
    - A minimum length of at least 1,000 linear feet.
    - A combined total of at least 8,000 linear feet,
    - A combined total of at least 3,500 linear feet of pipeline construction within the public right-of-way, and
    - A combined total of at least three (3) cast-in-place concrete vaults.

Project Public Information Manager (PIM) A:_____

INFORMATION REQUIRED OF BIDDER

Project Public Information Manager shall have a minimum of the following requirements with supporting documentation:

- Experience:
  - Bachelor's degree in Communications, Public Relations or Marketing and two (2) years of related experience,

    OR
  - At least ten (10) years related experience;
- Have successfully performed as Public Information Manager on at least two (2) construction projects including:
  - Greater than 10 months of active construction duration
  - Communications with Owner and Municipal Public Relations Managers,
  - Communications with residential and commercial owners,
  - Traffic Control with detours and closed intersections for durations longer than 1 week,
  - Tracking stakeholder interactions and concerns and documented resolutions,

6. **Previous Contractor Project Experience**

Past project experience shall be provided for each requirement. The Owner shall be entitled to contact each and every reference listed by the contractor. The Contractor, by submitting a prequalification proposal, expressly agrees that any information concerning the CONTRACTORS in possession of said entities and references may be made available to the owner.

Provide the information identified in Attachment C for each project listed below.

Requirements:

Contractor shall have successfully completed at least four (4) pipeline projects which all include the following:

- 24-inch diameter welded steel pressure pipeline or larger,
- Culinary waterlines with a minimum of 1,000 linear feet,

INFORMATION REQUIRED OF BIDDER

- Reinforced cast-in-place concrete vault work,
- Pipeline construction within the public right of way, with traffic control requirements, and
- At least one (1) project successfully completed with a total value of at least $5,000,000.

1. _____

2. _____

3. _____

List at least one (1) project successfully completed with a total value of at least $5,000,000.

4. _____

INFORMATION REQUIRED OF BIDDER

7. Name and title of officers of Contractor's firm:

_____

_____

_____

8. Name of person who inspected site of proposed work for your firm:

Name: _____

Date of Inspection: _____

9. Surety company who will provide the required bonds on this contract: _____

   Agent's Name:_____

   Telephone:_____

10. Workers Compensation Insurance Policy #: _____

INFORMATION REQUIRED OF BIDDER

ATTACHMENT A
(Copy as necessary – recommended to provide more projects than required, if using a different form, ensure ALL required information is clearly identified)

Project Manager Data Sheet

Name: _____

Years experienced as Project Manager: _____ Years of other construction experience: _____

Positions: _____

Qualifying Project #1: _____

Project Summary: _____

_____

_____

Year Completed: _____ Number of Cast-in-place concrete vaults installed: _____

Total Cost: _____ Length of pipeline in public Right-of-Way: _____

Diameter(s) of pipelines: _____ Pipeline Material(s): _____

Length of 24” or larger welded steel pressure pipe: _____

Owner: _____Owner Contact and Number: _____

Qualifying Project #2: _____

Project Summary: _____

_____

_____

Year Completed: _____ Number of Cast-in-place concrete vaults installed: _____

Total Cost: _____ Length of pipeline in public Right-of-Way: _____

Diameter(s) of pipelines: _____ Pipeline Material(s): _____

Length of 24” or larger welded steel pressure pipe: _____

Owner: _____Owner Contact and Number: _____

INFORMATION REQUIRED OF BIDDER

ATTACHMENT B

Superintendent Data Sheet

Name: _____

Years experienced as Superintendent: _____ Years of other construction experience: _____

Positions: _____

Qualifying Project #1: _____

Project Summary: _____

_____

_____

Year Completed: _____ Number of Cast-in-place concrete vaults installed: _____

Total Cost: _____ Length of pipeline in public Right-of-Way: _____

Diameter(s) of pipelines: _____ Pipeline Material(s): _____

Length of 24” or larger welded steel pressure pipe: _____

Owner: _____Owner Contact and Number: _____

Qualifying Project #2: _____

Project Summary: _____

_____

_____

Year Completed: _____ Number of Cast-in-place concrete vaults installed: _____

Total Cost: _____ Length of pipeline in public Right-of-Way: _____

Diameter(s) of pipelines: _____ Pipeline Material(s): _____

Length of 24” or larger welded steel pressure pipe: _____

Owner: _____Owner Contact and Number: _____

Qualifying Project #3: _____

Project Summary: _____

_____

_____

Year Completed: _____ Number of Cast-in-place concrete vaults installed: _____

Total Cost: _____ Length of pipeline in public Right-of-Way: _____

Diameter(s) of pipelines: _____ Pipeline Material(s): _____

INFORMATION REQUIRED OF BIDDER

Length of 24” or larger welded steel pressure pipe: _____

Owner: _____Owner Contact and Number: _____

INFORMATION REQUIRED OF BIDDER

ATTACHMENT C

Public Information Manager (PIM) Data Sheet

Name: _____

Bachelor's Degree (or NA): _____ Year: _____

Years experience in public relations: _____ Positions: _____

Qualifying Project #1: _____

Project Summary: _____

_____

_____

Regular Communication with: _____

Year Completed: _____ Active Construction Time: _____

Total time traffic detours: _____ Total Cost: _____

Owner: _____Owner Contact and Number: _____

Qualifying Project #2: _____

Project Summary: _____

_____

_____

Regular Communication with: _____

Year Completed: _____ Active Construction Time: _____

Total time traffic detours: _____ Total Cost: _____

Owner: _____Owner Contact and Number: _____

INFORMATION REQUIRED OF BIDDER

ATTACHMENT D

Contractor Project Experience Summary

Qualifying Project #1: _____

Project Summary: _____

_____

_____

Year Completed: _____ Number of Cast-in-place concrete vaults installed: _____

Total Cost: _____ Length of pipeline in public Right-of-Way: _____

Diameter(s) of pipelines: _____ Pipeline Material(s): _____

Length of 24” or larger welded steel pressure pipe: _____

Owner: _____Owner Contact and Number: _____

Qualifying Project #2: _____

Project Summary: _____

_____

_____

Year Completed: _____ Number of Cast-in-place concrete vaults installed: _____

Total Cost: _____ Length of pipeline in public Right-of-Way: _____

Diameter(s) of pipelines: _____ Pipeline Material(s): _____

Length of 24” or larger welded steel pressure pipe: _____

Owner: _____Owner Contact and Number: _____

Qualifying Project #3: _____

Project Summary: _____

_____

_____

Year Completed: _____ Number of Cast-in-place concrete vaults installed: _____

Total Cost: _____ Length of pipeline in public Right-of-Way: _____

Diameter(s) of pipelines: _____ Pipeline Material(s): _____

Length of 24” or larger welded steel pressure pipe: _____

Owner: _____Owner Contact and Number: _____

INFORMATION REQUIRED OF BIDDER

Qualifying Project #4: _____

Project Summary: _____

_____

_____

Year Completed: _____ Number of Cast-in-place concrete vaults installed: _____

Total Cost: _____ Length of pipeline in public Right-of-Way: _____

Diameter(s) of pipelines: _____ Pipeline Material(s): _____

Length of 24” or larger welded steel pressure pipe: _____

Owner: _____Owner Contact and Number: _____

AGREEMENT

An Agreement made as of the _____ day of _____, 20___, by and between the Jordan Valley Water Conservancy District, a Utah special district ("OWNER"), and _____, a _____ corporation qualified to do business and doing business in the State of Utah ("CONTRACTOR").

TERMS:

OWNER and CONTRACTOR, in consideration of the mutual covenants hereinafter set forth, agree as follows:

ARTICLE I
WORK

CONTRACTOR shall complete all Work as specified or indicated in the Contract Documents for the _____. The Work is generally described as follows:

> Furnishing all labor, services, materials, equipment, and supplies except for such materials, equipment, and services as may be stipulated in the Contract Documents to be furnished by the OWNER; furnishing and removing all plant machinery, temporary structures, tools, supplies, transportation, utilities, and all other items, facilities and equipment, and to do everything required by this Agreement and the Contract Documents; accepting all responsibility for and paying for all loss and damage arising out of the nature of the Work aforesaid, or from the action of the elements, or from any unforeseen difficulties which may arise during the prosecution of the Work until its acceptance by OWNER, and for all risks of every description connected with the Work; also for all expenses resulting from the suspension or discontinuance of work, except as in the Contract Documents are expressly stipulated to be borne by OWNER.

ARTICLE II
ENGINEER

The Project has been designed by the OWNER. The OWNER will assume all duties and responsibilities and have the rights and authority assigned to ENGINEER in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents.

[ALTERNATE PARAGRAPH]The Project has been designed by _____, a _____ corporation qualified to do business and doing business in the State of Utah, who is hereinafter called "ENGINEER" and who is to act as OWNER's representative, assume all duties and responsibilities and have the rights and

authority assigned to ENGINEER in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents.

ARTICLE III
CONTRACT TIME

3.1 The Work shall be complete, in accordance with paragraphs 14.08 and 14.09 of the General Conditions, on or before _____.

3.2 Liquidated Damages: OWNER and CONTRACTOR recognize that time is of the essence of this Agreement and that the OWNER will suffer financial loss if the Work is not completed within the time specified in paragraph 3.1 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. They also recognize the delays, expense and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by OWNER if the Work is not completed on time. Accordingly, instead of requiring any proof of loss, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty) CONTRACTOR shall pay OWNER the amount specified in Article 14.07 of the General Conditions and in Article 18.01 of the Supplementary General Conditions for each day that expires after the time specified in paragraph 3.1 for final completion until the Work is substantially complete. And, after Substantial Completion if CONTRACTOR neglects, refuses or fails to complete the remaining Work within forty-five (45) days or any proper extension thereof granted by OWNER, CONTRACTOR shall pay OWNER the amount specified in Article 14.07 of the General Conditions and in Article 18.01 of the Supplemental General Conditions for each day that expires after the forty-five (45) days until readiness for final payment.

ARTICLE IV
CONTRACT PRICE

All payments to Contractor shall be made in accordance with the Contract Documents. OWNER shall pay CONTRACTOR for completion of the Work in accordance with the Contract Documents in current funds those prices stated in the approved Bid Schedule as named in the Notice of Award.

ARTICLE V
PAYMENT PROCEDURES

CONTRACTOR shall submit Applications for Payment in accordance with Article 14 of the General Conditions. Applications for Payment will be processed by ENGINEER as provided in the General Conditions.

5.1 Progress Payments: OWNER shall make progress payments on account of the Contract Price on the basis of CONTRACTOR's Applications for Payment

as recommended by ENGINEER, on a monthly basis. All progress payments will be on the basis of the progress of the Work measured by the schedule of values established in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Conditions.

5.2 Final Payment: Upon final completion and acceptance of the Work in accordance with Article 14 of the General Conditions, OWNER shall pay the remainder of the Contract Price as recommended by ENGINEER as provided in Article 14.

ARTICLE VI
INTEREST

All moneys not paid when due as provided in Article 14 of the General Conditions shall bear interest at the rate of twelve percent (12%) per annum.

ARTICLE VII
CONTRACTOR'S REPRESENTATION

In order to induce OWNER to enter into the Agreement, CONTRACTOR makes the following representations:

7.1 CONTRACTOR has familiarized itself with the nature and extent of the Contract Documents, Work, site, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance or furnishing of the Work.

7.2 CONTRACTOR has studied carefully all exploration reports and test of subsurface conditions and drawings of physical conditions which are identified in the Supplementary General Conditions, as provided in paragraph 4.02 of the General Conditions, and accepts the Technical Data contained in such reports and drawings upon which CONTRACTOR is entitled to rely.

7.3 CONTRACTOR has obtained and carefully studied (or assumes responsibility for obtaining and carefully studying) all such examinations, investigations, explorations, tests, reports and studies (in addition to or to supplement those referred to in paragraph 7.2 above) which pertain to the subsurface or physical conditions at or contiguous to the site or otherwise may affect the cost, progress, performance or furnishing of the Work as CONTRACTOR considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of paragraph 4.02 of the General Conditions; and no additional examinations, investigations, explorations, tests, reports,

studies or similar information or data are or will be required by CONTRACTOR for such purposes.

7.4 CONTRACTOR has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing Underground Facilities at or contiguous to the site and assumes responsibility for the accurate location of said Underground Facilities.

7.5 CONTRACTOR has correlated the results of all observations, examinations, investigations, explorations, tests, reports and studies with the terms and conditions of the Contract Documents.

7.6 CONTRACTOR has given ENGINEER written notice of all conflicts, errors or discrepancies that he had discovered in the Contract Documents and the written resolution thereof by ENGINEER is acceptable to CONTRACTOR.

ARTICLE VIII
CONTRACT DOCUMENTS

The Contract Documents for the _____, which comprise the entire agreement between OWNER and CONTRACTOR concerning the Work, consist of the following:

8.1 This Agreement;
8.2 Performance and Payment Bonds;
8.3 Notice of Award;
8.4 Notice to Proceed;
8.5 General Conditions;
8.6 Supplemental General Conditions;
8.7 Notice Inviting Bids;
8.8 Instructions to Bidders;
8.9 Information Required of Bidder;
8.10 Technical Specifications;
8.11 Drawings - Sheets number one through _____;
8.12 Addendum number one through _____; and,
8.13 CONTRACTOR's Bid, including all schedules and explanatory attachments; attached as Exhibit A.

The CONTRACTOR (1) acknowledges that he has received a copy of each document, specified above, (2) acknowledges that he has read and understands each document specified above and (3) agrees to every term, condition and contract obligation set forth in each document specified above.

There are no Contract Documents other than those listed above in this Article 8. The Contract Documents may only be amended, modified or supplemented as provided in paragraphs 3.03 of the General Conditions.

ARTICLE IX
FEDERAL REQUIREMENTS

The CONTRACTOR shall comply with federal regulations as stated in the Supplemental General Conditions, Article 21.

ARTICLE X
MISCELLANEOUS

10.1 Terms used in this Agreement which are defined in Article 1 of the General Conditions will have the meanings indicated in the General Conditions.

10.2 No assignment by a party hereto of any rights under or interests in the Contract Documents will be binding on another party hereto without the written consent of the party sought to be bound; and specifically but without limitation, moneys that may become due and moneys that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

10.3 In the event any legal action or other proceeding is brought for the enforcement of this Agreement and/or the Contract Documents, or for damages, because of an alleged dispute, breach, default or misrepresentation in connection with any of the provisions thereof, the successful or prevailing party shall be entitled to recover reasonable attorneys' fees and other costs incurred in the action or proceeding, in addition to any other relief to which it may be entitled.

10.4 Any notice to be given hereunder shall be deemed given when sent by registered or certified mail, postage prepaid to the parties at their respective addresses stated below or at any other address when notice of such change of address has been given as provided in this Article 10.4.

[SIGNATURE PAGE FOLLOWS]

"OWNER":	"CONTRACTOR"
Jordan Valley Water Conservancy District 8215 South 1300 West West Jordan, Utah 84088	Name Address City, State Zip Utah License No. 0000
By: Alan E. Packard Its: General Manager/CEO	By: _____ Its: _____

EXHIBIT A

CONTRACTOR'S BID

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS,

That _____, as Contractor, and _____ as Surety, are held firmly bound unto the Jordan Valley Water Conservancy District hereinafter called "Owner," in the sum of $_____ for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has been awarded and is about to enter into the annexed Agreement with Owner to perform all work required under the Bidding Schedule(s) of the Owner's Contract Documents entitled Rosecrest Pipeline Capacity Upgrades

NOW THEREFORE, if Contractor shall perform all the requirements of the Agreement required to be performed on his part, at the times and in the manner specified therein, then this obligation shall be null and void, otherwise it shall remain in full force and effect.

PROVIDED, that any alterations in the work to be done or the materials to be furnished, or changes in the time of completion, which may be made pursuant to the terms of the Agreement, shall not in any way release Contractor or Surety thereunder, nor shall any extensions of the time granted under the provisions of the Agreement release either the Contractor or Surety, and notice of such alterations or extensions of the work, materials or time to complete made under the Agreement is hereby waived by Surety. This Bond is furnished in compliance and in accordance with 14-1-18, Utah Code Ann., as amended, and 63-56-38 Utah Code Ann., as amended.

SIGNED AND SEALED, this _____ day of _____, 20__.

_____ _____

By: _____ By: _____

Its: _____ Its: _____

(SEAL) (SEAL)

(SEAL AND NOTARIAL ACKNOWLEDGMENT OF SURETY)

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS,

That _____ as Contractor, and _____ as Surety, are held firmly bound unto the Jordan Valley Water Conservancy District hereinafter called "Owner," in the sum of $_____ for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has been awarded and is about to enter into the annexed Agreement with Owner to perform all work required under the Bidding Schedule(s) of the Owner's Contract Documents entitled, Rosecrest Pipeline Capacity Upgrades

NOW THEREFORE, if said Contractor, or subcontractor, fails to pay for any materials, equipment, or other supplies, or for rental of same, used in connection with the performance of work contracted to be done, or for amounts due under applicable State law for any work or labor thereon, said Surety will pay for the same in an amount not exceeding the sum specified above, and, in the event suit is brought upon this bond, a reasonable attorney's fee to be fixed by the court. This bond shall inure to the benefit of any persons, companies, or corporations entitled to file claims under applicable State law.

PROVIDED, that any alterations in the work to be done or the materials to be furnished, or changes in the time of completion, which may be made pursuant to the terms of the Agreement, shall not in any way release Contractor or Surety thereunder, nor shall any extensions of time granted under the provisions of said contract release either Contractor or the Surety, and notice of such alterations or extensions of the work, materials or time to complete made under the Agreement is hereby waived by Surety. This bond is furnished in compliance and in accordance with 14-1-18 and 19 Utah Code Ann., as amended, and 63-56-38 Utah Code Ann., as amended.

SIGNED AND SEALED, this _____ day of _____, 20___.

_____ _____

By: _____ By: _____

Its: _____ Its: _____

(SEAL) (SEAL)

(SEAL AND NOTARIAL ACKNOWLEDGMENT OF SURETY)

NOTICE OF AWARD

To: Contractor's Name and Address

Re: Rosecrest Pipeline Capacity Upgrades

You are hereby notified that the OWNER has accepted your bid for the above referenced project in the amount of $_____.

Furnish the required Contractor's Performance Bond, Payment Bond and Certificates of Insurance within ten calendar days from the date of this notice to you. An acknowledged copy of this Notice of Award, together with all future correspondence regarding this project, shall be sent to the District's Project Manager: Conor Tyson.

When the Agreement is provided, sign and return it within ten calendar days from receipt of the agreement.

Dated this ____ day of _____, 20___.

_____
Shane K Swensen, PE
Chief Engineer

ACCEPTANCE OF NOTICE

Receipt of the above Notice of Award is hereby acknowledged by:

____(Contractor's Name goes here - underlined)_____

This _____ day of _____, 20___.

Signature:_____

Printed Name:_____

Title: _____

NOTICE TO PROCEED

To:

Re: Rosecrest Pipeline Capacity Upgrades

You are hereby notified to commence work in accordance with the Agreement dated _____, on or before _____, and you are to complete the work within 825 days from the date of this Notice to Proceed.

An acknowledged copy of this Notice to Proceed should be returned to the Owner, Attention: Conor Tyson.

Dated this _____ day of _____.

_____
Travis P. Christensen, P.E.
Engineering Group Leader

ACCEPTANCE OF NOTICE

Receipt of the above Notice to Proceed is hereby acknowledged by:

____(Contractor's Name goes here - underlined)_____

This _____ day of _____, 20___.

Signature:_____

Printed Name:_____

Title: _____

JORDAN VALLEY WATER CONSERVANCY DISTRICT

PAYMENT APPLICATION AND CERTIFICATE No. ___ DATE: _____

SHEET _____ OF _____

PERIOD FROM _____ TO _____, 20___

PROJECT: Rosecrest Pipeline Capacity Upgrades

JVWCD PROJECT NO.: 4350

CONTRACTOR: _____

ADDRESS: _____

ENGINEER: _____

1. ORIGINAL CONTRACT PRICE:..... $_____

2. NET CHANGE ORDERS APPROVED TO DATE: ..... $_____
(Attach Summary Sheet)

3. REVISED CONTRACT AMOUNT: ..... $_____
(Sum of Lines 1 & 2)

4. TOTAL VALUE OF WORK COMPLETED TO DATE ... . $_____
(Attached Payment Breakdown)

5. PERCENT PROJECT COMPLETE: ..... _____%
(Divide Line 4 by 3 and multiply by 100)

6. LESS AMOUNT RETAINED (5%) ..... $_____

7. MATERIALS ON HAND..... $_____
(95% of Value, Listing Attached)

8. SUBTOTAL (Sum of Lines 4, Line 6 and Line 7)..... $_____

9. LESS PREVIOUS PAYMENTS ..... $_____

10. CURRENT PAYMENT DUE: ..... $_____
(Line 8 & 9)

JORDAN VALLEY WATER CONSERVANCY DISTRICT

Payment Application and Certificate No _____

SHEET _____ OF _____

CONTRACTOR'S Certification:

The undersigned CONTRACTOR certifies that: (1) all previous progress payments received from OWNER on account of work done under the Contract referred to herein have been applied to discharge in full all obligations of CONTRACTOR incurred in connection with work covered by prior Applications for Payment numbered 1 through _____ inclusive; and, (2) title to all materials and equipment incorporated in said Work or otherwise listed in or covered by this Application for Payment will pass to OWNER at time of payment free and clear of all liens, claims, security interests and encumbrances (except such as covered by bond acceptable to OWNER).

Dated: _____ CONTRACTOR: _____

By: _____

Engineer's Recommendation:

This Application (with accompanying documentation) meets the requirements of the Contract Documents and payment of the amount due this application is recommended.

ENGINEER

Dated _____ _____

Project Representative

Dated _____ _____

Project Manager

JORDAN VALLEY WATER CONSERVANCY DISTRICT

CHANGE ORDER

Change Order No. _____

Date: _____

Page ___ of ___

NAME OF PROJECT: Rosecrest Pipeline Capacity Upgrades

PROJECT NUMBER: 4350

CONTRACTOR: _____

CONTRACT DATE: _____

The following changes are hereby made to the CONTRACT DOCUMENTS:

1)

2)

3)

Total Change to CONTRACT PRICE: ..... $

Original CONTRACT PRICE: ..... $

Current CONTRACT PRICE adjusted by previous CHANGE ORDER(S) ..... $

The new CONTRACT PRICE including this CHANGE ORDER will be ..... $

The CONTRACT TIME will be increased by _____ calendar days.

The date for Substantial Completion will be _____, 20___.

The Contractor agrees to furnish all labor and materials and perform all work as necessary to complete the change order items for the price named herein, which includes all supervision and miscellaneous costs. This change order constitutes full and mutual accord and satisfaction for all time and all costs related to this change. By acceptance of this change order the Contractor agrees that the change order represents an equitable adjustment to the Contract, and further agrees to waive all right to file a claim arising out of or as a result of this change. This document will become a supplement to the Contract, and all provisions will apply hereto, upon approval by the Owner.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

CHANGE ORDER
(CONTINUED)

Change Order No. _____

Date: _____

Page ___ of ___

Recommended:

Engineer – Bowen Collins & Associates	Date

Accepted:

Contractor -	Date

Approved:

Owner - Jordan Valley Water Conservancy District	Date

JORDAN VALLEY WATER CONSERVANCY DISTRICT

CONTRACTOR'S CERTIFICATE
OF
SUBSTANTIAL COMPLETION

OWNER:	ENGINEER:
Jordan Valley Water Con. District 8215 South 1300 West West Jordan, Utah 84088 801-565-4300	Bowen Collins & Associates 154 East 14075 South Draper, Utah 84020 801-495-2224

PROJECT: Rosecrest Pipeline Capacity Upgrades

ATTENTION: _____

FROM: _____
Firm or Corporation

This is to certify that I,_____ am an authorized official of _____ working in the capacity of_____ _____and have been properly authorized by said firm or corporation to sign the following statements pertaining to the subject contract:

I know of my own personal knowledge, and do hereby certify, that the work of the contract described above has been substantially performed and all materials used and installed to date are in accordance with, and in conformity to, the contract drawings and specifications. A list of all incomplete work is attached.

The Contractor hereby releases the Owner and its agents from all claims of and liability to the Contractor for anything done or furnished for or relating to the work, as further provided in Article 14.08B of the General Conditions, except demands against the Owner for the remainder of progress payments retained to date, and unresolved written claims prior to this date.

The contract work is now substantially complete, ready for its intended use, and ready for your inspection. You are requested to issue a Certificate of Substantial Completion.

SIGNATURE: _____

DATE: _____

JORDAN VALLEY WATER CONSERVANCY DISTRICT

CONTRACTOR'S CERTIFICATE
OF
FINAL COMPLETION

OWNER:	ENGINEER:
Jordan Valley Water Con. District 8215 South 1300 West West Jordan, Utah 84088 801-565-4300	Bowen Collins & Associates 154 East 14075 South Draper, Utah 84020 801-495-2224

PROJECT: Rosecrest Pipeline Capacity Upgrades

ATTENTION: Project Representative: _____

FROM: _____
Firm or Corporation

This is to certify that I, _____ am an authorized official of _____ working in the capacity of_____ _____and have been properly authorized by said firm or corporation to sign the following statements pertaining to the subject contract:

I know of my own personal knowledge, and do hereby certify, that the work of the contract described above has been performed and all materials used and installed to date are in accordance with, and in conformity to, the contract drawings and specifications.

The Contract work is now complete in all parts and requirements, excepting the attached list of minor deficiencies and the reasons for each being incomplete to date, for which exemption from final payment requirements is requested in conformance to Article 14.09A of the General Conditions of our Contract (if no exemptions requested, write "none") _____. The work is now ready for your final inspection. The following items required from the Contractor prior to application for final payment (such as O & M Manuals, guarantees, record drawings, etc.) are submitted herewith, if any:

_____

_____

JORDAN VALLEY WATER CONSERVANCY DISTRICT

I understand that neither the issuance by the Engineer of a Notice of Completion, nor the acceptance thereof by the Owner, shall operate as a bar or claim against the Contractor under the terms of the guarantee provisions of the Contract Documents.

SIGNATURE: _____

DATE: _____

JORDAN VALLEY WATER CONSERVANCY DISTRICT

CONSENT OF SURETY FOR FINAL PAYMENT

PROJECT NAME: Rosecrest Pipeline Capacity Upgrades

LOCATION: _____

TYPE OF CONTRACT: _____

AMOUNT OF CONTRACT: _____

In accordance with the provisions of the above-named contract between the Owner and the Contractor, the following named surety:

_____

_____

_____

on the Payment Bond of the following named Contractor:

_____

_____

_____

hereby approves of final payment to the Contractor, and further agrees that said final payment to the Contractor shall not relieve the Surety Company named herein of any of its obligations to the following named Owner (as set forth in said Surety company's bond):

_____

_____

IN WITNESS WHEREOF, the Surety Company has hereunto set its hand and seal this _____ day of _____, 20___.

_____
(Name of Surety Company)

_____
(Signature of Authorized Representative)

_____
(Name of Authorized Representatives)

_____
(Title)

JORDAN VALLEY WATER CONSERVANCY DISTRICT

AFFIDAVIT OF PAYMENT

To All Whom It May Concern:

WHEREAS, the undersigned has been employed by the Jordan Valley Water Conservancy District to furnish labor and materials under a contract dated _____for the project entitled Rosecrest Pipeline Capacity Upgrades, in the County of Salt Lake, State of Utah, of which Jordan Valley Water Conservancy District is the Owner.

NOW, THEREFORE, this _____ day of _____, 20__, the undersigned, as the Contractor for the above-named Contract pursuant to the Conditions of the Contract hereby certifies that, except as listed below, he has paid in full or has otherwise satisfied all obligations for all materials and equipment furnished, for all work, labor, and services performed, and for all known indebtedness and claims against the Contractor for damages arising in any manner in connection with the performance of the Contract referenced above for which the Owner or his property might in any way be held responsible.

EXCEPTIONS: (If none, write "None". If required by the Owner, the Contractor shall furnish bond satisfactory to the Owner for each Exception.)

_____

Contractor (Name of sole ownership, corporation or partnership)

(affix corporate seal here)

_____

(Signature of Authorized Representative)

Title: _____

GENERAL CONDITIONS

ARTICLE 1 - DEFINITIONS

Wherever used in these General Conditions or in the other Contract Documents the following terms have the meanings indicated:

Addenda - Written or graphic instruments issued prior to the opening of Bids which make additions, deletions, or revisions to the Contract Documents.

Agreement - The written contract between the OWNER and the CONTRACTOR for the performance of the WORK pursuant to the Contract Documents. Documents incorporated into the contract by reference become part of the contract and of the Agreement.

Application for Payment - The form furnished by the ENGINEER and completed by the CONTRACTOR to request progress or final payment including supporting documentation to substantiate the amounts for which payment is requested.

Bonds - Performance, and Payment Bonds and other instruments which protect against loss due to inability or refusal of the CONTRACTOR to perform pursuant to the Contract Documents.

Change Order - A document recommended by the ENGINEER, which is signed by the CONTRACTOR and the OWNER and authorizes an addition, deletion, or revision in the WORK, or an adjustment in the Contract Price or the Contract Time, issued on or after the Effective Date of the Agreement.

Contract Documents - Information and Instructions, forms (including the Schedule of Prices and all required certificates and affidavits), Agreement, Performance Bond, Payment Bond, General Conditions, Supplemental General Conditions, Technical Specifications, Drawings and all Addenda and Change Orders executed pursuant to the provisions of the Contract Documents.

Contract Price - The total monies payable by the OWNER to the CONTRACTOR under the terms and conditions of the Contract Documents.

Contract Time - The number of successive Days stated in the Contract Documents for the completion of the WORK. The Contract Time begins to run on the date specified in the Notice to Proceed.

CONTRACTOR - The person, firm, or corporation with whom the OWNER has executed the Agreement.

Cost Proposal - The offer or proposal of the pipeline installation subcontractor to the CONTRACTOR to provide the work required under these Contract Documents.

Day - A calendar day of 24 hours measured from midnight to the next midnight.

Defective Work - Work that: is unsatisfactory, faulty, or deficient; does not conform to the Contract Documents; does not meet the requirements of any inspection, reference standard, test, or approval referred to in the Contract Documents; has been damaged prior to the ENGINEERS's recommendation of final payment.

Drawings - The drawings, plans, maps, profiles, diagrams, and other graphic representations which show the character, location, nature, extent, and scope of the WORK.

Effective date of the Agreement - The date indicated in the Agreement on which it was executed, but if no such date is indicated it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

ENGINEER - The person, firm, or corporation named as such in the Contract Documents.

Field Order - A written order issued by the ENGINEER which may or may not involve a change in the WORK.

Laws and Regulations; Laws or Regulations - Laws, rules, regulations, ordinances, codes, and/or orders promulgated by a lawfully constituted body authorized to issue such Laws and Regulations.

Notice of Award - The OWNER's written notice to the apparent successful Bidder stating that upon compliance with the conditions precedent enumerated therein by the apparent successful Bidder within the time specified, the OWNER will enter into the Agreement.

Notice to Proceed - The OWNER's written notice to the CONTRACTOR authorizing the CONTRACTOR to proceed with the work and establishing the date of commencement of the Contract Time.

OWNER - The Jordan Valley Water Conservancy District.

Partial Utilization - Placing a portion of the WORK in service for the purpose for which it is intended (or a related purpose) before reaching Substantial Completion of the WORK.

Project - A unit of total construction of which the WORK to be provided under the Contract Documents, may be the whole, or a part thereof.

Project Representative - The authorized representative of the ENGINEER who is assigned to the site or any part thereof.

Proposer - Any person, firm or corporation submitting a proposal for the work.

Schedule of Prices - The offer or proposal of the CONTRACTOR setting forth the price or prices for the work to be performed.

Shop Drawings - All drawings, diagrams, illustrations, schedules and other data which are specifically prepared by or for the CONTRACTOR to illustrate some portion of WORK and all illustrations, brochures, standard schedules, performance charts, instruction, and diagrams to illustrate material or equipment for some portion of the WORK.

Specifications - (Same definition as for Technical Specifications hereinafter).

Subcontractor - An individual, firm, or corporation having a direct contract with the CONTRACTOR or with any other Subcontractor for the performance of a part of the WORK at the site.

Substantial Completion - That state of construction when the WORK has progressed to the point where, in the opinion of the ENGINEER as evidenced by the Certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the WORK can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to any work refer to substantial completion thereof.

Supplementary General Conditions - The part of the Contract Documents which make additions, deletions, or revisions to these General Conditions.

Supplier - A manufacturer, fabricator, supplier, distributor, materialman, or vendor.

Technical Data - The factual information contained in reports describing physical conditions, including exploration method, plans, logs, laboratory test methods and factual data. Technical Data does not include conclusions, interpretations, interpolations, extrapolations or opinions contained in reports or reached by the CONTRACTOR.

Technical Specifications - Those portions of the Contact Documents consisting of the written technical descriptions of products and execution of the WORK.

Underground Utilities - All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments and any encasements containing such facilities which have been installed under ground to furnish any of the following services or

materials: water, sewage and drainage removal, electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, traffic, or other control systems.

WORK - The entire construction required to be furnished under the Contract Documents. WORK is the result of performing services, furnishing labor and furnishing and incorporating materials and equipment into the construction, all as required by the Contract Documents.

GENERAL CONDITIONS

ARTICLE 2 - PRELIMINARY MATTERS

2.01 DELIVERY OF BONDS/INSURANCE CERTIFICATES

A. The CONTRACTOR shall deliver to the OWNER the Agreement, Bonds, Insurance Policies and Certificates required by the Contract Documents within ten (10) days after receiving the Notice of Award from the OWNER.

2.02 COPIES OF DOCUMENTS

A. The OWNER shall furnish the CONTRACTOR 5 copies of the Contract Documents, together with 5 sets of full-scale Drawings. Additional quantities of the Contract Documents will be furnished at reproduction cost.

2.03 STARTING THE PROJECT

A. The CONTRACTOR shall begin construction of the WORK within 10 days after the commencement date stated in the Notice to Proceed, but shall not commence construction prior to the commencement date.

2.04 BEFORE STARTING CONSTRUCTION

A. Before undertaking each part of the WORK, the CONTRACTOR shall carefully study and compare the Contract Documents to check and verify pertinent figures and dimensions shown thereon with all applicable field measurements. The CONTRACTOR shall promptly report in writing to the ENGINEER any conflict, error, or discrepancy which the CONTRACTOR may discover and shall obtain a written interpretation or clarification from the ENGINEER before proceeding with any work affected thereby.

B. The CONTRACTOR shall submit to the ENGINEER for review those documents called for in each section of the Technical Specifications.

2.05 PRECONSTRUCTION CONFERENCE

A. The CONTRACTOR shall attend a preconstruction conference with the OWNER, the ENGINEER and others as appropriate to discuss the construction of the WORK in accordance with the Contract Documents.

2.06 FINALIZING SCHEDULES

A. At least 7 days before the CONTRACTOR's submittal of its first Application for Payment, the CONTRACTOR, the ENGINEER, and others as appropriate will meet to finalize the schedules submitted in accordance with the Technical Specifications.

GENERAL CONDITIONS

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 INTENT

A. The Contract Documents comprise the entire agreement between OWNER and CONTRACTOR concerning the WORK. The Contract Documents are complementary, what is called for by one is as binding as if called for by all. The Contract Documents will be construed in accordance with the law of the place of the Project.

B. It is the intent of the Contract Documents to describe the WORK, functionally complete, to be constructed in accordance with the Contract Documents. All work, materials, or equipment that may be reasonably inferred from the Contract Documents as being required to produce the completed work shall be supplied 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. Reference to standard specifications, manuals, or codes or any technical society, organization, or association, or to the Laws or Regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids, except as may be otherwise specifically stated. However, no provision of any referenced standard specification, manual, or code (whether or not specifically incorporated by reference in the Contract Documents) shall be effective to change the duties and responsibilities of the OWNER, the CONTRACTOR, or the ENGINEER or any of their consultants, agents, or employees from those set forth in the Contract Documents.

C. If, during the performance of the WORK, the CONTRACTOR finds a conflict, error or discrepancy in the Contract Documents, the CONTRACTOR shall immediately report it to the ENGINEER in writing and before proceeding with the work affected thereby. The ENGINEER shall then make a written interpretation, clarification, or correction from the ENGINEER.

3.02 ORDER OF PRECEDENCE OF CONTRACT DOCUMENTS

A. In resolving conflicts resulting from conflicts, errors, or discrepancies in any of the Contract Documents, the order of precedence shall be as follows:

1. Change Orders
2. Agreement
3. Addenda
4. Contractor's Bid (Bid Form)
5. Supplemental General Conditions
6. Notice Inviting Bids
7. Instructions to Bidders
8. General Conditions
9. Technical Specifications
10. Referenced Standard Specifications
11. Drawings

B. With reference to the Drawings the order of precedence is as follows:

1. Figures govern over scaled dimensions
2. Detail drawings govern over general drawings
3. Addenda/change order drawings govern over general drawings
4. Contract Drawings govern over standard drawings

3.03 AMENDING AND SUPPLEMENTING CONTRACT DOCUMENTS

A. The Contract Documents may be amended by a Change Order (pursuant to Article 10) to provide for additions, deletions or revisions in the WORK or to modify terms and conditions.

3.04 REUSE OF DOCUMENTS

A. Neither the CONTRACTOR, Subcontractor, Supplier, nor any other person or organization performing any of the WORK under a contract with the OWNER shall have or acquire any title to or ownership rights in any of the Drawings, Technical Specifications, or other documents used on the WORK, and they shall not reuse any of them on the extensions of the Project or any other project without written consent.

GENERAL CONDITIONS

ARTICLE 4 - AVAILABILITY OF LANDS; PHYSICAL CONDITIONS: REFERENCE POINTS

4.01 AVAILABILITY OF LANDS

A. The OWNER shall furnish the lands, rights-of-way and easements upon which the WORK is to be performed and for access thereto, together with other lands designated for the use of the CONTRACTOR in the Contract Documents. Easements for permanent structures or permanent changes in existing major facilities will be obtained and paid for by the OWNER, unless otherwise provided in the Contract Documents. Nothing contained in the Contract Documents shall be interpreted as giving the CONTRACTOR exclusive occupancy of the lands or rights-of-way provided. The CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment. The CONTRACTOR shall not enter upon nor use any property not under the control of the OWNER until a written temporary construction easement agreement has been executed by the CONTRACTOR and the property owner, and a copy of the easement furnished to the ENGINEER prior to its use. Neither the OWNER nor the ENGINEER shall be liable for any claims or damages resulting from the CONTRACTOR's unauthorized trespass or use of any properties.

4.02 PHYSICAL CONDITIONS - SUBSURFACE AND EXISTING STRUCTURES

A. Explorations and Reports: The paragraph entitled "Physical Conditions" of the Supplementary General Conditions identifies exploration reports and subsurface conditions tests at the site that have been utilized by the ENGINEER in the preparation of the Contract Documents. The CONTRACTOR may rely upon the accuracy of the Technical Data contained in these reports. The CONTRACTOR is responsible for the interpretation, extrapolation or interpolation of all technical as well as nontechnical data and its reliance on the completeness, opinions and interpretation of the reports.

B. Existing Structures: The paragraph entitled "Physical Conditions" of the Supplementary General Conditions identifies the drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Utilities referred to in Paragraph 4.04 herein) which are at or contiguous to the site that have been utilized by the ENGINEER in the preparation of the Contract Documents. The CONTRACTOR is responsible for the interpretation, extrapolation or interpolation of all technical as well as nontechnical data and its reliance on the completeness, opinions and interpretation of the reports.

4.03 DIFFERING SITE CONDITIONS

A. The CONTRACTOR shall notify the ENGINEER upon encountering any of the following unforeseen conditions, hereinafter called "differing site conditions," during the prosecution of the WORK. The CONTRACTOR's notice to the ENGINEER shall be in writing and delivered before the differing site conditions are disturbed, but in no event later than 14 days after their discovery.

1. Subsurface or latent physical conditions at the site of the WORK differing materially from those indicated, described, or delineated in the Contract Documents including those reports and documents discussed in Paragraph 4.02; and

2. Physical conditions at the site of the WORK of an unusual nature differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents including those reports and documents discussed in Paragraph 4.02.

B. The ENGINEER will review the alleged differing site conditions, determine the necessity of obtaining additional explorations or tests with respect to verifying their existence and extent and advise the OWNER in writing of the ENGINEER's findings and conclusions.

C. If the OWNER concludes that because of newly discovered conditions a change in the Contract Documents is required, a Change Order will be issued as provided in Article 10 to reflect and document the consequences of the differing site conditions.

D. In each such case, an increase or decrease in the Contract Price or an extension or shortening of the Contract Time, or any combination thereof, will be allowable to the extent that they are attributable to the differing site conditions. If the OWNER and the CONTRACTOR are unable to agree as to the amount or length of the Change Order, a claim may be made as provided in Articles 11 and 12.

E. The CONTRACTOR's failure to give written notice of differing site conditions within 14 days of their discovery and before they are disturbed shall constitute a waiver of all claims in connection therewith, whether direct or consequential in nature.

4.04 PHYSICAL CONDITIONS - UNDERGROUND UTILITIES

A. Shown or Indicated: The information and data shown or indicated in the Contract Documents with respect to existing Underground Utilities at or contiguous to the site are based on information and data furnished to the OWNER or the ENGINEER by the owners of Underground Utilities or by others. Unless it is expressly provided in the Supplementary General Conditions and/or the Section entitled "Protection and Restoration of Existing Facilities" of the Technical Specifications, the OWNER and the ENGINEER shall not be responsible for the accuracy or completeness of any Underground Utilities information or data. The CONTRACTOR's responsibility relating to underground utilities are: review and check all information and data, locate all Underground Utilities shown or indicated in the Contract Documents, coordinate the WORK with the owners of Underground Utilities during construction, the safeguard and protect the of Underground Utilities, and repair any damage to Underground Utilities resulting from the WORK. The cost of all these activities will be considered as having been included in the Contact Price.

B. Not Shown or Indicated: If an Underground Utility not shown or indicated in the Contract Documents is uncovered or revealed at or contiguous to the site and which the CONTRACTOR could not reasonably have been expected to be aware of, the CONTRACTOR shall give written notice to the OWNER of that utility and the ENGINEER, specifying the location of the utility in question.

4.05 REFERENCE POINTS

A. The ENGINEER will provide one bench mark, near or on the site of the WORK, and will provide two points near or on the site to establish a base line for use by the ENGINEER for alignment control. Unless otherwise specified in the Technical Specifications, the CONTRACTOR shall furnish all other lines, grades, and bench marks required for proper execution of the WORK.

B. The CONTRACTOR shall preserve all bench marks, stakes, and other survey marks. In case of their removal or destruction by its own employees or by its subcontractor's employees, the CONTRACTOR shall be responsible for the accurate replacement of reference points by professionally qualified personnel at no additional cost to the OWNER.

GENERAL CONDITIONS

ARTICLE 5 - BONDS AND INSURANCE

5.01 PERFORMANCE AND OTHER BONDS

A. The CONTRACTOR shall furnish Performance and Payment Bonds, each in the amount set forth in the Supplementary General Conditions as security for the faithful performance and payment of all the CONTRACTOR's obligations under the Contract Documents. All insurance companies, sureties, and bond companies shall have an AM Best rating of A- or better, with a Financial Size Category of XII or better. Sureties shall also be listed on the Department of the Treasury's Circular 570, with an acceptable underwriting limitation limit. The Performance Bond shall remain in effect at least until one year after the date of Notice of Completion, except as otherwise provided by Law or Regulation or by the Contract Documents. After the ENGINEER issues the Notice of Completion, the amount of the Performance Bond may be reduced to 10 percent of the Contract Price, or $1,000, whichever is greater. The CONTRACTOR shall also furnish such other Bonds as are required by the Supplementary General Conditions.

B. If the surety on any Bond furnished by the CONTRACTOR is declared a bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the WORK is located, the CONTRACTOR shall within 7 days after written approval by the OWNER of a substitute Bond and Surety substitute the approved Bond and Surety.

5.02 INSURANCE

A. The CONTRACTOR shall purchase and maintain the insurance required under this paragraph. All insurance companies, sureties, and bond companies shall have an AM Best rating of A- or better, with a Financial Size Category of XII or better. Sureties shall also be listed on the Department of the Treasury's Circular 570, with an acceptable underwriting limitation limit. This insurance shall include the specific coverages set out herein and be written for not less than the limits of liability and coverages provided in the Supplementary General Conditions, or required by law, whichever is greater. The CONTRACTOR's liabilities under the Agreement shall not be deemed limited in any way to the insurance coverage required.

B. The CONTRACTOR shall furnish the OWNER and ENGINEER with certificates indicating the type, amount, class of operations covered, effective dates and expiration dates of all policies. All insurance policies purchased and maintained (or the certificates or other evidence thereof) shall contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 30 days' prior written

notice has been given to the OWNER by certified mail. All insurance shall remain in effect until the ENGINEER issues the Notice of Completion and at all times thereafter when the CONTRACTOR may be correcting, removing, or replacing defective work in accordance with Paragraph 13.06 or completing punch list items required by the Notice of Completion. In addition, the insurance required herein (except for Worker's Compensation and Employer's Liability) shall name the OWNER, the ENGINEER, and their officers, agents, and employees as "additional insured" under the policies.

1. Workers' Compensation and Employer's Liability: This insurance shall protect the CONTRACTOR against all claims under applicable state workers' compensation laws. The CONTRACTOR shall also be protected against claims for injury, disease, or death of employees which, for any reason, may not fall within the provisions of a workers' compensation law. This policy shall include an "all states" endorsement. The CONTRACTOR shall require each subcontractor similarly to provide Workers' Compensation Insurance for all of the latter's employees to be engaged in the WORK unless its employees are covered by the protection afforded by the CONTRACTOR's Workers' Compensation Insurance. In the event a class of employees is not protected under the Workers' Compensation Statute, the CONTRACTOR or Subcontractor, as the case may be, shall provide adequate employer's liability insurance for the protection of its employees not protected under the statute.

2. Comprehensive General Liability: This insurance shall be written in comprehensive form and shall protect the CONTRACTOR against all claims arising from injuries to persons other than its employees and damage to property of the OWNER or others arising out of any act or omission of the CONTRACTOR or its agents, employees or subcontractors. The policy shall include the following endorsements: (1) Protective Liability endorsement to insure the contractual liability assumed by the CONTRACTOR under the indemnification provisions in these General Conditions; (2) Broad Form Property Damage endorsement; (3) Personal Injury endorsement to cover personal injury liability for intangible harm. The Comprehensive General Liability coverage shall contain no exclusion relative to blasting, explosion, collapse of building, or damage to underground structures.

3. Comprehensive Automobile Liability: This insurance shall be written in comprehensive form. The policy shall protect the CONTRACTOR against all claims for injuries to employees, members of the public and

damage to property of others arising from the use of CONTRACTOR's motor vehicles, whether they are owned, non-owned, or hired, and whether used or operated on or off the site. The motor vehicle insurance required under this paragraph shall include: (a) motor vehicle liability coverage; (b) personal injury protection coverage and benefits; and (c) uninsured motor vehicle coverage.

4. Subcontractor's Insurance: The CONTRACTOR shall require each of its subcontractors to procure and to maintain Comprehensive General Liability Insurance and Comprehensive Automobile Liability Insurance of the type and in the amounts specified in the Supplementary General Conditions or insure the activities of its subcontractors in the CONTRACTOR's own policy, in like amount.

5. Builder's Risk: This insurance shall be of the "all risk" type, shall be written in completed value form, and shall protect the CONTRACTOR, the OWNER, and the ENGINEER against damage to buildings, structures, materials and equipment. The amount of this insurance shall not be less than the insurable value of the WORK at completion. Builder's risk insurance shall provide for losses to be payable to the CONTRACTOR, the OWNER, and the ENGINEER as their interests may appear. The policy shall contain a provision that in the event of payment for any loss under the coverage provided, the insurance company shall have no rights of recovery against the CONTRACTOR, the OWNER, and the ENGINEER. The Builder's Risk policy shall insure against all risks of direct physical loss or damage to property from any external cause including flood and earthquake. Allowable exclusions, if any, shall be as specified in the Supplementary General Conditions.

GENERAL CONDITIONS

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

6.01 SUPERVISION AND SUPERINTENDENCE

A. The CONTRACTOR shall supervise and direct the WORK competently and efficiently, devoting the attention and applying the skills and expertise necessary to perform the WORK in accordance with the Contract Documents. The CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction and safety precautions and programs incidental thereto. The CONTRACTOR shall be responsible to see that the finished WORK complies accurately with the Contract Documents.

B. The CONTRACTOR shall employ the Superintendent named in "Information Required of Bidder" on the work site at all times during the progress of the WORK. The superintendent shall not be replaced without the OWNER's written consent. The superintendent will be the CONTRACTOR's representative at the site and shall have authority to act on behalf of the CONTRACTOR. All communications given to the superintendent shall be as binding as if given to the CONTRACTOR. The CONTRACTOR shall issue all its communications to the OWNER through the ENGINEER.

C. The CONTRACTOR's superintendent shall be present at the site of the WORK at all times while work is in progress. Failure to observe this requirement shall be considered suspension of the WORK by the CONTRACTOR until the superintendent is again present at the site.

6.02 LABOR, MATERIALS, AND EQUIPMENT

A. The CONTRACTOR shall provide skilled, competent and suitably qualified personnel to survey and lay out the WORK and perform construction as required by the Contract Documents. When required in writing by the OWNER or ENGINEER, the CONTRACTOR or any subcontractor shall discharge any person who is, in the opinion of the OWNER or ENGINEER, incompetent, disorderly, or otherwise unsatisfactory and shall not again employ the discharged person on the WORK without the consent of the OWNER or ENGINEER. The CONTRACTOR shall at all times maintain good discipline and order at the site.

B. Except in connection with the safety or protection of persons the WORK, or property at the site or adjacent thereto, all work at the site shall be performed during regular working hours, and the CONTRACTOR will not permit overtime work or the performance of work on Saturday, Sunday or any legal holiday without the OWNER's written consent given after prior written notice

to the ENGINEER. Except as otherwise provided in this Paragraph, the CONTRACTOR shall receive no additional compensation for overtime work, i.e., work in excess of 8 hours in any one calendar day or 40 hours in any one calendar week, even though such overtime work may be required under emergency conditions and may be ordered by the ENGINEER in writing. Additional compensation will be paid the CONTRACTOR for overtime work in the event extra work is ordered by the ENGINEER and the Change Order specifically authorizes the use of overtime work, but only to the extent that the CONTRACTOR pays overtime wages on a regular basis being paid by for overtime work of a similar nature in the same locality.

C. All costs of inspection and testing performed during overtime work approved solely for the convenience of the CONTRACTOR shall be borne by the CONTRACTOR. The OWNER shall have the authority to deduct the costs of all inspection and testing from any partial payments otherwise due to the CONTRACTOR.

D. Unless otherwise specified in the Contract Documents, the CONTRACTOR shall furnish, erect, maintain and remove the construction plant, and temporary works and assume full responsibility for all materials, equipment, labor, transportation, construction equipment, machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities and all other facilities and incidentals necessary for the furnishing, performance testing, start-up and completion of the WORK.

E. All materials and equipment incorporated into the WORK shall be of new and good quality, except as otherwise provided in the Contract Documents. If required by the ENGINEER, the CONTRACTOR shall furnish satisfactory evidence (including reports of required tests) as to the kind and quality of materials and equipment. The CONTRACTOR shall apply, install, connect, erect, use, clean, and condition all material and equipment in accordance with the instructions of the manufacturer and Supplier except as otherwise provided in the Contract Documents.

6.03 ADJUSTING PROGRESS SCHEDULE

A. The CONTRACTOR shall submit any adjustments in the progress schedule to the ENGINEER for acceptance in accordance with the provisions for "Contractor Submittals" in the Technical Specifications.

6.04 SUBSTITUTES OR "OR-EQUAL" ITEMS

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or “or-equal” item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to ENGINEER for review under the circumstances described below:

1. “Or-Equal” Items: If in ENGINEER’s sole discretion an item of material or equipment proposed by CONTRACTOR is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by ENGINEER as an “or-equal” item, in which case review and approval of the proposed item may, in ENGINEER’s sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this paragraph 6.04.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment ENGINEER determines that: (i) it is a least equal in quality, durability, appearance, strength, and design characteristics; (ii) it will reliably perform at least equally well the function imposed by the design concept of the completed Project as a functioning whole, and;

b. CONTRACTOR certifies that: (i) there is no increase in cost to the OWNER; and (ii) it will conform substantially, even with deviations, to the detailed requirements of the item named in the Contract Document.

2. Substitute Items

a. If in ENGINEER’s sole discretion an item of material or equipment proposed by CONTRACTOR does not qualify as an “or-equal” item under paragraph 6.04.A.1, it will be considered a proposed substitute item.

b. CONTRACTOR shall submit sufficient information as provided below to allow ENGINEER to determine that the item of material or

equipment proposed is essentially equivalent to that named and an acceptable substitute therefore. Requests for review of proposed substitute items of material or equipment will not be accepted by ENGINEER from anyone other than CONTRACTOR.

c. The procedure for review by ENGINEER will be as set forth in paragraph 6.04.A.2.d, as supplemented in the Technical Specifications and as ENGINEER may decide is appropriate under the circumstances.

d. CONTRACTOR shall first make written application to ENGINEER for review of a proposed substitute item of material or equipment that CONTRACTOR seeks to furnish or use. The application shall certify that the proposed substitute item will perform adequately the functions and achieve the results called for by the general design, be similar in substance to that specified, and be suited to the same use as that specified. The application will state the extent, if any, to which the use of the proposed substitute item will prejudice CONTRACTOR's achievement of Substantial Completion on time, whether or not use of the proposed substitute item will require a change in any of the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) to adapt the design to the proposed substitute item, and whether or not incorporation or use of the substitute item is subject to payment of any license fee or royalty. All variations of the proposed substitute item from that specified will be identified in the application, and available engineering, sales, maintenance, repair, and replacement services will be indicated. The application will also contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change, all of which will be considered by ENGINEER in evaluating the proposed substitute item. ENGINEER may require CONTRACTOR to furnish additional data about the proposed substitute item.

B. Substitute Construction Methods or Procedures: If a specific means, method, technique, sequence, or procedure of construction is shown or indicated in and expressly required by the Contract Documents, CONTRACTOR may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by ENGINEER. CONTRACTOR shall submit sufficient information to allow ENGINEER, in

ENGINEER's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The procedure for review by ENGINEER will be similar to that provided in subparagraph 6.04.A.2.

C. Engineer's Evaluation: ENGINEER will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to paragraphs 6.04.A and 6.04.B. ENGINEER will be the sole judge of acceptability. No "or-equal" or substitute will be ordered, installed or utilized until ENGINEER's review is complete, which will be evidenced by either a Change Order for a substitute or an approved Shop Drawing for an "or equal." ENGINEER will advise CONTRACTOR in writing of any negative determination.

D. Special Guarantee: OWNER may require CONTRACTOR to furnish at CONTRACTOR's expense a special performance guarantee or other surety with respect to any substitute.

E. ENGINEER's Cost Reimbursement: ENGINEER will record time required by ENGINEER and ENGINEER's Consultants in evaluating substitute proposed or submitted by CONTRACTOR pursuant to paragraphs 6.04.A.2 and 6.04.B and in making changes in the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) occasioned thereby. Whether or not ENGINEER approves a substitute item so proposed or submitted by CONTRACTOR, CONTRACTOR shall reimburse OWNER for the charges of ENGINEER and ENGINEER's Consultants for evaluation each such proposed substitute.

F. CONTRACTOR's EXPENSE: CONTRACTOR shall provide all data in support of any proposed substitute or "or-equal" at CONTRACTOR's expense.

6.05 CONCERNING SUBCONTRACTORS, SUPPLIERS, AND OTHERS

A. The CONTRACTOR shall be responsible to the OWNER and the ENGINEER for the acts and omissions of its subcontractors and their employees to the same extent as the CONTRACTOR is responsible for the acts and omissions of its own employees. Nothing contained in this paragraph shall create any contractual relationship between any subcontractor and the OWNER or the ENGINEER nor relieve the CONTRACTOR of any liability or obligation under the Agreement.

6.06 PERMITS

A. Unless otherwise provided in the Supplementary General Conditions, the CONTRACTOR shall obtain and pay for all construction permits and licenses from the agencies having jurisdiction, including furnishing the insurance and bonds required by such agencies. The costs incurred by the CONTRACTOR in compliance with this paragraph shall not be made the basis for claims for additional compensation. The OWNER shall assist the CONTRACTOR, when necessary, in obtaining such permits and licenses. The CONTRACTOR shall pay all governmental charges and inspection fees necessary for the prosecution of the WORK, which are applicable at the time of opening of Bids, including all utility connection charges for utilities required by the WORK.

B. The CONTRACTOR shall pay all license fees and royalties and assume all costs when any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others when issued in the construction of the WORK or incorporated into the WORK. If a particular invention, design, process, product, or device is specified in the Contract Documents for incorporation into or use in the construction of the WORK and if to the actual knowledge of the OWNER or the ENGINEER its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of these rights shall be disclosed by the OWNER in the Contract Documents. The CONTRACTOR shall indemnify, defend and hold harmless the OWNER and the ENGINEER and anyone directly or indirectly employed by either of them from and against all claims, damages, losses, and expenses (including attorneys' fees and court costs) arising out of any infringement of patent rights or copyrights incident to the use in the performance of the WORK or resulting from the incorporation in the WORK of any invention, design, process, product, or device not specified in the Contract Documents.

6.07 LAWS AND REGULATIONS

A. The CONTRACTOR shall observe and comply with all federal, state, and local laws, ordinances, codes, orders, and regulations which in any manner affect those engaged or employed on the WORK, the materials used in the WORK, or the conduct of the WORK. If any discrepancy or inconsistency should be discovered in the Contract Documents in relation to any law, ordinance, code, order, or regulations, the CONTRACTOR shall report the same in writing to the ENGINEER. The CONTRACTOR shall indemnify, defend and hold harmless the OWNER, the ENGINEER and their officers, agents, and employees against all claims and from violation of any law, ordinance, code, order, or regulation, whether by CONTRACTOR or by its employees or subcontractors. Any particular law or regulation specified or

referred to elsewhere in the Contract Documents shall not in any way limit the obligation of the CONTRACTOR to comply with all other provisions of federal, state, and local laws and regulations. Where an individual State act on occupational safety and health standards has been approved by Federal authority, then the provision of said State act shall control.

6.08 EQUAL OPPORTUNITY

A. The Contractor agrees to abide by: the provisions of Title VII of the Civil Rights Act of 1964 (42USC § § 2000e et seq.), which prohibits discrimination against any employee or applicant for employment on the basis of race, religion, color, or national origin; Executive Order No. 11246, as amended, which prohibits discrimination on the basis of sex; 45 CFR 90, which prohibits discrimination on the basis of age; Section 504 of the Rehabilitation Act of 1973, (42 USC § 794), which prohibits discrimination on the basis of handicap; Utah Executive Order dated June 30, 1989, which prohibits sexual harassment in the workplace; and the Americans with Disabilities Act (42 USC § § 12111 et seq.), which prohibits discrimination against qualified employees and applicants with a disability.

6.09 TAXES

A. The CONTRACTOR shall pay all sales, consumer, use, and other similar taxes required to be paid by the CONTRACTOR in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the WORK.

6.10 USE OF PREMISES

A. The CONTRACTOR shall confine construction equipment, stored materials and equipment, and other operations of workers to (1) the Project site, (2) the land and areas identified for the CONTRACTOR's use in the Contract Documents, and (3) other lands whose use is acquired by Laws and Regulations, rights-of-way, permits, and easements. The CONTRACTOR shall be fully responsible to the owner and occupant of such lands for any damage to the lands or areas contiguous thereto, resulting from the performance of the WORK or otherwise. Should any claim be made against the OWNER or the ENGINEER by owner or occupant of lands because of the performance of the WORK, the CONTRACTOR shall promptly settle the claim by agreement, or resolve the claim through litigation. The CONTRACTOR shall, to the fullest extent permitted by Laws and Regulations, indemnify, defend, and hold the OWNER and the ENGINEER harmless from and against all claims, damages, losses, and expenses (including, but not limited to, fees of engineers, architects, attorneys, and other professionals and court costs) arising directly, indirectly, or consequentially out of any action, legal or equitable, brought by any owner or occupant of land against the OWNER or the ENGINEER to the extent the claim is based or arises out of the CONTRACTOR's performance of the WORK.

6.11 SAFETY AND PROTECTION

A. The CONTRACTOR shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the WORK. The CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. All employees on the WORK and other persons and organizations who may be affected thereby.

2. All the WORK and materials and equipment to be incorporated therein, whether in storage on or off the site; and

3. Other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

B. The CONTRACTOR shall comply with all applicable Laws and Regulations (whether referred to herein or not) of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury, or loss and shall erect and maintain all necessary safeguards for such safety and protection. The CONTRACTOR shall notify owners of adjacent property and utilities when prosecution of the WORK may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

C. Unless the CONTRACTOR otherwise designates in writing a different individual as the responsible individual, the CONTRACTOR's superintendent shall be CONTRACTOR's representative at the site whose duty shall be the prevention of accidents.

6.12 SHOP DRAWINGS AND SAMPLES

A. After checking and verifying all field measurements and after complying with the applicable procedures specified in the Technical Specifications, the CONTRACTOR shall submit all shop drawings to the ENGINEER for review and approval in accordance with the approved schedule for shop drawings submittals specified in the Technical Specifications.

B. The CONTRACTOR shall also submit to the ENGINEER for review and approval all samples in accordance with the approved schedule of sample submittals specified in the Technical Specifications.

C. Before submitting shop drawings or samples, the CONTRACTOR shall determine and verify all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers, and similar data with respect thereto and review or coordinate each shop drawing or sample with other shop drawings and samples and with the requirements of the WORK and the Contract Documents.

6.13 CONTINUING THE WORK

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

6.14 INDEMNIFICATION

A. To the fullest extent permitted by Laws and Regulations, the CONTRACTOR shall indemnify, defend, and hold harmless the OWNER, the ENGINEER, and their officers, agents, and employees, against and from all claims and liability arising under or by reason of the Agreement or any performance of the WORK, but not from the sole negligence or willful misconduct of the OWNER and/or the ENGINEER. Such indemnification by the CONTRACTOR shall include but not be limited to the following:

1. Liability or claims resulting directly or indirectly from the negligence or carelessness of the CONTRACTOR or its agents in the performance of the WORK, or in guarding or maintaining the same, or from any improper materials, implements, or appliances used in its construction, or by or on account of any act or omission of the CONTRACTOR or its agents;

2. Liability or claims arising directly or indirectly from or based on the violation of any law, ordinance, regulation, order, or decree, whether by the CONTRACTOR or its agents;

3. Liability or claims arising directly or indirectly from the use or manufacture by the CONTRACTOR, its agents, or the OWNER in the performance of this Agreement of any copyrighted or uncopyrighted composition, secret process, patented or unpatented invention, article, or appliance, unless otherwise specifically stipulated in this Agreement.

4. Liability or claims arising directly or indirectly from the breach of any warranties, whether express or implied, made to the OWNER or any other parties by the CONTRACTOR or its agents;

5. Liabilities or claims arising directly or indirectly from the willful misconduct of the CONTRACTOR or its agents; and,

6. Liabilities or claims arising directly or indirectly from any breach of the obligations assumed herein by the CONTRACTOR.

B. The CONTRACTOR shall reimburse the OWNER, and the ENGINEER for all costs and expense, (including but not limited to fees and charges of engineers, architects, attorneys, and other professional and court costs) incurred by the OWNER, and the ENGINEER in enforcing the provisions of this Paragraph.

C. The indemnification obligation under this Paragraph shall not be limited in any way by any limitation of the amount or type of damages, compensation, or benefits payable by or for the CONTRACTOR or any such subcontractor or other person or organization under workers' compensation acts, disability benefit acts, or other employee benefit acts.

6.15 CONTRACTOR'S DAILY REPORTS

A. The CONTRACTOR shall complete a daily report indicating manpower, major equipment, subcontractors, weather conditions, etc., involved in the performance of the WORK. The daily report shall be completed on forms prepared by the CONTRACTOR and acceptable to the ENGINEER, and shall be submitted to the ENGINEER at the conclusion of each work day.

6.16 ASSIGNMENT OF CONTRACT

A. The CONTRACTOR shall not assign, sublet, sell, transfer, or otherwise dispose of the Agreement or any portion thereof, or its right, title, or interested therein, or obligations thereunder, without the written consent of the OWNER except as imposed by law. If the CONTRACTOR violates this provision, the Agreement may be terminated at the option of the OWNER. In such event, the OWNER shall be relieved of all liability and obligations to the CONTRACTOR and to its assignee or transferee, growing out of such termination.

ARTICLE 7 - OTHER WORK

7.01 RELATED WORK

A. The OWNER may perform other work related to the Project at the site by the OWNER's own forces, have other work performed by utility owners, or let other direct contracts for the performance of the other work which may contain General Conditions similar to these. If the fact that such other work is to be performed was not noted in the Contact Documents, written notice thereof will be given to the CONTRACTOR prior to commencing any other work.

B. The CONTRACTOR shall afford each utility owner and other contractor who is a party to a direct contract (or the OWNER, if the OWNER is performing the additional work with the OWNER's employees) proper and safe access to the site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of the other work. The CONTRACTOR shall properly connect and coordinate the WORK with the other work. The CONTRACTOR shall do all cutting, fitting, and patching of the WORK that may be required to make its several parts come together properly and integrate with the other work. The CONTRACTOR shall not endanger any work of others by cutting, excavating, or otherwise altering their work and shall only cut or alter their work with the written consent of the ENGINEER and the others whose work will be affected.

C. If the proper execution or results of any part of the CONTRACTOR's work depends upon the integration of work with the completion of other work by any other contractor or utility owner (or the OWNER), the CONTRACTOR shall inspect and report to the ENGINEER in writing all delays, defects, or deficiencies in the other work that renders it unavailable or unsuitable for proper integration with the CONTRACTOR's work. Except for the results or effects of latent or nonapparent defects and deficiencies in the other work, the CONTRACTOR's failure to report will constitute an acceptance of the other work as fit and proper for integration with the CONTRACTOR's work and as a waiver of any claim for additional time or compensation associated with the integration of the CONTRACTOR's work with the other work.

7.02 COORDINATION

A. If the OWNER contracts with others for the performance of other work on the Project at the site, a coordinator will be identified to the extent that the coordinator can be identified at this time, in the Supplementary General Conditions and delegated the authority and responsibility for coordination of the activities among the various contractors. The specific matters over which the coordinator has authority and the extent of the coordinator's authority and responsibility will be itemized in the Supplementary General Conditions or in a notice to the CONTRACTOR at such time as the identity of the coordinator is determined.

GENERAL CONDITIONS

ARTICLE 8 - OWNER'S RESPONSIBILITIES

8.01 COMMUNICATIONS

A. The OWNER shall issue all its communications to the CONTRACTOR through the ENGINEER.

8.02 PAYMENTS

A. The OWNER shall make payments to the CONTRACTOR as provided in Paragraphs 14.05 and 14.09.

8.03 LANDS, EASEMENTS, AND SURVEYS

A. The OWNER's duties with respect to providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. The OWNER shall identify and make available to the CONTRACTOR copies of exploration reports and subsurface conditions tests at the site and in existing structures which have been utilized by the ENGINEER in preparing the Drawings and Technical Specifications as set forth in Paragraph 4.02

8.04 CHANGE ORDERS

A. The OWNER shall execute approved Change Orders for the conditions described in Paragraph 10.01D.

8.05 INSPECTIONS AND TESTS

A. The OWNER's responsibility with respect to inspection, tests, and approvals is set forth in Paragraph 13.03B.

8.06 SUSPENSION OF WORK

A. In connection with the OWNER's right to stop work or suspend work, see Paragraphs 13.04 and 15.01. Paragraphs 15.02 and 15.03 deal with the OWNER's right to terminate services of the CONTRACTOR under certain circumstances.

GENERAL CONDITIONS

ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

9.01 OWNER'S REPRESENTATIVE

A. The ENGINEER will be the OWNER's representative during the construction period. The duties, responsibilities and the limitations of authority of the ENGINEER as the OWNER's representative during construction are set forth in a separate agreement with the OWNER and are summarized hereafter.

9.02 VISITS TO SITE

A. The ENGINEER will make visits to the site during construction to observe and inspect the progress and quality of the WORK and to determine, in general if the WORK is proceeding in accordance with the Contract Documents.

9.03 PROJECT REPRESENTATION

A. The ENGINEER will furnish a Project Representative to observe and inspect the performance of the WORK. The Project Representative and/or other authorized agents of the Engineer shall serve as the chief Owner/Engineer contact(s) with the Contractor during the construction phase. All submittals shall be delivered to and communications between the Engineer and the Contractor shall be handled by the Project Representative and/or other authorized agents. The Project Representative shall be the chief authorized representative of the Owner and the Engineer at the site of the work in all on-site relations with the Contractor.

9.04 CLARIFICATIONS AND INTERPRETATIONS

A. The ENGINEER will issue with reasonable promptness written clarifications or interpretations of the requirements of the Contract Documents (in the form of Drawings or otherwise) as the ENGINEER may determine necessary, which shall be consistent with or reasonably inferable from the overall intent of the Contract Documents.

9.05 AUTHORIZED VARIATIONS IN WORK

A. The ENGINEER may authorize minor variation in the WORK as described in the Contact Documents when such variations do not involve an adjustment in the Contract Price or the Contract Time and are consistent with the overall intent of the Contract Documents. These variations shall be accomplished by issuing a Field Order. The issuance of a Field Order requires the CONTRACTOR to perform the work described in the order promptly. If the

CONTRACTOR believes that a Field Order justifies an increase in the Contract Price or an extension of the Contract Time and parties are unable to agree as the amount or extent thereof, the CONTRACTOR may make a claim therefor as provided in Article 11 or 12.

9.06 REJECTION OF DEFECTIVE WORK

A. The ENGINEER is authorized to reject work which the ENGINEER believes to be defective and require special inspection or testing of the WORK as provided in Paragraph 13.03G, whether or not the WORK is fabricated, installed, or completed.

9.07 CONTRACTOR SUBMITTALS, CHANGE ORDERS, AND PAYMENTS

A. The ENGINEER will review for approval all Contractor submittals, including shop drawings, samples, substitutes, and "or equal" items, etc., in accordance with the procedures set forth in the Technical Specifications.

B. In connection with the ENGINEER's responsibilities as to Change Orders, see Articles 10, 11, and 12.

C. In connection with the ENGINEER's responsibilities with respect to Applications for Payment, see Article 14.

9.08 DECISIONS ON DISPUTES

A. All claims, disputes, and other matters concerning the acceptability of the WORK, the interpretation of the requirements of the Contract Documents pertaining to the performance of the WORK, and claims for changes in the Contract Price or Contract Time under Articles 11 and 12 will be referred to the ENGINEER in writing with a request for formal decision in accordance with this paragraph. The ENGINEER will render a decision in writing within 30 days of receipt of the request. Written notice of each claim, dispute, or other matter will be delivered by the CONTRACTOR to the ENGINEER promptly (but in no event later than 30 days) after the occurrence of the event. Written supporting data will be submitted to the ENGINEER with the written claim unless the ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim.

B. When reviewing the claim or dispute, the ENGINEER will not show partiality to the OWNER or the CONTRACTOR and will incur no liability in connection with any interpretation or decision rendered in good faith. The ENGINEER's rendering of a decision with respect to any claim, dispute, or other matter (except any which have been waived by the making or acceptance of final

payment as provided in Paragraph 14.12) shall be a condition precedent to the OWNER's or the CONTRACTOR's exercise of their rights or remedies under the Contract Documents or by Law or Regulations with respect to the claim, dispute, or other matter.

9.09 LIMITATION ON ENGINEER'S RESPONSIBILITIES

A. Neither the ENGINEER's authority to act pursuant to its agreement with the OWNER, nor the description of that authority under this Article 9, nor any other description of the ENGINEER's responsibility in the Contract Documents, nor any decision made by the ENGINEER in good faith either to exercise or not exercise its authority, shall give rise to any duty or responsibility on the part of the ENGINEER to the CONTRACTOR, any Subcontractor, any Supplier, any surety or any other person or organization performing any part of the WORK.

B. Whenever in the Contract Documents the terms "as ordered," "as directed," "as required," as allowed," "as reviewed," "as approved," or terms of like effect or import are used, or the adjectives "reasonable," "suitable," "acceptable," "proper," or "satisfactory" or adjectives of like effect or import are used to describe a requirement, direction, review, or judgement of the ENGINEER as to the WORK, it is intended that such requirement, direction, review, or judgment will be solely to evaluate the WORK for compliance with the Contract Documents, unless there is a specific statement indicating otherwise. The use of any such term or adjective shall not be effective to assign to the ENGINEER any duty or authority to supervise or direct the performance of the WORK or any duty or authority to undertake responsibility contrary to the provisions of its agreement with the OWNER.

C. The ENGINEER will not be responsible for the CONTRACTOR's means, methods, techniques, sequences, or procedures of construction not specified in the Contact Documents or the safety precautions and programs incident thereto.

D. The ENGINEER will not be responsible for the acts or omissions of the CONTRACTOR nor of any subcontractor, supplier, or any other person or organization performing any of the WORK to the extent that such acts or omissions are not reasonably discoverable considering the level of observation and inspection required by the ENGINEER's agreement with the OWNER.

GENERAL CONDITIONS

ARTICLE 10 - CHANGES IN THE WORK

10.01 GENERAL

A. Without invalidating the Agreement and without notice to any surety, the OWNER may at any time or from time to time, order additions, deletions, or revisions in the WORK; these will be authorized by a written Field Order and/or a Change Order issued by the ENGINEER. Upon receipt of any of these documents, the CONTRACTOR shall promptly proceed with the work involved pursuant to the applicable conditions of the Contract Documents.

B. If the OWNER and the CONTRACTOR are unable to agree upon the increase or decrease in the Contract Price or an extension or shortening of the Contract Time, if any, that should be allowed as a result of a Field Order, a claim may be made therefor as provided in Articles 11 or 12.

C. The CONTRACTOR shall not be entitled to an increase in the Contract Price nor an extension of the Contract Time with respect to any work performed that is not required by the Contact Documents as amended, modified, or supplemented by Change Order, except in the case of an emergency and except in the case of uncovering work provided in the Paragraph 13.03G.

D. The OWNER and the CONTRACTOR shall execute appropriate Change Orders covering:

1. Changes in the WORK which are ordered by the OWNER pursuant to Paragraph 10.01A;

2. Changes required because of acceptance of defective work under Paragraph 13.06;

3. Changes in the Contract Price or Contact Time which are agreed to by the parties; or

4. Any other changes agreed to by the parties.

E. If the provisions of any Bond require notice of any change to be given to a surety, the giving of these notices will be the CONTRACTOR's responsibility. The CONTRACTOR shall provide for the amount of each applicable Bond to be adjusted accordingly.

10.02 ALLOWABLE QUANTITY VARIATIONS

A. Whenever a unit price and quantity have been established for a bid item in the Contract Documents, the quantity stated may be increased or decreased to a maximum of 25 percent with no change in the unit price. An adjustment in the quantity in excess of 25 percent will be sufficient to justify a change in the unit price. Changes in the quantity of all bid items established in the Contract Documents, regardless of whether the changes are more or less than 25 percent and at the unit price established in the Contract Documents or adjusted otherwise, shall be documented by Change Orders.

B. In the event a part of the WORK is to be entirely eliminated and no lump sum or unit price is named in the Contract Documents to cover the eliminated work, the price of the eliminated work shall be agreed upon in writing by the OWNER and the CONTRACTOR. If the OWNER and the CONTRACTOR fail to agree upon the price of the eliminated work, the price shall be determined in accordance with the provisions of Article 11.

GENERAL CONDITIONS

ARTICLE 11 - CHANGE OF CONTRACT PRICE

11.01 GENERAL

A. The Contact Price constitutes the total compensation payable to the CONTRACTOR for performing the WORK. Except as directed by Change Orders, all duties, responsibilities, and obligations assigned to or undertaken by the CONTRACTOR shall be at its expense without change in the Contract Price.

B. The Contract Price may only be changed by a Change Order. Any claim for an increase in the Contact Price shall be based on written notice delivered by the CONTRACTOR to the ENGINEER promptly (but in no event later than 30 days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the amount of the claim with supporting data shall be delivered with the claim, unless the ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim, and shall be accompanied by the CONTRACTOR's written statement that the amount claimed covers all known amounts (direct, indirect, and consequential) to which the CONTRACTOR is entitled as a result of the occurrence of the event. If the OWNER and the CONTRACTOR cannot otherwise agree on the amount involved, all claims for adjustment in the Contract Price shall be determined by the ENGINEER in accordance with Paragraph 9.08A. No claim for an adjustment in the Contact Price will be valid if not submitted in accordance with this Paragraph 11.01B.

C. The value of any work covered by a Change Order or of any claim for an increase or decrease in the Contact Price shall be determined in one of the following ways:

1. Where the work involved is covered by unit prices contained in the Contract Documents, by application of unit prices to the quantities of the items involved.

2. By mutual acceptance of a lump sum, which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.

3. On the basis of the cost of work (determined as provided in Paragraphs 11.02 and 11.03) plus a CONTRACTOR's fee for overhead and profit (determined as provided in Paragraph 11.04).

11.02 COST OF WORK (BASED ON TIME AND MATERIALS)

A. General: The term "cost of work" means the sum of all costs necessarily incurred and paid by the CONTRACTOR for labor, materials, and equipment in the proper performance of work. Except as otherwise may be agreed to in writing by the OWNER, such costs shall be in amounts no higher than those prevailing in the locality of the Project.

B. Labor: The cost of labor used in performing work by the CONTRACTOR, a subcontractor, or other forces will be the sum of the following:

1. The actual wages paid plus any employer payments to, or on behalf of workers for fringe benefits including health and welfare, pension, vacation, and similar purposes. The cost of labor may include the rates paid to foremen when determined by the ENGINEER that the services of foremen do not constitute a part of the overhead allowance.

2. All payments imposed by state and federal laws including, but not limited to, compensation insurance, and social security payments.

3. The amount paid for subsistence and travel required by collective bargaining agreements, or in accordance with the regular practice of the employer.

At the beginning of the extra work and as later requested by the ENGINEER, the CONTRACTOR shall furnish the ENGINEER proof of labor compensation rates being paid.

C. Materials: The cost of materials used in performing work will be the cost to the purchaser, whether CONTRACTOR or subcontractor, from the supplier thereof, except as the following are applicable:

1. Trade discounts available to the purchase shall be credited to the OWNER notwithstanding the fact that such discounts may not have been taken by the CONTRACTOR.

2. For materials secured by other than a direct purchase and direct billing to the purchaser, the cost shall be deemed to be the price paid to the actual supplier as determined by the ENGINEER. Markup except for actual costs incurred in the handling of such materials will not be allowed.

3. Payment for materials from sources owned wholly or in part by the purchaser shall not exceed the price paid by the purchaser for similar materials from these sources on extra work items or current wholesale price for the materials delivered to the work site, whichever is lower.

4. If in the opinion of the ENGINEER the cost of material is excessive, or the CONTRACTOR does not furnish satisfactory evidence of the cost of the material, then the cost shall be deemed to be the lowest current wholesale price for the quantity concerned, delivered to the work site less trade discount. The OWNER reserves the right to furnish materials for the extra work and no claim shall be made by the CONTRACTOR for costs and profit on such materials.

D. Equipment: The CONTRACTOR will be paid for the use of equipment at the rental rate listed for the equipment specified in the Supplementary General Conditions. The rental rate will be used to compute payments for equipment whether the equipment is under the CONTRACTOR's control through direct ownership, leasing, renting, or another method of acquisition. The rental rate to be applied for use of each item of equipment shall be the rate resulting in the least total cost to the Owner for the total period of use. If it is deemed necessary by the CONTRACTOR to use equipment not listed in the Supplementary General Conditions an equitable rental rate for the equipment will be established by the ENGINEER. The CONTRACTOR may furnish cost data which might assist the ENGINEER in the establishing the rental rate.

1. All equipment shall, in the opinion of the ENGINEER, be in good working condition and suitable for the purpose for which the equipment is to be used.

2. Before construction equipment is used on the extra work, the CONTRACTOR shall plainly stencil or stamp an identifying number thereon at a conspicuous location, and shall furnish to the ENGINEER, in duplicate, a description of the equipment and its identifying number.

3. Unless otherwise specified, manufacturers' ratings and manufacturer approved modifications shall be used to classify equipment for the determination of applicable rental rates. Equipment which has no direct power unit shall be powered by a unit of at least the minimum rating recommended by the manufacturer.

4. Individual pieces of equipment or tools having a replacement value of $100 or less, whether or not consumed by use, shall be considered to be small tools and no payment will be made therefore.

5. Rental time will not be allowed while equipment is inoperative due to breakdowns.

E. Equipment on the Work: The rental time to be paid for equipment used on the WORK shall be the time the equipment is in productive operation on the extra work being performed and, in addition, shall include the time required to move the equipment to the location of the extra work and return it to the original location or to another location that requires no more moving time than that required to return it to its original location. Moving time will not be paid if the equipment is used on other than the extra work, even though located at the site of the extra work. Loading and transporting costs will be allowed, in lieu of moving time, when the equipment is moved by means other than its own power. However, no payment will be made for loading and transporting costs when the equipment is used on other than the extra work even though located at the site of the extra work. The following shall be used in computing the rental time of equipment on the WORK.

1. When hourly rates are listed, any part of an hour less than 30 minutes of operation shall be considered to be 1/2-hour of operation, and any part of an hour in excess of 30 minutes will be considered one hour of operation.

2. When daily rates are listed, any part of a day less than 4 hours operation shall be considered to be 1/2-day of operation. When owner-operated equipment is used to perform extra work to be paid for on a time and materials basis, the CONTRACTOR will be paid for the equipment and operator, as set forth in Paragraph (3), (4), and (5), following.

3. Payment for the equipment will be made in accordance with the provisions in Paragraph 11.02D, herein.

4. Payment for the cost of labor and subsistence or travel allowance will be made at the rates paid by the CONTRACTOR to other workers operating similar equipment already on the WORK, or in the absence of such labor, established by collective bargaining agreements for the type of workmen and location of the extra work, whether or not the operator is actually covered by such an agreement. A labor surcharge will be added to the cost of labor described herein in accordance with the provisions of Paragraph 11.02B, herein, which surcharge shall constitute full compensation for payments imposed by state and federal laws and all payments made to on behalf of workers other than actual wages.

5. To the direct cost of equipment rental and labor, computed as provided herein, will be added the allowances for equipment rental and labor as provided in Paragraph 11.04, herein.

11.03 SPECIAL SERVICES

A. Special work or services are defined as that work characterized by extraordinary complexity, sophistication, or innovation or a combination of the foregoing attributes which are unique to the construction industry. The following may be considered by the ENGINEER in making estimates for payment for special services:

1. When the ENGINEER and the CONTRACTOR, by agreement, determine that a special service or work is required which cannot be performed by the forces of the CONTRACTOR or those of any of its subcontractors, the special service or work may be performed by an entity especially skilled in the work to be performed. After validation of invoices and termination of market values by the ENGINEER, invoices for special services or work based upon the current fair market value thereof may be accepted without complete itemization of labor, material, and equipment rental cost.

2. When the CONTRACTOR is required to perform work necessitating special fabrication or machining process in a fabrication or a machine shop facility away from the job site, the charges for that portion of the work performed at the off-site facility may by agreement, be accepted as a special service and accordingly, the invoices from the work may be accepted without detailed itemization.

3. All invoices for special services will be adjusted by deducting all trade discounts offered or available, whether the discounts were taken or not. In lieu of the allowances for overhead and profit specified in Paragraph 11.04, herein, an allowance of 5 percent will be added to invoices for special services.

B. All work performed hereunder shall be subject to all of the provisions of the Contract Documents and the CONTRACTOR's sureties shall be bound with reference hereto as under the original Agreement. Copies of all amendments to surety bonds or supplemental surety bonds shall be submitted to the OWNER for review prior to the performance of any work hereunder.

11.04 CONTRACTOR'S FEE

A. WORK ordered on the basis of time and materials will be paid for at the actual necessary cost as determined by the ENGINEER, plus allowances for overhead and profit. For extra work involving a combination of increases and decreases in the WORK the actual necessary cost will be the arithmetic sum of the additive and deductive costs. The allowance for overhead and profit shall include full compensation for superintendence, bond and insurance premiums, taxes, office expenses, and all other items of expense or cost not included in the cost of labor, materials, or equipment provided for under Paragraphs 11.02B, C, and D, herein including extended overhead and home office overhead. The allowance for overhead and profit will be made in accordance with the following schedule:

ACTUAL NECESSARY COST OVERHEAD AND PROFIT ALLOWANCE

Labor ..... 10 percent

Materials ..... 10 percent

Equipment ..... 10 percent

B. It is understood that labor, materials, and equipment may be furnished by the CONTRACTOR or by the subcontractor, the allowance specified herein shall be applied to the labor, materials, and equipment costs of the subcontractor, to which the CONTRACTOR may add 5 percent of the subcontractor's total cost for the extra work. Regardless of the number of hierarchical tiers of subcontractors, the 5 percent increase above the subcontractor's total cost which includes the allowances for overhead and profit specified herein may be applied one time only for each separate work transaction.

GENERAL CONDITIONS

ARTICLE 12 - CHANGE OF CONTRACT TIME

12.01 GENERAL

A. The Contract Time may only be changed by a Change Order. Any claim for an extension of the Contract time shall be based on written notice delivered by the CONTRACTOR to the ENGINEER promptly (but in no event later than 30 days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the extent of the claim with supporting data shall be delivered within 30 days after such occurrence (unless the ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim) and shall be accompanied by the CONTRACTOR's written statement that the adjustment claimed is the entire adjustment to which the CONTRACTOR has reason to believe it is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Time shall be determined by the ENGINEER in accordance with Paragraph 9.08 if the OWNER and the CONTRACTOR cannot otherwise agree. No claim for an adjustment in the Contract Time will be valid if not submitted in accordance with the requirements of this Paragraph 12.01A.

B. The Contract Time will be extended in an amount equal to time lost if the CONTRACTOR makes a claim as provided in Paragraph 12.01A and the ENGINEER determines that the delay was caused by events beyond the control of the CONTRACTOR. Examples of events beyond the control of the CONTRACTOR include acts or neglect by the OWNER or others performing additional work as contemplated by Article 7, or by acts of God or of the public enemy, fire, floods, epidemics, quarantine restrictions, strikes, labor disputes, sabotage, or freight embargoes.

C. All time limits stated in the Contract Documents are of the essence.

D. None of the aforesaid time extensions shall entitle the CONTRACTOR to any adjustment in the Contract Price or any damages for delay. Furthermore, the CONTRACTOR hereby indemnifies and holds harmless the OWNER and ENGINEER, their officers, agents and employees from and against all claims, damages, losses and expenses (including lost property and attorney's fees) arising out of or resulting from the temporary suspension of work whether for the OWNER's convenience as defined in Article 15.01 (a) or for whatever other reasons including the stoppage of work by the ENGINEER for the CONTRACTOR's failure to comply with any order issued by the ENGINEER.

12.02 EXTENSIONS OF THE TIME FOR DELAY DUE TO INCLEMENT WEATHER

A. "Inclement weather" is any weather condition or conditions resulting immediately therefrom, causing the CONTRACTOR to suspend construction operations or preventing the CONTRACTOR from proceeding with at least 75 percent of the normal labor and equipment force engaged on the WORK.

B. Should the CONTRACTOR prepare to begin work at the regular starting time at the beginning of any regular work shift on any day on which inclement weather, or its effects on the condition of the WORK prevents work from beginning at the usual starting time and the crew is dismissed as a result thereof, the CONTRACTOR will not be charged for a working day whether or not conditions change thereafter during the day and the major portion of the day could be considered to be suitable for construction operations.

C. The CONTRACTOR shall base its construction schedule upon the inclusion of the number of days of inclement weather specified in the paragraph entitled "Inclement weather delays" of the Supplementary General Conditions. No extension of the Contract Time due to inclement weather will be considered until after the stated number of days of inclement weather has been reached. However, no reduction in Contract Time will be made if the number of inclement weather days is not reached.

12.03 EXTENSIONS OF TIME FOR OTHER DELAYS

A. If the CONTRACTOR is delayed in completion of the WORK beyond the time named in the Contract Documents for the completion of the WORK, by acts of God or of the public enemy, fire, floods, epidemics, quarantine restrictions, strikes, labor disputes, industry-wide shortage of raw materials, sabotage or freight embargoes, the CONTRACTOR shall be entitled to an adjustment in the Contract Time. No such adjustment will be made unless the CONTRACTOR shall notify the ENGINEER in writing of the causes of delay within 15 calendar days from the beginning of any such delay. The ENGINEER shall ascertain the facts and the extent of the delay. No adjustment in time shall be made for delays resulting from noncompliance with the Contract, accidents, failure on the part of the CONTRACTOR to carry out the provisions of the Contract including failure to provide materials, equipment or workmanship meeting the requirements of the Contract Documents; the occurrence of such events shall not relieve the CONTRACTOR from the necessity of maintaining the required progress.

B. In the event that Contract completion is delayed beyond the Contract Time named in the Specifications by reason of shortages of raw materials required for CONTRACTOR-furnished items, the CONTRACTOR shall be entitled to

an adjustment in the Contract Time in like manner as if the WORK had been suspended for the convenience and benefit of the OWNER; provided, however, that the CONTRACTOR shall furnish documentation acceptable to the OWNER and ENGINEER that he placed or attempted to place firm orders with suppliers at a reasonable time in advance of the required date of delivery of the items in question, that such shortages shall have developed following the date such orders were placed or attempts made to place same, that said shortages are general throughout the affected industry, that said shortages are shortages of raw materials required to manufacture CONTRACTOR-furnished items and not simply failure of CONTRACTOR's suppliers to manufacture, assemble or ship items on time, and that the CONTRACTOR shall, to the degree possible, have made revisions in the sequence of his operations, within the terms of the Contract, to offset the expected delay. The CONTRACTOR shall notify the ENGINEER, in writing, concerning the cause of delay, within 15 calendar days of the beginning of such delay. The validity of any claim by the CONTRACTOR to an adjustment in the Contract Time shall be determined by the OWNER acting through the ENGINEER, and his findings thereon shall be based on the ENGINEER's knowledge and observations of the events involved and documentation submitted by the CONTRACTOR, showing all applicable facts relative to the foregoing provisions. Only the physical shortage of raw materials will be considered under these provisions as a cause for adjustment of time and no consideration will be given to any claim that items could not be obtained at a reasonable, practical, or economical cost or price, unless it is shown to the satisfaction of the OWNER that such items could have been obtained only at exorbitant prices entirely out of line with current rates taking into account the quantities involved and the usual practices in obtaining such quantities.

C. If the CONTRACTOR is delayed in completion of the WORK by reason of changes made under the provisions of Article 10 or changed conditions as provided under Article 4.03, or by failure of the OWNER to acquire or clear right-of-way as provided under Article 15.01, or by any act of the ENGINEER or of the OWNER, not contemplated by the Contract, an adjustment in the Contract time will be made by the OWNER in like manner as if the WORK had been suspended for the convenience and benefit of the OWNER, except, that if the WORK is increased as a result of changes, the OWNER, at his sole discretion, may grant an adjustment in the number of calendar days for completion of the Contract. In the event of such delay, the CONTRACTOR shall notify the ENGINEER in writing of the causes of delay within 15 calendar days from the beginning of any such delay.

GENERAL CONDITIONS

ARTICLE 13 - WARRANTY AND GUARANTEE; TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK

13.01 WARRANTY, GUARANTEE AND MAINTENANCE PERIOD

A. The CONTRACTOR warrants and guarantees to the OWNER and the ENGINEER that all work, equipment, materials and workmanship are in accordance with the Contract Documents and are not defective. Prompt notice of defects discovered by the OWNER or ENGINEER shall be given to the CONTRACTOR. All defective work, whether or not in place, may be rejected, corrected, or accepted as provided in this Article 13.

B. If within one (1) year after the date of Final Completion, as set by the Engineer's Notice of Completion, or a longer period of time prescribed by Laws or Regulations or by the terms of any applicable special guarantee or specific provisions of the Contract Documents, any work is found to be defective, the OWNER shall notify the CONTRACTOR in writing and the CONTRACTOR shall promptly, without cost to the OWNER and in accordance with the OWNER's written notification, either correct the defective work, or, if it has been rejected by the OWNER, remove it from the site and replace it with non-defective work. In the event the CONTRACTOR does not promptly comply with the notification, or in an emergency where delay would cause serious risk of loss or damage, the OWNER may have the defective work corrected or rejected work removed and replaced. All direct, indirect, and consequential costs of the removal and replacement including but not limited to fees and charges of engineers, architects, attorneys and other professionals will be paid by the CONTRACTOR. This paragraph shall not be construed to limit nor diminish the CONTRACTOR's absolute guarantee to complete the WORK in accordance with the Contract Documents.

13.02 ACCESS TO WORK

A. The ENGINEER, other representatives of the OWNER, testing agencies, and governmental agencies with jurisdictional interests shall have access to the work at reasonable times for their observation, inspections, and testing. The CONTRACTOR shall provide proper and safe conditions for their access.

13.03 TESTS AND INSPECTIONS

A. The CONTRACTOR shall give the ENGINEER timely notice of readiness of the WORK for all required inspections, tests, or approvals.

B. If Laws or Regulations of any public body other than the OWNER, with jurisdiction over the WORK require any work to be specifically inspected, tested, or approved, the CONTRACTOR shall pay all costs in connection therewith. The CONTRACTOR shall also be responsible for and shall pay all costs in connection with any inspection or testing required in connection with the OWNER's or the ENGINEER's acceptance of a Supplier of materials or equipment proposed as a substitution or-equal to be incorporated in the WORK and of materials or equipment submitted for review prior to the CONTRACTOR's purchase for incorporation in the WORK. The cost of all inspections, tests, and approvals with the exception of the above which are required by the Contract Documents shall be paid by the OWNER (unless otherwise specified).

C. The ENGINEER will make, or have made, such inspections and test as the ENGINEER deems necessary to see that the WORK is being accomplished in accordance with the requirements of the Contract Documents. The Contractor without additional cost to the OWNER, shall provide the labor and equipment necessary to make the WORK available for inspections. Unless otherwise specified in the Supplementary General Conditions or the OWNER-ENGINEER Agreement, all other costs of inspection and testing will be borne by the OWNER. In the event the inspections or tests reveal non-compliance with the requirements of the Contract Documents, the CONTRACTOR shall bear the cost of corrective measures deemed necessary by the ENGINEER, as well as the cost of subsequent re-inspection and retesting. Neither observations by the ENGINEER nor inspections, tests, or approvals by others shall relieve the CONTRACTOR from the CONTRACTOR's obligation to perform the WORK in accordance with the Contract Documents.

D. All inspections, tests, or approvals other than those required by Laws or Regulations of any public body having jurisdiction shall be performed by properly licensed organizations selected by the OWNER.

E. If any work (including the work of others) that is to be inspected, tested, or approved is covered without the ENGINEER's written authorization, it must, if requested by the ENGINEER, be uncovered for testing, inspection, and observation. The uncovering shall be at the CONTRACTOR's expense unless the CONTRACTOR timely notified the ENGINEER of the CONTRACTOR's intention to cover the same and the ENGINEER failed to act with reasonable promptness in response to the notice.

F. In any work is covered contrary to the written request of the ENGINEER, it must, if requested by the ENGINEER, be uncovered for the ENGINEER's observation and replaced at the CONTRACTOR's expense.

G. If the ENGINEER considers it necessary or advisable that covered work be observed, inspected or tested by the ENGINEER or others, the ENGINEER shall direct the CONTRACTOR to uncover, expose, or otherwise make available for observation, inspection, or testing that portion of the work in question. The CONTRACTOR shall comply with the ENGINEER's direction and furnish all necessary labor, material, and equipment. If found the work is defective, the CONTRACTOR shall bear all direct, indirect and consequential costs of uncovering, exposure, observation, inspection, and testing and of satisfactory reconstruction of the work, including but not limited to fees and charges for engineers, architects, attorneys, and other professionals. However, if the work is not defective, the CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both. The increase in Contract Time and Contract Price shall be the CONTRACTOR's actual time and costs directly attributable to uncovering and exposing the work. If the parties are unable to agree as to the amount or extent of the changes, the CONTRACTOR may make a claim therefor as provided in Articles 11 and 12.

13.04 OWNER MAY STOP THE WORK

A. If the WORK is defective, or the CONTRACTOR fails to perform work in such a way that the completed WORK will conform to the Contract Documents, the OWNER may order the CONTRACTOR to stop the WORK, or any portion thereof, until the cause for the order has been eliminated. This right of the OWNER to stop the WORK shall not give rise to any duty on the part of the OWNER to exercise this right for the benefit of the CONTRACTOR or any other party.

13.05 CORRECTION OR REMOVAL OF DEFECTIVE WORK

A. When directed by the ENGINEER, the CONTRACTOR shall promptly correct all defective work, whether or not fabricated, installed, or completed, or, if the

work has been rejected by the ENGINEER, remove it from the site and replace it with non-defective work. The CONTRACTOR shall bear all direct, indirect and consequential costs of correction or removal, including but not limited to fees and charges of engineers, architects, attorneys, and other professionals made necessary thereby.

13.06 ACCEPTANCE OF DEFECTIVE WORK

A. If, instead of requiring correction or removal and replacement of defective work, the OWNER prefers to accept the work, the OWNER may do so. The CONTRACTOR shall bear all direct, indirect, and consequential costs attributable to the OWNER's evaluation of and determination to accept the defective work. If any acceptance of defective work occurs prior to final payment, a Change Order will be issued incorporating the necessary revisions in the Contact Documents with respect to the WORK, and the OWNER shall be entitled to an appropriate decrease in the Contract Price.

GENERAL CONDITIONS

ARTICLE 14 - PAYMENTS TO CONTRACTOR, LIQUIDATED DAMAGES AND COMPLETION

14.01 SCHEDULE OF VALUES (LUMP SUM PRICE BREAKDOWN)

A. The schedule of values or lump sum price breakdown established as provided in the Technical Specifications shall serve as the basis for progress payments and will be incorporated into the form of Application for Payment included in the Contract Documents.

14.02 UNIT PRICE BID SCHEDULE

A. Progress payments for unit price work will be based on the number of units completed.

14.03 APPLICATION FOR PROGRESS PAYMENT

A. Unless otherwise prescribed by the Owner, on the 25th of each month, the CONTRACTOR shall submit to the ENGINEER for review and approval, an Application for Payment completed and signed by the CONTRACTOR covering the WORK completed as of the date of the Application and accompanied by such supporting documentation as required by the Contract Documents.

B. The Application for Payment shall identify, as a sub-total, the amount of the CONTRACTOR's Total Earnings to Date, plus the Value of Materials at the Site which have not yet been incorporated in the WORK, and less a deductive adjustment for materials installed which were not previously incorporated in the WORK, but for which payment was allowed under the provisions of payment for Materials Stored at the Site but not yet incorporated in the WORK.

C. The Net Payment Due to the CONTRACTOR shall be the above-mentioned sub-total, from which shall be deducted the retainage amount and the total amount of all previous payments made to the CONTRACTOR.

D. The OWNER may withhold and retain 5% of each approved progress payment to the CONTRACTOR. The total retention proceeds withheld shall not exceed 5% of the total construction price. All retention proceeds shall be placed by the OWNER in an interest-bearing account. The interest accrued shall be for the benefit of the CONTRACTOR and its subcontractors, and it shall be paid after the WORK has been completed and accepted by the OWNER. CONTRACTOR shall ensure that any interest accrued on the

retainage is distributed by the CONTRACTOR to its subcontractors on a pro rata basis.

E. Any retention proceeds withheld, and any accrued interest, shall be released by the OWNER pursuant to an Application for Payment from the CONTRACTOR within 45 days from the later of:

1. the date the OWNER receives the final Application for Payment from the CONTRACTOR;

2. the date that a certificate of occupancy or final acceptance notice is issued to:

   (a) the Contractor who obtained the building permit from the building inspector or from a public agency;

   (b) the OWNER; or

   (c) the ENGINEER.

3. the date the CONTRACTOR accepts final payment for the Work; or

4. the date that a public agency or building inspector having authority to issue its own certificate of occupancy does not issue the certificate but permits partial or complete occupancy of a newly constructed or remodeled building; provided, however, that if only partial occupancy of a building is permitted, any retention proceeds withheld and retained, and any accrued interest, shall be partially released in direct proportion to the value of the part of the building occupied.

Each Application for Payment from the CONTRACTOR shall include documentation of lien releases or waivers.

F. Notwithstanding any other provision in this Article to the contrary,

1. If the CONTRACTOR is in default or breach of the terms and conditions of the Contract Documents, the OWNER may withhold from payment to the CONTRACTOR for so long as reasonably necessary an amount necessary to cure the breach or default of the CONTRACTOR; or

2. If the WORK or a portion of the WORK has been substantially completed, the OWNER may retain until completion up to twice the

fair market value of the WORK of the CONTRACTOR that has not been completed:

(a) in accordance with the Contract Documents; or

(b) in the absence of applicable provisions in the Contract Documents to generally accepted craft standards.

3. If the OWNER refuses payment under subparagraphs (F)(i) or (ii), it shall describe in writing within 45 days of withholding such amounts what portion of the WORK was not completed according to the standards specified in the Contract Documents.

G. The CONTRACTOR shall distribute retention proceeds as outlined below:

1. Except as provided in Paragraph 14.03.G.2, below, if the CONTRACTOR receives retention proceeds, it shall pay each of its subcontractors from whom retention has been withheld each subcontractor's share of the retention received within ten days from the day that all or any portion of the retention proceeds is received from the OWNER.

2. Notwithstanding Paragraph 14.03.G.1, above, if a retention payment received by the CONTRACTOR is specifically designated for a particular subcontractor, payment of the retention shall be made to the designated subcontractor.

H. Except as otherwise provided in the Supplementary General Conditions, the value of materials stored at the site shall be valued at 95 percent of the value of the materials. This amount shall be based upon the value of all acceptable materials and equipment stored at the site or at another location agreed to in writing by the OWNER; provided, each individual item has a value of more than $5,000 and will become a permanent part of the WORK. The Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that the CONTRACTOR has received the materials and equipment free and clear of all liens, charges, security interests, and encumbrances (which are hereinafter in these General Conditions referred to as "Liens") and evidence that the materials and equipment are covered by appropriate property insurance and other arrangements to protect the OWNER's interest therein, all of which will be satisfactory to the OWNER.

14.04 CONTRACTOR'S WARRANTY OF TITLE

A. The CONTRACTOR warrants and guarantees that title to all work, materials, and equipment covered by an Application for Payment, whether incorporated in the WORK or not, will pass to the OWNER no later than the time of final payment free and clear of all liens.

14.05 REVIEW OF APPLICATIONS FOR PROGRESS PAYMENT

A. The ENGINEER will, within 7 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to the OWNER, or return the Application to the CONTRACTOR indicating in writing the ENGINEER's reasons for refusing to recommend payment. In the later case, the CONTRACTOR may make the necessary corrections and resubmit the Application. Thirty days after presentation of the Application for Payment with the ENGINEER's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.05B) become due and when due will be paid by the OWNER to the CONTRACTOR.

B. The OWNER may refuse to make payment of the full amount recommended by the ENGINEER to compensate for claims made by the OWNER on account of the CONTRACTOR's performance of the WORK or other items entitling the OWNER to a credit against the amount recommended, but the OWNER must give the CONTRACTOR written notice within 7 days (with a copy to the ENGINEER) stating the reasons for such action.

14.06 PARTIAL UTILIZATION

A. The OWNER may utilize or place into service any item of equipment or other usable portion of the WORK at any time prior to completion of the WORK. The OWNER shall notify the CONTRACTOR in writing of its intent to exercise this right. The notice will identify the equipment or specific portion or portions of the WORK to be utilized or otherwise placed into service.

B. It shall be understood by the CONTRACTOR that until such written notification is issued, all responsibility for care and maintenance of all items or portions of the WORK to be partially utilized shall be borne by the CONTRACTOR. Upon the issuance of a notice of partial utilization, the ENGINEER will deliver to the OWNER and the CONTRACTOR a written recommendation as to division of responsibilities between the OWNER and the CONTRACTOR with respect to security, operation, safety, maintenance,

heat, utilities and insurance. Upon the OWNER's acceptance of these recommendations, the ENGINEER's aforesaid recommendation will be binding on the OWNER and the CONTRACTOR until final payment.

C. The CONTRACTOR shall retain full responsibility for satisfactory completion of the WORK, regardless of whether a portion thereof has been partially utilized by the OWNER and the CONTRACTOR's one year correction period shall commence only after the date of Final Completion for the WORK.

14.07 LIQUIDATED DAMAGES

A. The CONTRACTOR shall pay to the OWNER the amount specified in the Supplemental General Conditions, not as a penalty but as liquidated damages, if he fails to complete the WORK or specified parts of the WORK within the time or times agreed upon. The periods for which these damages shall be paid shall be the number of Days from the agreed date or Contract Time as contained in the Agreement, or from the date of termination of any extension of time approved by the OWNER, to the date or dates on which the ENGINEER certifies Substantial Completion of WORK or specified parts of the WORK as provided in Article 14.08, herein. The OWNER may deduct the amount of said damages from any monies due or to become due the CONTRACTOR. After Substantial Completion, if the CONTRACTOR fails to complete the remaining WORK within 45 days or any proper extension thereof granted by OWNER, CONTRACTOR shall pay OWNER the amount stated in the Supplemental General Conditions as liquidated damages for each day that expires after the 45 days until readiness for final payment.

B. The said amount is fixed and agreed upon by and between the CONTRACTOR and the OWNER because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the OWNER would sustain; and said amount is agreed to be the amount of damages which the OWNER would sustain. Said damages are not in lieu of but in addition to other actual or consequential damages to which the OWNER may be entitled.

C. All times specified in the Contract Documents are hereby declared to be of the essence.

14.08 SUBSTANTIAL COMPLETION

A. When the CONTRACTOR considers the WORK ready for its intended use, and the CONTRACTOR has delivered to the ENGINEER all maintenance and operating instructions, schedules, guarantees, bonds, certificates of

inspection, marked-up record documents and other documents, all as required by the Contract Documents, the CONTRACTOR may notify the OWNER and the ENGINEER in writing that the WORK is substantially complete and request that the ENGINEER prepare a Certificate of Substantial Completion. Within a reasonable time thereafter, the OWNER, the CONTRACTOR, and the ENGINEER shall make an inspection of the WORK to determine the status of completion. If the ENGINEER does not consider the WORK substantially complete, the ENGINEER will notify the OWNER and CONTRACTOR in writing giving the reasons therefor. If the ENGINEER considers the WORK substantially complete, the ENGINEER will prepare and deliver to the OWNER for its execution the Certificate of Substantial Completion signed by the ENGINEER and CONTRACTOR, which shall fix the date of Substantial Completion.

B. The Certificate of Substantial Completion shall be a release by the CONTRACTOR of the OWNER and its agents from all claims and liability to the CONTRACTOR for anything done or furnished for, or relating to, the WORK or for any act or neglect of the OWNER or of any person relating to or affecting the WORK, to the date of Substantial Completion, except demands against the OWNER for the remainder of the amounts kept or retained from progress payments and excepting pending, unresolved claims filed in writing prior to the date of Substantial Completion. At the time of delivery of the Certificate of Substantial Completion, the ENGINEER will deliver to the OWNER and the CONTRACTOR, if applicable, a written recommendation as to division of responsibilities between the OWNER and the CONTRACTOR with respect to security, operation, safety, maintenance, heat, utilities and insurance. Upon the OWNER's acceptance of these recommendations, the ENGINEER's recommendation will be binding on the OWNER and the CONTRACTOR until final payment.

C. The OWNER, upon written notice to the CONTRACTOR, shall have the right to exclude the CONTRACTOR from the WORK after the date of Substantial Completion, and complete all or portions of the WORK at the CONTRACTOR's expense.

14.09 COMPLETION AND FINAL PAYMENT

A. Upon written certification from the CONTRACTOR that the WORK is complete (if a Certificate of Substantial Completion has been issued this certification must occur within 45 days of that date), the ENGINEER will make a final inspection with the OWNER and the CONTRACTOR. If the OWNER and ENGINEER do not consider the WORK complete, the ENGINEER will notify the OWNER and the CONTRACTOR in writing of all particulars in which this inspection reveals that the WORK is incomplete or defective. The CONTRACTOR shall immediately take the measures necessary to remedy these deficiencies. If the ENGINEER and OWNER consider the WORK complete, the CONTRACTOR may proceed to file its application for final payment pursuant to this Article. At the request of the CONTRACTOR, the ENGINEER may recommend to the OWNER that certain minor deficiencies in the WORK that do not prevent the entire WORK from being used by the OWNER for its intended use, and the completion of which will be unavoidably delayed due to no fault of the CONTRACTOR, be exempted from being completed prerequisite to final payment. These outstanding items of pickup work, or "punch list items", shall be listed on the ENGINEER's Notice of Completion, together with the recommended time limits for their completion, and extended warranty requirements for those items and the value of such items.

B. After the issuance of the Notice of Completion and after the CONTRACTOR has completed corrections that have not been exempted to the satisfaction of the ENGINEER and delivered to the ENGINEER all required additions and modifications to maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, marked-up record documents and other documents, all as required by the Contract Documents; and after the ENGINEER has indicated that the WORK is acceptable, the CONTRACTOR may make application for final payment following the procedure for progress payments. The final application for payment shall be accompanied by all documentation called for in the Contract Documents and other data and schedules as the OWNER or ENGINEER may reasonably require, including an affidavit of the CONTRACTOR that all labor, services, material, equipment and other indebtedness connected with the WORK for which the OWNER or his property might in any way be responsible, have been paid or otherwise satisfied, and a consent of the payment bond surety to final payment, all in forms approved by the OWNER.

14.10 FINAL APPLICATION FOR PAYMENT

A. If, on the basis of the ENGINEER's observation of the WORK during construction and final inspection, and the ENGINEER's review of the final application for payment and accompanying documentation, all as required by the Contract Documents, the ENGINEER is satisfied that the WORK has been completed and the CONTRACTOR has fulfilled all of his obligations under the Contract Documents, the ENGINEER will, within ten days after receipt of the final application for payment, indicate in writing his recommendation of payment and present the application to the OWNER for payment. Thereupon, the ENGINEER will give written notice to the OWNER and the CONTRACTOR that the WORK is acceptable by executing the ENGINEER's Notice of Completion. Otherwise, the ENGINEER will return the application to the CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment, in which case the CONTRACTOR shall make the necessary corrections and resubmit the application.

B. Within 45 calendar days after the ENGINEER's filing of the Notice of Completion, the OWNER will make final payment including all deducted retainage (except as noted below) to the CONTRACTOR. The OWNER's remittance of final payment shall be the OWNER's acceptance of the WORK if formal acceptance of the WORK is not indicated otherwise. The final payment shall be that amount remaining after deducting all prior payments and all amounts to be kept or retained under the provisions of the Contract, including the following items:

1. Liquidated damages, as applicable.

2. All amounts retained by the OWNER under Paragraph 14.03(F).

14.11 CONTRACTOR'S CONTINUING OBLIGATIONS

A. The CONTRACTOR's obligation to perform and complete the WORK in accordance with the Contract Documents shall be absolute. Neither recommendation of any progress or final payment by the ENGINEER, nor the issuance of a Certificate of Substantial Completion or Notice of Completion, nor payment by the OWNER to the CONTRACTOR under the Contract Documents, nor any use or occupancy of the WORK or any part thereof by the OWNER, nor any act of acceptance by the OWNER nor any failure to do so, nor any review of a shop drawing or sample submittal, will constitute an acceptance of work or materials not in accordance with the Contract Documents or a release of the CONTRACTOR's obligation to perform the WORK in accordance with the Contract Documents.

14.12 FINAL PAYMENT TERMINATES LIABILITY OF OWNER

A. Final payment is defined as the last progress payment made to the CONTRACTOR for earned funds, less deductions listed in Paragraph 14.10B herein. The acceptance by the CONTRACTOR of the final payment referred to in Paragraph 14.10 herein, shall be a release of the OWNER and its agents from all claims of liability to the CONTRACTOR for anything done or furnished for, or relating to, the work or for any act or neglect of the OWNER or of any person relating to or affecting the work, except demands against the OWNER for the remainder, if any, of the amounts kept or retained under the provisions of Paragraph 14.10 herein; and excepting pending, unresolved claims filed prior to the date of the Certificate of Substantial Completion.

GENERAL CONDITIONS

ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

15.01 SUSPENSION OF WORK BY OWNER

A. The OWNER acting through the ENGINEER may, by written notice to the Contractor, temporarily suspend the WORK, in whole or in part, for a period or periods of time, but not to exceed 90 days, for the convenience and benefit of the OWNER upon the occurrence of any one or more of the following: (1) unsuitable weather; (2) delay in delivery of OWNER- furnished equipment or materials, or such other conditions as are considered unfavorable for prosecution of the work; (3) Shortfall in construction funds; (4) Constraints imposed by public entities, public utilities, property owners or legal proceedings; (5) Failure or delay in acquisition of easements or right-of-way by the OWNER; or (6) Other conditions which, in the opinion of the OWNER, warrant a delay in the WORK. Suspended WORK shall be resumed by the CONTRACTOR within 10 calendar days of receipt from the ENGINEER of written notice to proceed. Whenever the OWNER temporarily suspends work for any conditions enumerated in this Article 15.01 A, the CONTRACTOR shall be entitled to an adjustment in the Contract Time as specified in Article 12.03 C.

B. The suspension of work shall be effective upon receipt by the Contractor of the written order suspending the work and shall be terminated upon receipt by the Contractor of the written order terminating the suspension.

C. The CONTRACTOR hereby indemnifies and holds harmless the OWNER and ENGINEER, their officers, agents and employees, from and against all claims, damages, losses and expenses, including lost profits and attorney's fees, arising out of or resulting from the temporary suspension of the WORK, whether for the OWNER's convenience described in this Article or for whatever other reasons, including the stoppage of work by the ENGINEER for the CONTRACTOR's failure to comply with any order issued by the ENGINEER.

15.02 TERMINATION OF AGREEMENT BY OWNER (CONTRACTOR DEFAULT)

A. In the event of default by the CONTRACTOR, the OWNER may give written notice to the CONTRACTOR of OWNER's intent to terminate the Agreement. The notice shall state the event of default and the time allowed to remedy the default. It shall be considered a default by the CONTRACTOR whenever the CONTRACTOR shall: (1) declare bankruptcy, become insolvent, or assign its assets for the benefit of its creditors; (2) fail to provide materials or workmanship meeting the requirements of the Contract Documents; (3) disregard or violate provisions of the Contract Documents or ENGINEER's

instructions, (4) fail to prosecute the WORK according to the approved progress schedule; or, (5) fail to provide a qualified superintendent, competent workmen, or materials or equipment meeting the requirements of the Contract Documents. If the CONTRACTOR fails to remedy the conditions constituting default within the time allowed, the OWNER may then issue a Notice of Termination.

B. In the event the Agreement is terminated in accordance with Paragraph 15.02A, the OWNER may take possession of the WORK and may complete the WORK by whatever method or means the OWNER may select. The cost of completing the WORK shall be deducted from the balance which would have been due the CONTRACTOR had the Agreement not been terminated and the WORK completed in accordance with the Contract Documents. If such cost exceeds the balance which would have been due, the CONTRACTOR shall pay the excess amount to the OWNER. If such cost is less than the balance which would have been due, the CONTRACTOR shall have no claim to the difference.

15.03 TERMINATION OF AGREEMENT BY OWNER (FOR CONVENIENCE)

A. The OWNER may terminate the Agreement at any time if it is found that reasons beyond the control of either the OWNER or CONTRACTOR make it impossible or against the OWNER's interests to complete the WORK. In such a case, the CONTRACTOR shall have no claims against the OWNER except: (1) for the value of the work, as determined by the engineer, performed by the Contractor up to the date the Agreement is terminated; and, (2) for the cost of materials and equipment on hand, in transit, or on definite commitment, as of the date the Agreement is terminated, which would be needed in the WORK and which meet the requirements of the Contact Documents. The value of work performed and the cost of materials and equipment delivered to the site, as mentioned above, shall be determined by the ENGINEER in accordance with the procedure prescribed from making the final application for payment and final payment under Paragraphs 14.09 and 14.10.

15.04 TERMINATION OF AGREEMENT BY CONTRACTOR

A. The CONTRACTOR may terminate the Agreement upon 10 days written notice to the OWNER, whenever: (1) the WORK has been suspended under the provisions of Paragraph 15.01, for more than 90 consecutive days through no fault or negligence of the CONTRACTOR, and notice to resume work or to terminate the agreement has not been received from the OWNER within this time period; or, (2) the OWNER should fail to pay the

CONTRACTOR any monies due him in accordance with the terms or the Contract Documents and within 60 days after presentation to the OWNER by the CONTRACTOR of a request therefor, unless within said 10-day period the OWNER shall have remedied the condition upon which the payment delay was based. In the event of such termination, the CONTRACTOR shall have no claims against the OWNER except for those claims specifically enumerated in Paragraph 15.03, and as determined in Accordance with the requirements of that paragraph.

GENERAL CONDITIONS

ARTICLE 16 - MISCELLANEOUS

16.01 GIVING NOTICE

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

16.02 TITLE TO MATERIALS FOUND ON THE WORK

A. The OWNER reserves the right to retain title to all soils, stone, sand, gravel, and other materials developed and obtained from excavations and other operations connected with the WORK. Unless otherwise specified in the Contract Documents, neither the CONTRACTOR nor any subcontractor shall have any right, title, or interest in or to any such materials. The CONTRACTOR will be permitted to use in the WORK, without charge, any such materials which meet the requirements of the Contract Documents.

16.03 RIGHT TO AUDIT

A. If the CONTRACTOR submits a claim to the OWNER for additional compensation, the OWNER shall have the right, as a condition to considering the claim, and as a basis for evaluation of the claim, and until the claim has been settled, to audit the CONTRACTOR's books. This right shall include the right to examine books, records, documents, and other evidence and accounting procedures and practices, sufficient to discover and verify all direct and indirect costs of whatever nature claimed to have been incurred or anticipated to be incurred and for which the claim has been submitted. The right to audit shall include the right to inspect the CONTRACTOR's plants, or such parts thereof, as may be or have been engaged in the performance of the WORK. The CONTRACTOR further agrees that the right to audit encompasses all subcontracts and is binding upon subcontractors. The right to examine and inspect herein provided for shall be exercisable through such representatives as the OWNER deems desirable during the CONTRACTOR's normal business hours at the office of the CONTRACTOR. The CONTRACTOR shall make available to the OWNER for auditing, all relevant accounting records and documents, and other financial data, and upon request, shall submit true copies of requested records to the OWNER.

16.04 ASBESTOS

A. If the CONTRACTOR during the course of work observes the existence of asbestos in any structure or building, the CONTRACTOR shall promptly notify the OWNER and the ENGINEER. The OWNER shall consult with the ENGINEER regarding removal or encapsulation of the asbestos material and the CONTRACTOR shall not perform any work pertinent to the asbestos material prior to receipt or special instruction from the OWNER through the ENGINEER.

SUPPLEMENTAL GENERAL CONDITIONS

ARTICLE 17- GENERAL

17.01 GENERAL

1. These Supplemental General Conditions amend or supplement the General Conditions of the Contract and any other provisions of the Contract Documents as indicated herein. All provisions which are not so amended or supplemented remain in full force and effect.

2. The terms used in these Supplemental General Conditions which are defined in the General Conditions of the Contract have the meanings assigned to them in the General Conditions of the Contract herein.

17.02 SUPPLEMENTAL DEFINITIONS

1. ENGINEER

The "Engineer" is Bowen, Collins, and Associates, Inc.

17.03 TESTING COSTS

1. Paragraph 13.03 of the General Conditions is amended as follows: the CONTRACTOR shall pay all testing costs. The Owner reserves the right to have additional tests performed by a testing organization selected by the OWNER and at the OWNER’s expense.

SUPPLEMENTAL GENERAL CONDITIONS

ARTICLE 18 - AMOUNTS OF LIQUIDATED DAMAGES, BONDS AND INSURANCE

18.01 AMOUNT OF LIQUIDATED DAMAGES

A. As provided in Article 14.07 of the General Conditions, the Contractor shall pay to the Owner as liquidated damages the amount of $1,000 for each calendar day's delay beyond the Contract Time for substantial completion. The Contractor shall pay to the Owner as liquidated damages the amount of $200 for each calendar day's delay beyond 45 calendar days from the date of substantial Completion until the Engineer issues the Notice of Final Completion.

18.02 PERFORMANCE AND OTHER BOND AMOUNTS

A. The CONTRACTOR shall furnish a satisfactory Performance Bond in the amount of 100 percent of the Contract Price and a satisfactory Payment Bond in the amount of 100 percent of the Contract Price.

18.03 INSURANCE AMOUNTS

The limits of liability for the insurance required by Paragraph 5.02 of the General Conditions shall provide for not less than the following amounts or greater where required by Laws and Regulations:

A. Workers' Compensation under Paragraph 5.02B.1 of the General Conditions:

1. State: Utah — Statutory

B. Comprehensive General Liability: (under Paragraph 5.02B.2 of the General Conditions):

1. Bodily Injury (including completed operations and products liability):

$ 500,000 — Each Occurrence
$ 1,000,000 — Annual Aggregate

Property Damage:

$ 500,000 — Each Occurrence
$ 1,000,000 — Annual Aggregate
or a combined single limit of — $1,000,000

2. Property Damage liability insurance including, Explosion, Collapse and Underground coverages, where applicable.

3. Personal Injury, with employment exclusion deleted

$ 1,000,000 Annual Aggregate

C. Comprehensive Automobile Liability: (Under Paragraph 5.02B.3 of the General Conditions:)

1. Bodily Injury

$ 500,000 Each Person
$ 1,000,000 Each Occurrence

2. Property Damage:

$ 500,000 Each Occurrence

or combined single limit of $1,000,000

D. Builders Risk: Not required.

SUPPLEMENTAL GENERAL CONDITIONS

ARTICLE 19 - PHYSICAL CONDITIONS AND WEATHER DELAYS

19.01 INCLEMENT WEATHER DELAYS

A. The Contractor's construction schedule shall be based upon the inclusion of at least five (5) day(s) of inclement weather delays. Reference Article 12, paragraph 12.02 of the General Conditions for additional requirements.

SUPPLEMENTAL GENERAL CONDITIONS

ARTICLE 20 - SUBCONTRACT LIMITATIONS

20.01 SUBCONTRACT LIMITATIONS

A. In addition to the provisions of Paragraph 6.05 of the General Conditions, the CONTRACTOR shall perform not less than 20 percent of the WORK with its own forces (i.e., without subcontracting). The 20 percent requirement shall be understood to refer to the WORK, the value of which totals not less than 20 percent of the Contract Price.

ARTICLE 21 - MISCELLANEOUS

21.01 PATENTS AND COPYRIGHTS

The Contractor shall indemnify and save harmless the Owner, the Engineer, and their officers, agents, and employees, against all claims or liability arising from the use of any patented or copyrighted design, device, material, or process by the Contractor or any of his subcontractors in the performance of the work.

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DIVISION 01
GENERAL REQUIREMENTS

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SECTION 01 11 00
SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. The Work to be performed under this Contract consists of furnishing all tools, equipment, materials, supplies, and manufactured articles and furnishing all labor, transportation, and services, including fuel, power, water, and essential communications, and performing all Work, or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The Work shall be complete, and all Work, materials, and services not expressly indicated or called for in the Contract Documents, which may be necessary for the complete, safe, and proper construction of the Work in good faith shall be provided by Contractor as though originally so indicated, at no increase in cost to Owner.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of this Contract comprises the construction of the Rosecrest Pipeline. The project includes 7,800 feet of new 24" diameter welded steel pipe, along with new 16", 20" and 30" welded steel pipe, construction of three cast-in-place vaults, two drains with blow-off structures, and air valve vaults. Work includes connections between the existing pipelines and the new vaults and Rosecrest Pipeline. Project work also includes cathodic protection, demolition of existing structures, replacement of fire hydrants, site restoration and instrumentation. The Work is primarily located along Rosecrest Road from 13400 South to the Rosecrest Reservoir off of Emmeline Drive.

B. The Work of this Contract comprises of the full reconstruction of the Rosecrest Road from 13400 South to Rocky Point Drive and full mill and overlay of the Rosecrest Road from Rocky Point Drive to Crown Rose Drive and extents shown at 13400 South. Project work includes replacement of identified curb and gutter, waterways and ADA ramps along Rosecrest Road. Work also includes adjustments of all existing monument, valve and manhole collars, as well as adding any missing collars and striping of the roadway.

C. The Work is located mostly in Herriman City, Utah with work in 13400 South which is the boundary between Riverton City and Herriman City, in Salt Lake County as indicated on the Drawings.

1.3 CONTRACT METHOD

A. The Work hereunder will be constructed under a single unit price contract.

1.4 STREAMLINED SPECIFICATIONS

A. These specifications are written in streamlined or declarative style, often using incomplete sentences. This imperative language is directed to Contractor unless specifically noted otherwise.

B. Omissions of such words and phrases as “Contractor shall,” “in conformity therewith,” “shall be,” “as shown on the Drawings,” “a,” “an,” “the,” and “all” are intentional in streamlined sections.
   1. Omitted words shall be supplied by inference in the same manner as when a note appears on the Drawings.
   2. Omission of such words shall not relieve Contractor from providing the items and work described herein or indicated on the Drawings.
   3. Words “shall be” are included by inference where a colon (:) is used within sentences or phrases.

1.5 WORK BY OTHERS

A. Owner reserves the right to perform or award other work concurrent with the Work included in this Contract
   1. Work may be conducted at or adjacent to the Site by other contractors during the performance of the Work under this Contract. Conduct operations to cause a minimum of interference with the Work of such other contractors and cooperate fully with such contractors to provide continued safe access to their respective portions of the Site, as required to perform Work under their respective contracts.

B. Interference With Work On Utilities:
   1. Cooperate and coordinate fully with all utility forces of Owner or forces of other public or private agencies engaged in the relocation, altering, or otherwise rearranging of any facilities which interfere with the progress of the Work.
   2. Schedule the Work to minimize interference with said relocation, altering, or other rearranging of facilities.

1.6 WORK SEQUENCE

A. Schedule and perform the Work in such a manner as to result in the least possible disruption to the public's use of roadways, driveways, and utilities. Utilities shall include but not be limited to water, sewerage, drainage structures, ditches and canals, gas, electric, cable television, and telephone. Refer to Utility Adjustment and other plan and profile sheets for approximate location of utilities. However, there is no guarantee as to accuracy or completeness. Contractor shall incorporate as-built locations on the reproducible record plans, in red ink, showing proper location on each sheet where these utilities are located.

1.7 CONTRACTOR USE OF PROJECT SITE

A. Use of the Project Site shall be limited to construction operations, including on-Site storage of materials, on-Site fabrication facilities, and field offices.

1.8 OWNER USE OF THE PROJECT SITE

A. Cooperate and coordinate with Owner to facilitate Owner's operations and projects and to minimize interference with Contractor's operations at the same time. In any event, Owner shall be allowed safe access to the Project Site during the period of construction.

1.9 PARTIAL UTILIZATION OF THE WORK BY OWNER

A. Owner may take partial utilization of the Work upon successful tie in of the new pipeline with the existing system. Partial utilization may involve the placing into service of the Rosecrest Pipeline, 13400 South pipeline, Herriman City and Riverton City metering vaults, and any project appurtenances that are completed and ready to be placed into service.

1.10 CONTRACTOR'S WORKING HOURS

A. Perform work within Owner's regular working hours from Monday thru Friday, 7 AM to 7 PM. If Contractor desires to work overtime or work on a Saturday, Sunday, or any legal holiday, obtain prior approval from Owner and Engineer.

1.11 STORAGE

A. Storage conditions shall be acceptable to Owner for all materials and equipment not incorporated into the Work but included in Applications for Payment. Such storage arrangements and conditions shall be presented in writing for Owner's review and approval and shall afford adequate and satisfactory security and protection. Off-site storage facilities shall be accessible to Engineer. The stored materials shall be insured for full value. Certificates of liability insurance coverage must be submitted to Engineer with the request for payment by Contractor. All arrangements and costs for storage facilities shall be paid by Contractor, unless specifically designated in the Contract Documents to be furnished by Owner.

1.12 NOTICES TO OWNERS OF ADJACENT PROPERTIES AND UTILITIES

A. Notify Owners of adjacent property and utilities when prosecution of the Work may affect them, refer to Section 01 71 40 – Public Information Program.

B. When it is necessary to temporarily deny access by owners or tenants to their property, or when any utility service connection must be interrupted, give notices sufficiently in advance to enable the affected person(s) to provide for their needs, but notice shall not be less than 7 days. Notices shall conform to any applicable local ordinance and, whether delivered orally or in writing, shall include appropriate information concerning the interruption and instructions on how to limit any resulting inconvenience.

C. Utilities and other concerned agencies shall be contacted at least seven days prior to cutting or closing streets or other traffic areas or excavating near underground utilities or pole lines.

D. Review with the various utility companies the construction methods, safety procedures, and Work to be done in the vicinity of utilities. When temporary relocation of utilities is necessary, provide sufficient advance notice to the utility involved.

1.13 LINES AND GRADES

A. Perform all Work to the lines, grades, and elevations shown on the Drawings.

B. Basic horizontal and vertical control points will be established or designated as provided in General Conditions paragraphs. Use these points as datum for the Work. Perform any

additional survey, layout, or measurement work needed for proper construction of the Work as a part of the Work at no additional cost to Owner.

C. Employ experienced instrument personnel, competent assistants, and such instruments, tools, stakes, and other materials required to complete the survey, layout, and measurement work. In addition, furnish, without additional charge, competent personnel and such tools, stakes, and other materials as Engineer may require in establishing or designating control points or in checking survey, layout, and measurement of Work performed.

D. Keep Engineer informed, a reasonable time in advance, of the times and places at which Work is to be done, so that horizontal and vertical control points may be established, and any checking deemed necessary by Engineer may be done with minimum delay to the Project.

E. Remove and reconstruct Work, which is improperly located.

1.14 PROJECT MEETINGS

A. Preconstruction Conference
   1. Prior to the commencement of Work at the Site, a preconstruction conference will be held at a mutually agreed time and place which shall be attended by Contractor's Project Manager, its Superintendent, its Safety Representative, its Public Information Manager, and its Subcontractors as Contractor deems appropriate. Other attendees will be:
      a. Engineer
      b. Representatives of Owner
      c. Governmental representatives as appropriate
      d. Others as requested by Contractor, Owner, or Engineer
      e. Engineer’s Representative
   2. Bring to the conference, any submittals so indicated in Section 01 33 20 - Contractor Submittals.
   3. The purpose of the conference is to designate responsible personnel, discuss contract requirements and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The complete agenda will be furnished by Engineer prior to the meeting date. However, be prepared to discuss all the items listed below.
      a. Contractor's assignments for safety and first aid, including Designated Competent person(s) and Contractor's safety Representative.
      b. Status of Contractor's insurance and bonds.
      c. Contractor's tentative schedules.
      d. Transmittal, review, and distribution of Contractor's submittals.
      e. Processing applications for payment.
      f. Maintaining record documents.
      g. Critical Work sequencing.
      h. Field decisions and Change Orders.
      i. Use of project site, office and storage areas, security, housekeeping, and Owner's needs.
      j. Major equipment deliveries and priorities.
      k. Permits required for construction.
      l. Utilities required for construction.
      m. Contract Owner and channels of communication.
      n. Coordination with others.

4. Engineer will preside at the preconstruction conference and will arrange for keeping and distributing the minutes to all persons in attendance.

B. Progress Meetings

1. Engineer will schedule and hold regular on-Site progress meetings at least weekly and at other times as deemed necessary by Engineer or as required by progress of the Work. Contractor, Engineer, and all Subcontractors active on the Site must attend each meeting. Contractor may at its discretion request attendance by representatives of its Suppliers, manufacturers, and other Subcontractors.
2. Engineer will preside at the meetings and will arrange for keeping and distributing the minutes. The purpose of the meetings will be to review the progress of the Work, discuss safety, maintain coordination of efforts, discuss commercial issues, discuss changes in scheduling, and resolve other problems, which may develop. During each meeting, all parties are required to present any issues, which may impact its Work, with a view toward resolving these issues expeditiously.

1.15 AVAILABLE SUPPLEMENTAL DATA

A. Geotechnical Report: Geotechnical data referenced in these Contract Documents are based upon the report titled "JVWCD Rosecrest Pipeline", prepared by RB&G Engineering, Inc, dated February 1, 2025. Report is available in Appendix A.

B. Inspection Reports from Herriman City showing locations where ADA ramp deficiencies were noted during onsite inspections in 2025. Inspections reports available in Appendix B.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

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SECTION 01 14 40
CONSTRUCTION AND SCHEDULE RESTRAINTS

PART 1 - GENERAL

1.1 SUMMARY

A. Schedule, sequence, and perform the Work in a manner, which minimizes disruption to the public and to the operation and maintenance of existing facilities.

B. Allow for construction and schedule constraints in preparing the construction schedules required under Section 01 32 16 – Construction Progress Schedule. Include all the activities necessary to satisfy all constraints included and referenced in the Contract Documents.

1.2 PERMITS

A. Abide by the conditions of all permits, easements, and private agreements made and obtain written acceptance of the constructed conditions from each issuer of the permit, easement, or private agreement prior to acceptance of Work by Owner, at no additional expense to Owner.

1.3 COORDINATION WITH OTHER CONSTRUCTION

A. Be responsible for coordinating the Work depicted in the Contract Documents with Owner, Engineer, and all other contractors or suppliers working at, or near the Project Site in accordance with the General Conditions and Supplementary General Conditions.

1.4 SCHEDULE CONSTRAINTS

A. Be responsible to coordinate and plan the construction activities to integrate each schedule constraint into performance of the overall Work.

B. The listing of schedule constraints below does not mean that all constraints or special conditions have been identified. The list is not a substitute for the duty to coordinate and plan for completion, all Work by the Substantial/Contract Completion Dates specified in the Contract Documents.

C. Special Listing: The following constraints affect the construction schedule.

1. Coordinate shutdown schedules with the Owner a minimum of 30 days in advance of each shutdown. Additional notice requirements are below for specific locations. Note that the shutdown durations and dates indicated below are defined as the duration the Contractor will have possession of the shutdown pipelines. JVWCD staff are anticipated to be draining each pipeline approximately two (2) days prior to a Contractor's requested shutdown date. JVWCD may also be anticipated to be filling for up to two (2) days following the end date of each shutdown duration.

2. Rosecrest Pipeline (Existing and New)

a. Shutdown Duration: 7 days,

1) Shutdown is not to occur without New Rosecrest Pipeline ready to put into operation.

b. Shutdown Window: Low demand months, November through March.
c. The existing Rosecrest Pipeline is to remain in operation until the new Rosecrest Pipeline has been cleaned, disinfected, tested and is ready to be commissioned with connections to the system. The existing Rosecrest Pipeline is primarily fed from the 13400 South Pipeline and can be secondarily fed from the 5600 West pipeline. There are several isolation valves along the existing pipeline that may aid in shutdown sequencing.
d. Provide shutdown sequencing plan to JVWCD 30 days in advance.
e. There are 2 service connections to the Foothill Area and 5 fire hydrant connections along the existing Rosecrest Pipeline that must be relocated to the Herriman City system prior to shutdown of the existing Rosecrest Pipeline.

3. 13400 South Pipeline

a. Shutdown Duration: 28 days
b. Shutdown Window: Low demand months, November through March.
c. Shutdown of the 13400 South Pipeline cannot be concurrent with shutdown of the 5600 West Pipeline.
d. Riverton City has two supply connections from this pipeline and at least 1 of them must be maintained at all times. Coordinate maintaining the service line at 13400 South with JVWCD prior to any demolition or shutdown of the 13400 South Pipeline and feed this service from the 5600 West Pipeline as required.
e. Notify JVWCD 30 days in advance of shutdown dates and coordinate with JVWCD for isolation valve operations.
f. Traffic Control restrictions may require night work or extended hours for construction at this location, schedule work to meet shutdown requirements and traffic control requirements.

4. 5600 West Pipeline

a. Shutdown Duration: 28 days
b. Shutdown Window: Low demand months, November through February.
c. Shutdowns cannot occur concurrently with Mountain View Corridor project (UDOT) work for Riverton City waterline relocations or JVWCD waterline relocations.
    1) UDOT work coordination is required for shutdowns associated with the work at 12600 South, as these shutdowns affect Riverton City.
    2) UDOT work coordination is required for shutdowns associated with work at 13400 South, as these shutdowns affect JVWCD and Riverton City.
d. Shutdown cannot occur concurrently with the 13400 South Pipeline shutdown.
e. Notify JVWCD 30 days in advance of shutdown dates and coordinate with JVWCD for isolation valve operations.
f. Traffic Control restrictions may require night work or extended hours for construction at this location, schedule work to meet shutdown requirements and traffic control requirements.
g. Supply to Riverton City and Herriman City at 13400 South must be provided during shutdown of this waterline.

5. Foothill Service Area Connections (JVWCD and Herriman City Culinary Waterlines)

a. There are two connections for supply to the Foothill Area, one is located at Rocky Point Drive and the other at 13680 South. Both are currently fed off the existing JVWCD Rosecrest Pipeline.

b. There are two connections for supply to the Foothill Area, one is located at Rocky Point Drive and the other at 13680 South. Both are currently fed off the existing JVWCD Rosecrest Pipeline.

c. Only one connection may be shut down at a time while the other services the Foothill Area.

d. Shutdown Duration: 24 hours

1) Hot taps do not require shutdowns but require District Inspector to be onsite.

e. Shutdown Window: None.

6. Herriman City Pump Station

a. Shutdown Duration: 1 week (7 days)

b. Shutdown Window: Low demand months, November through March.

c. Coordinate with Herriman City for shutdown 30 days in advance.

7. Herriman City Main Culinary Waterlines

a. Shutdown Duration: 24 hours

1) Hot Taps do not require shutdowns but require City Inspectors to be onsite.

b. Shutdown window: Low demand months, November through March.

c. Notify Herriman City 30 days in advance of planned connections.

d. The two relocations from JVWCD to Heriman City system (located one at 13680 South and one at Rocky Point Drive) are to occur prior to shutdown of existing Rosecrest Pipeline. Maintain service to one of these connections at all times.

8. Riverton City Main Culinary Waterlines

a. Shutdown Duration: 4 hours

b. Shutdown window: November through March; but not during Holidays – Thanksgiving, Christmas and New Year's Eve.

c. Notify Riverton City 30 days in advance of shutdown dates.

d. This work may require weekend or night construction due to customer usage requirements during daytime hours.

e. Only one shutdown is allowed for the connection to the main line at 13400 South.

f. Must maintain at least 1 service at all times; there are two services off the 13400 South pipeline, one at the Rosecrest Rd intersection and one further east at 4800 West.

9. Enbridge Gas Relocation

a. Enbridge gas line relocations for the Interconnect Vault and the Rocky Point Drive Mainline Valve Vault are needing to be completed by Enbridge prior to the construction of the Interconnect Vault and the Rocky Point Vault. Enbridge relocation completion dates are unknown at this time, but for

bidding purposes it is assumed to be March 1st, 2026. Allow for Enbridge relocation to be performed prior to construction in this area.

10. Blackridge Elementary School and Crown Rose Drive

a. Work occurring along Rosecrest Road at the elementary school shall occur during summer months when school is not in session.

b. Work occurring at the intersection of Crown Rose Drive and Rosecrest Road shall occur during summer months when school is not in session as this is a Safe Walk Route to the elementary.

c. Estimated Work Window: June 8th, 2026, thru August 7th, 2026 – direct coordinate with the Jordan School District on exact dates for the School Year Calendar restrictions is required.

11. SCHEDULE B - Rosecrest Roadway Improvements

a. Asphalt paving is to comply with Herriman City requirements as defined in the Herriman City standards and specifications.

b. Blackridge Elementary School and Crown Rose Drive restrictions also apply to Schedule B.

c. Contractor is to maintain at least half of the Rosecrest roadway open at a time during roadway treatment.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 20 00
MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 GENERAL PROGRESS PAYMENT REQUIREMENTS

A. A Payment for Work performed shall be in accordance with installed quantities as assessed in comparison to the Schedule of Values and the Construction Schedule. Engineer will verify measurements and quantities. Each activity necessary to manage and complete the Work is identified on the Contract schedules. Each activity will be assigned its respective value, a portion of the Contract Price, as shown on the Schedule of Values (Roll-up), and detailed cost loaded activity schedule.

B. Payment for all lump sum costs and services incurred on this Agreement shall be based on the earned value of Work accomplished during the reporting period. Earned value is determined by the completion percentage of each activity as determined by the Schedule of Values and the Construction Schedule applied to the total value of the activity. No construction activity shall be deemed 100 percent complete until Contractor has completed the physical check out and inspection of the completed Work and has submitted the signed inspection form to Engineer.

C. Earned value is derived from the current status of Contractor Construction Schedule as determined by the monthly schedule status submittals. Each schedule status submittal is reviewed and approved by Engineer prior to Contractor obtaining approval for the Summary of Earned Values or quantities installed and the Application for Payment.

1.2 APPLICATION FOR PAYMENT

A. Submit application for payment on Owner's form and be certified by signature of an Authorized Officer of Contractor.

B. The Application for Payment shall contain all necessary references and attachments that substantiate the invoice for progress payment (e.g., certified payrolls, labor reports, progress schedule data, and Summary of Earned Values). It shall substantiate the invoice for progress payment and shall be preceded or accompanied by the schedule and status data as a condition of payment, in accordance with the Construction Schedule and the Schedule of Values.

1.3 REVIEWS/APPLICATION FOR PAYMENT

A. Review meetings between Contractor and Engineer will be held weekly and within 7 Days prior to the payment application date designated by Engineer. Three Days prior to the last review meeting of the month, submit an updated schedule and a signed application for payment showing a Summary of Earned Values for the reporting and payment period so that Engineer can compare earned values to available status data. Make any adjustments to the Master Record Documents, updated schedule, and payment applications required by Engineer. Upon completion of the adjustments, Engineer will sign the payment request and forward it to Owner. Engineer will determine payment amounts if agreement with Contractor is not reached.

1.4 PAYMENT FOR SUPPLIES AND MATERIALS

A. Payment based on the actual cost of supplies, materials and equipment on hand shall be made by Owner with a paid invoice. "Actual cost" of materials shall be the invoice amount, and shall not include any costs associated with installation, testing, etc. Contractor shall be entitled to payment of the actual cost of supplies, materials, and equipment only if it (1) presents an invoice to Owner with the application for payment and (2) states in the application for payment that the materials have been delivered and stored in the time and manner specified in the contract between Contractor and his Supplier or Subcontractor. If Contractor fails to comply with those conditions, Owner may withhold payment in accordance with the provisions. Owner expressly reserves the right to withhold payment until Contractor presents to Owner a paid invoice, or some other proof of payment satisfactory to Owner, for Owner's use in verifying the accuracy of the actual cost of the supplies, materials or equipment. Payment for supplies, materials or equipment on hand does not alter the responsibility of Contractor for all supplies, materials and equipment until Final Acceptance of the Work.

1.5 MEASUREMENT AND PAYMENT

A. Unit prices or lump sum amounts to include full compensation for furnishing all labor, materials, products, tools, equipment, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit, taxes, and doing all work shown on the Drawings, defined in the Specifications, and/or stipulated herein.

B. Payment covers the cost of incidental work which includes: progress schedule; QC program; safety procedure plan; maintaining construction schedule; submittals; manufacturer's service in accordance with the specifications; dust control; irrigation, surface water and drainage management; pipeline connections except as identified specifically in other bid items; coordination with property owners, businesses, contractors, and government agencies; all provisions required to provide and maintain access to all properties affected by construction operations; construction surveying; saw cutting, removal, and disposal of existing trench pavement; unclassified excavation; pot hole excavations; trench excavations; structure excavations; removal and disposal of waste materials; trench dewatering; pipe zone material; select import fill material; compaction of backfill materials; fees from the County Surveyor for monument restoration; untreated base course at depth indicated; hauling and stockpiling of materials and equipment; stockpiling and restoration of topsoil in unimproved areas; protection and support of existing surface and subsurface features; providing assistance to other utility companies in locating and relocating service laterals, as needed; replacement and restoration of existing utilities (mains and services) and other items damaged by the CONTRACTOR's operations; removal and replacement of landscape materials and irrigation systems equal to or better than existing if damaged by the CONTRACTOR's operations; and all other necessary work, to install the Work complete in place.

C. Contractor's shall note that the information provided in this section is intended for use as a general description of the breakdown of work to be included in the Bid Schedule. **The following descriptions are NOT intended to represent a complete listing of all elements of Work required by the Contract Documents.** It is the Contractor's responsibility to make sure that costs for all Work required in the plans and specifications is accounted for in the appropriate Bid Items, whether or not specifically described in this Measurement and

Payment section. The Owner is not responsible for Contractor's failure to properly coordinate with Subcontractors and Suppliers regarding the breakdown of Work in these Contract Documents.

D. BID SCHEDULE , Measurement and Payment to be as follows:

1. Bid Item No. 1 – Mobilization, Demobilization, Temporary Facilities and Administrative Items

a. Measurement: Mobilization, Demobilization, Temporary Facilities, and Administrative Items will be paid for on a Lump Sum basis. Payment shall be made on a percent complete basis as described below.

b. Payment: Cost of mobilization and demobilization including but not limited to: bonds and insurance; contract administration; mobilization; demobilization; videotaping site conditions prior to construction; furnishing and erecting temporary construction facilities; project signs and obtaining any additional permits not already obtained by the OWNER. This pay item shall constitute full compensation for all labor, equipment, tools, supplies and materials required to complete this portion of the Work for this construction project.

c. For purposes of payment, this bid item shall be paid for on a percent complete basis. The lump sum bid price for this bid item shall not exceed 10 percent of the total bid price. Any bid proposal for mobilization, demobilization, temporary facilities, and administration items that is greater than 10 percent will be adjusted to the maximum amount of 10 percent of the total bid. The bid item so adjusted will be the Contractor's bid for that item, and the Contractor's bid for the project will be recalculated and the revised total used to compare with other bidders to determine the low bid. The OWNER will pay the adjusted lump sum price. Bid item will be paid on a percent complete basis as summarized in the following table:

Partial Payment	Amount	When Paid
1st	40 percent of bid item lump sum.	With 1st pay request
2nd	30 percent of bid item lump sum.	With 1st pay request following completion of 10 percent of contract
3rd	30 percent of bid item lump sum (for demobilization).	With 1st pay request following completion of 90 percent of contract

2. Bid Item No. 2 – Traffic Control

a. Measurement: Payment will be made on a Lump Sum basis.

b. Payment: Cost of traffic control including but not limited to: work for the cost for vehicular and pedestrian protection from work zone activity, services of a certified traffic control technician and a traffic control plan acceptable to Herriman City and Riverton City all in accordance with the project specification and construction drawings, including, but not limited to: all labor, materials, and equipment required to develop and implement a traffic control plan in accordance with the requirements; maintain smooth vehicular

traffic flow in the project area during construction; perform partial or complete road closures as allowed in the Contract Documents; signage, electronic message boards, barriers, warning devices, flaggers, and cleaning of roads to maintain a clean condition with no accumulation of dirt, debris, or other foreign objects as required by the Contract Documents and permits. Bid Price shall cover all labor, materials, and equipment required to maintain safe pedestrian access through the project area during construction; including but not limited to signage, warning devices, safety fencing, and maintaining a clean sidewalk that is free of dirt, gravel, and other construction debris.

c. For purposes of payment, this bid item shall be paid for on a percent complete basis. Bid item will be paid on a percent complete basis as summarized in the following table:

Partial Payment	Amount	When Paid
1st	40 percent of bid item lump sum.	With 1st pay request
2nd	20 percent of bid item lump sum.	With 1st pay request following completion of 10 percent of contract
3rd	20 percent of bid item lump sum.	With 1st pay request following completion of 60 percent of contract
4th	20 percent of bid item lump sum.	With 1st pay request following completion of 90 percent of contract

3. Bid Item No. 3 – Public Information and Engagement

a. Measurement: Payment will be made on a Lump Sum basis.

b. Payment: Cost of public engagement and information including but not limited to: work for creating a public information plan and the services of a qualified Public Information Manager all in accordance with the requirements; maintain smooth communications with the partner cities, stakeholders and public for the duration of the project; perform public engagement responsibilities as identified in the Contract Documents; partner and public notifications, meetings, one-on-one interactions; hotline or other methods to receive and track communications; coordination with schools, parks, commercial businesses and any other entities affected by the project. Price shall cover all labor, materials and equipment required to maintain public involvement throughout the project area and duration.

c. For purposes of payment, this bid item shall be paid for on a percent complete basis. Bid item will be paid on a percent complete basis as summarized in the following table:

Partial Payment	Amount	When Paid
1st	30 percent of bid item lump sum.	With 1st pay request

2nd	30 percent of bid item lump sum.	With 1st pay request following completion of 10 percent of contract
3rd	20 percent of bid item lump sum	With 1st pay request following completion of 60 percent of contract
4th	20 percent of bid item lump sum	With 1st pay request following completion of 90 percent of contract

4. Bid Item No. 4 – Welded Steel Pipe

a. Measurement: Payment for the construction of the welded steel pipe will be made on a Linear Feet basis.

b. Payment: Payment will be made based on the diameter and thickness shown in the drawings on a linear foot basis, to the nearest foot, along the pipe with no deduction for fittings, including furnishing and installing all pipe materials, fittings, and appurtenances; potholing existing utilities; coordinating with existing utility owners and supporting of existing utilities as required; site condition and construction progress surveys; asphalt sawcutting and removal; concrete flatwork sawcutting, and removal; temporary security fencing; excavation including all sheeting, shoring and bracing of excavations as required; dewatering; removal of existing pipeline if within a section for replacement; furnishing and installing the pipe and all appurtenances at the strength and wall thickness shown; welding and joint preparation; coating and lining; temporary coverings of pipeline ends; temporary dish heads; trench cutoff walls and trench plugs, as necessary; furnishing and installing pipe marking tape and markers; pipe zone and trench backfill materials; temporary and permanent existing utility support (CLSM), as required; and cleaning, disinfection and hydrostatic testing; and balance of all Work required for installation of the welded steel pipe as shown on the plans, Complete.

c. Payment for the cleaning, disinfection, and testing of the Rosecrest Pipeline system: Payment will be made on the basis of the Contractor's bid for the successful hydrostatic testing and disinfection of the pipeline so that final connections can be made to the existing pipelines and the new system commissioned; testing includes all drains and blowoffs; outlets; air valve structure; and all items within the testing extents, including the Rocky Point Drive Vault; Interconnect Vault to isolation valves on the 5600 West pipeline, Herriman and Riverton metering outlets, and dish head on the 16" Rosecrest Replacement pipeline; including furnishing and installing all materials, fittings, and appurtenances required for testing and disinfecting.

d. No Payment under this item for connections between existing pipelines and new pipelines, or testing associated with Fire Hydrants, Herriman connection at Rocky Point Drive or 13680 South Herriman City connection, these are to be paid under separate bid itemNo payment for over excavation unless approved in writing by Engineer prior to excavation.

e. Piping, equipment and appurtenances within the Interconnect Vault, Rocky Point Vault and Reservoir Vault to be paid under separate bid items.

f. No Payment under this item for cathodic protection; utility relocation(s); restoration; connections to existing pipelines. These Items are to be paid under separate bid items.

5. Bid Item No. 5 – Connection to Herriman City Pump Station, Complete

a. Measurement: Payment for the construction of the turnout to the Herriman City Pump Station will be made on a Lump Sum basis.

b. Payment includes all costs of pipe, work and materials associated with the construction of the pipeline as shown on the drawings: including furnishing and installing all pipe materials, valves, fittings, and appurtenances; including joint restraining devices; thrust blocks; miscellaneous fittings required for connection to existing system; potholing existing utilities; potholing existing pipeline for connection; site condition and construction progress surveys; asphalt sawcutting and removal; concrete flatwork sawcutting and removal; temporary asphalt as required; excavation including all sheeting, shoring and bracing of excavations as required; temporary and permanent existing utility support (CLSM), as required; dewatering; greasing and wrapping fittings with flanges and bolts; pipe marking tape and/or tracing wire; restoration of disturbed area; pipe zone and trench backfill materials; pipeline cleaning, disinfection and testing as required to meet Herriman City standards and specifications; and balance of all Work required for installation and commissioning of the pipeline as shown on the plans, Complete.

c. Asphalt pavement restoration to be paid under separate bid item.

6. Bid Item No. 6 – Foothill Service Area Connection to Herriman City System

a. Measurement: Payment for the construction of the connection between the Herriman City system and Foothill Service Area will be made on a Lump Sum basis.

b. Payment: Payment includes all costs of pipe, work and materials associated with the construction of the pipeline as shown on the drawings; including furnishing and installing all pipe materials, valves, fittings, and appurtenances to the size and pressure rating required; including joint restraining devices; thrust blocks; miscellaneous fittings required for connection to existing system; equipment and all items required for hot tap connections, where indicated; potholing existing utilities; potholing existing pipeline for connection; site condition and construction progress surveys; asphalt sawcutting and removal; concrete flatwork sawcutting and removal; excavation including all sheeting, shoring and bracing of excavations as required; temporary and permanent existing utility support (CLSM), as required; dewatering; greasing and wrapping fittings with flanges and bolts; pipe wrap; pipe marking tape and/or tracing wire; coatings required within vaults and manholes; parkstrip restoration; pipe zone and trench backfill materials; pipeline cleaning, disinfection and testing as required to meet Herriman City standards and specifications; and balance of all Work required for installation and commissioning of the pipeline as shown on the plans, Complete.

c. Payment at 13680 South: Payment includes manhole structure of the size indicated on the plans and meeting Herriman City requirements, complete; including work, labor, materials, tools and equipment required to supply, furnish and install manhole; precast sections and base; grade rings; cast iron frame and cover; concrete collar(s) to grade; seal joints with mastic; openings with seals; additional excavation; stabilization material and backfill;

inspections prior to commissioning and all other items as required for installation, complete. Payment includes abandonment of existing buried valve as indicated on the plans and meeting Herriman City requirements, complete; including work, labor, materials, tools and equipment required to locate, expose, and abandon in place; including furnishing and installing adapters, blind flanges, miscellaneous metals; thrust restraint; wax tape coatings; additional excavation and backfill.

d. Payment at Rocky Point: Payment includes pipeline, equipment and appurtenances installed in the Rocky Point Vault, complete.

e. No Payment under this item for asphalt pavement restoration, this is to be paid under separate bid item.

7. Bid Item No. 7 – Ductile Iron Pipe

a. Measurement: Payment for the construction of the ductile iron pipe shall be made on a Linear Feet basis.

b. Payment: Payment will be made based on the diameter and pressure rating indicated on the drawings on a linear foot basis, to the nearest foot, along the pipeline with no deductions for fittings, including furnishing and installing all pipe materials, valves, fittings, and appurtenances; including joint restraining devices; thrust blocks; miscellaneous fittings required for connection to existing system; equipment and all items required for hot tap connections, where indicated; removing, capping and abandoning existing pipelines, as required; potholing existing utilities; potholing existing pipeline for connection; site condition and construction progress surveys; asphalt sawcutting and removal; concrete flatwork sawcutting and removal; excavation including all sheeting, shoring and bracing of excavations as required; temporary and permanent existing utility support (CLSM), as required; dewatering; greasing and wrapping fittings with flanges and bolts; pipe wrap; pipe marking tape; pipe zone and trench backfill materials; pipe cleaning, disinfection and testing as required to meet requirements of pipeline Owner (Herriman City or Riverton City); and balance of all Work required for installation of the pipeline as shown on the plans, Complete.

c. Pay limit is at outside wall of vault, as shown in the drawings.

d. No Payment under this item for asphalt restoration or concrete flatwork. These Items are to be paid under separate bid items.

8. Bid Item No. 8 – Metered Connection to Customer, Interconnection Vault

a. Measurement: Payment for the metering portion to the JVWCD Customer in the Interconnection Vault will be made on a Lump Sum basis.

b. Payment: Payment will be made based on the lump sum bid for construction of the metering connection to the JVWCD customer; including furnishing and installing all pipe materials, valves, fittings, meters, and appurtenances; including all mechanical items, supports and miscellaneous metals; gaskets; instrumentation gauges; protective coatings and linings; any miscellaneous fittings, pipe supports; pipe cleaning, disinfection and testing as required to meet requirements of pipeline Owner (Herriman City or Riverton City); and balance of all Work required for installation of the pipeline as shown on the plans, Complete.

c. Pay limit begins at the isolation flange at the header and extends to the outside wall of the vault as shown in the drawings.

9. Bid Item No. 9 – Not Used

10. Bid Item No. 10 – Connection of New Waterline to Existing Waterline

a. Measurement: Payment for the work required to connect a new waterline to an existing waterline will be made on a per Each basis at the location indicated in the drawings.

b. Payment: Payment will be made on the basis of the Contractor's bid for work required for making the connection between the new waterline and the existing waterline for the size and type at the locations indicated in the drawings; potholing existing utilities to locate and verify; asphalt and concrete sawcutting and removal; furnishing and installing all materials, pipe, fittings, valves, thrust restraint and materials required to complete the connection; welding and joint preparation; repairs to coatings and linings; temporary controls; pipeline dewatering; abandonment of existing pipeline, where indicated; salvaging or removing and disposing of existing pipeline, fittings and appurtenances to make the connection; pipe zone and trench backfill; pipe marking tape and markers; cleaning and disinfection prior to connection; and all other requirements to complete the connection between the waterlines for commissioning of the pipeline within the required time constraints.

c. No Payment under this item for surface restoration, this is to be paid under separate bid items.

11. Bid Item No. 11 – Rosecrest Reservoir Vault & Sampling Manhole, Mechanical and Structural, Site Restoration, and Storm Drain Relocation

a. Measurement: Payment for the work at the Rosecrest Reservoir Vault and sampling manhole, site restoration, and storm drain relocation, will be made on a Lump Sum basis.

b. Payment: Payment will be made on the basis of the Contractor's lump sum bid for construction of the Rosecrest Reservoir Vault within the JVWCD property; including site condition and construction progress surveys; asphalt sawcutting and removal; clearing and grubbing and stock piling topsoil; temporary relocation of landscaping rocks; security fencing; potholing to locate existing pipeline to provide protection during construction; locating existing site utilities for connections including reservoir washdown piping and drains; all earthwork and shoring; protection of existing structures and pipelines; construction of the sampling manhole including precast sections and base; grade rings; cast iron frame and cover; concrete collar(s) to grade; seal joints with mastic; openings with seals; stabilization material; backfill and compaction; ladder; construction of the vault including structural concrete, rebar, stabilization material; backfill and compaction; lifting eyes and miscellaneous structural items; openings; hatches, accesses and ladders; furnishing and installing welded steel pipe and fittings; lining and coatings; furnishing and installing all materials and piping within the vault extents, as indicated; butterfly valves, gate valves, air valves, and all fittings and appurtenances; flowmeters, pumps, fans and all mechanical items, supports and miscellaneous metals; yard piping for drains and pumps including connections to existing piping, cleaning, disinfection and testing to extents required; vent piping, vent stacks and concrete pads; and balance of all Work required for the Rosecrest Reservoir Vault as shown on the plans, Complete.

c. Pay limit is at outside wall of vault, as shown on the plans.

d. Payment for site restoration: Payment will include costs of all labor, materials, equipment, appurtenances and coordination to re-grade site to final elevations and restore as indicated in the contract drawings; including

surveying; rough grading and fine grading; import or use of stored topsoil for all areas disturbed to receive seeding; topsoil to be installed for all seed areas at a depth of 4-inches; import of materials, as necessary; compaction and testing; restoration of the site for drainage flow and elevations back to pre-construction conditions or to final elevations as shown; rock retaining wall; relocation of rocks onsite to facilitate work; bollards; transition between asphalt and non-asphalt restoration areas and any other required restoration of the site.

e. Payment for storm drain relocation: Payment shall constitute full compensation for site condition and construction progress survey; asphalt sawcutting and removal; excavation, earthwork and shoring; furnishing and installing complete storm drain box, grate and pipe; removal of existing box and pipe; modifications to the existing storm drain structure, as required; miscellaneous metals; grout; stabilization materials; backfill and compaction; bypassing existing flows during work; pipe cleaning and inspection; restoration of area around box back to original conditions and all other items to complete the work.

f. No payment for instrumentation, electrical work, Rosecrest Pipeline cleaning, disinfection and testing, asphalt pavement restoration, as these are to be paid under separate items.

12. Bid Item No. 12 – Rosecrest Reservoir Vault, Electrical and Instrumentation

a. Measurement: Payment for the electrical work and instrumentation at the Rosecrest Reservoir Vault, including instrumentation work at the chlorination building, vaults and sampling manhole, complete, will be made on a Lump Sum basis.

b. Payment: Payment will be made on the basis of the Contractor's lump sum bid for all electrical work associated with the Rosecrest Reservoir Vault within the JVWCD property; including furnishing and installing all materials within project extents, as indicated; potholing to locate existing power to provide protection during construction; locating existing site power for connections; earthwork and shoring as required; all electrical work for relocations and connections with existing power meter, power panel, and remote terminal unit; installation of new electrical and controls, lighting, panels and all work for complete electrical; salvage and demolition of existing Reservoir Vault electrical items; and balance of all Work required for the Rosecrest Reservoir Vault site electrical as shown on the plans, Complete.

c. Payment will be made on the basis of the Contractor's lump sum bid for the construction associated with the instrumentation at the sampling manhole, vault and across the site, including modifications within and adjacent to the Chlorination Building at the Rosecrest Reservoir JVWCD property; asphalt sawcutting and removal; potholing and locating existing site utilities for connections including the reservoir level sensor, chlorination conduit, and water sampling; all earthwork and shoring; protection of existing structures and pipelines; sampling equipment and instrumentation including all fittings and appurtenances required for connections; repairs to pipeline coatings and linings at connection points; yard piping and conduits for water services, sampling and chlorine injection; work within the Chlorination Building for instrumentation and sampling; instrumentation work within the Rosecrest Reservoir Vault and balance of all Work required for the Rosecrest Reservoir instrumentation and chlorination building as shown on the plans, Complete.

d. Payment to include restoration of the Chlorination Building associated with work related directly to instrumentation. Restoration back to original condition with repairs made to openings created or abandoned, supports moved, or any other interior or exterior modifications of the building; grout repairs, penetration sealing, paint repairs and/or touch up to the ceiling, and general cleaning.

e. No payment for restoration of the site, as this is to be paid under separate items.

13. Bid Item No. 13 – Not Used

14. Bid Item No. 14 – Existing Rosecrest Reservoir Vault, Demolition

a. Measurement: Payment for the demolition of the existing Rosecrest Reservoir Vault will be made on a Lump Sum basis.

b. Payment: Payment will be made on the basis of the Contractor's lump sum bid for demolition of the Rosecrest Reservoir Vault within the JVWCD property; including salvage and removal of equipment; site condition and construction progress surveys; concrete sawcutting and removal of deck and walls down below existing grade; filling remaining structure with CLSM; removal and capping pipelines; backfill, compact and bring up to restoration grade elevation requirements.

15. Bid Item No. 15 – Not Used

16. Bid Item No. 16 – Rocky Point Mainline Valve Vault, Complete

a. Measurement: Payment for the work at the Rocky Point Mainline Valve Vault will be made on a Lump Sum basis.

b. Payment: Payment will be made on the basis of the Contractor's lump sum bid for construction of the Rocky Point Mainline Valve Vault, within the public rights-of-way; including site condition and construction progress surveys; asphalt/concrete sawcutting and removal; security fencing; all earthwork and shoring; protection of existing structures and pipelines; construction of the vault including structural concrete, rebar, stabilization material; backfill and compaction; openings; manhole access and ladder; furnishing and installing welded steel pipe and fittings; lining and coatings; butterfly valves, air valves and all fittings and appurtenances; furnishing and installing all materials and piping within the vault extents, as indicated; all mechanical items, supports and miscellaneous metals; vent piping; vent stack and concrete pad; restoration of parkstrip where air vent stack installed and balance of all Work required for the Rocky Point Vault as shown on the plans, Complete.

c. Pay limit is at outside wall of vault, as shown on the plans.

d. No Payment for the Foothill Area Connection piping, equipment and appurtenances as they are to be paid under separate bid item.

e. No payment for Enridge gas line relocation, this is to be paid under separate bid item.

f. No payment for asphalt restoration and Rosecrest Pipeline cleaning, disinfection and testing, as these are to be paid under separate bid items.

17. Bid Item No. 17 – 13400 South Interconnect Vault, Mechanical and Structural and Site Restoration

a. Measurement: Payment for the work at the 13400 South Interconnect Vault will be made on a Lump Sum basis.

b. Payment: Payment will be made on the basis of the Contractor's lump sum bid for construction of the 13400 South Interconnection Vault including site condition and construction progress surveys; acquisition of temporary

easements for work outside the public rights-of-way; asphalt/concrete sawcutting and removal; clearing and grubbing and stock piling topsoil; protection of existing trees; security fencing; potholing to locate existing pipelines to provide protection during construction; all earthwork and shoring; protection of existing structures and pipelines; coordination and removal of abandoned traffic controlling utilities; construction of the vault including structural concrete, rebar, stabilization material; backfill and compaction; openings; hatches, accesses and ladders; lifting eyes and miscellaneous structural items; furnishing and installing welded steel pipe and fittings; lining and coatings; furnishing and installing all materials and piping within the vault extents, as indicated; butterfly valves, gate valves, air valves, plug valve, and all fittings and appurtenances; sump pump, fans and all mechanical items, supports and miscellaneous metals; vent piping; vent stacks and concrete pads; drain piping and valves; blowoff structure and connection with storm drain system, complete; and balance of all Work required for the 13400 South Interconnection Vault as shown on the plans, Complete.

c. Pay limit is at outside wall of vault, as shown on the plans.

d. Payment for site restoration: Payment will include costs of all labor, materials, equipment, appurtenances and coordination to re-grade site to final elevations and restore as indicated in the contract drawings; including surveying; compaction; restoration of the site for drainage flow and elevations back to pre-construction conditions or to final elevations as shown; bollards; stamped concrete parkstrip; curb and gutter; sidewalks and ADA ramps to meet Riverton City standards and specifications and all other items to restore the disturbed area back to original conditions.

e. No Payment under this item for asphalt pavement restoration, this is to be paid under separate bid items.

f. No payment for Enridge gas line relocation, this is to be paid under separate bid item.

g. No Payment for instrumentation, electrical work as these are to be paid under separate bid items.

h. No payment for pipeline cleaning, disinfection and testing, as these are to be paid under separate bid items.

i. No payment for metered connections to customers, as these are to be paid under separate bid item.

18. Bid Item No. 18 – 13400 South Interconnect Vault, Electrical

a. Measurement: Payment for the electrical work associated with the 13400 South Interconnect Vault will be made on a Lump Sum basis.

b. Payment: Payment will be made on the basis of the Contractor's lump sum bid for all electrical work associated with the 13400 South Interconnect Vault; including furnishing and installing all materials; potholing to locate existing power to provide protection during construction; locating existing site power for connections; earthwork and shoring as required; installation of new electrical and controls, lighting, panels, remote terminal unit, power utility conduit, and all work for complete electrical and instrumentation; salvage and demolition of existing electrical items; restoration of areas outside of the 13400 South Vault restoration area and balance of all Work required for the 13400 South Interconnect Vault site electrical as shown on the plans, Complete.

19. Bid Item No. 19 – Demolition of Existing 13400 South Interconnect Vault, Riverton and Herriman Metering Vaults

a. Measurement: Payment for demolition of the existing 13400 South Interconnect vault, Riverton Metering vault and Herriman Metering vault shall be made on a Lump Sum basis.

b. Payment: Payment shall constitute full compensation for demolition of the existing vaults; including salvage and relocation of items to Owner; asphalt/concrete sawcutting and removal; concrete sawcutting and removal of deck and walls down below existing grade; filling remaining structure with CLSM; backfill, compaction and bringing up to restoration grade elevation; dewatering; abandonment of existing pipes; removal of air vents; abandonment of existing conduit; removal and disposal of items indicated on the plans; restoration of parkstrip areas back to original condition and other surface restoration outside of asphalt extents; and all items to complete work.

c. No Payment under this item for asphalt pavement restoration, this is to be paid under separate bid item.

20. Bid Item No. 20 – Not Used

21. Bid Item No. 21 – Air Valve Structure, Complete

a. Measurement: Payment for Air Valve Structure shall be made on a per Each basis for each structure.

b. Payment: Payment includes structure of the size indicated on the plans, complete; including work, labor, materials, tools and equipment required to supply, furnish and install precast sections; grade rings; cast iron frame and cover; concrete collar to grade; hatches with concrete curbing; seal joints with mastic; openings with seals; additional excavation; stabilization material and backfill; shall constitute full compensation for site condition and construction progress surveys; asphalt sawcutting and removal; security fencing; all earthwork and shoring; construction of the structure; concrete encasement; furnishing and installing all materials, valves, appurtenances, fittings, air vents, stacks and concrete vent pads; all miscellaneous metals; protective coatings; surface restoration of parkstrip and other areas disturbed by air vent piping, back to original conditions; and any other items to complete the work as shown on the plans, Complete.

c. No payment for Rosecrest Pipeline and cleaning, disinfection and testing, as these are to be paid under separate bid items.

d. No Payment under this item for curb and gutter, sidewalk and asphalt pavement restoration, this is to be paid under separate bid item.

22. Bid Item No. 22 – Drain and Blowoff Structure

a. Measurement: Payment for Drain and Blowoff Structure shall be made on a Lump Sum basis for the location indicated, complete.

b. Payment: Payment shall constitute full compensation for the construction of the drain and blowoff structure; including site condition and construction progress surveys; potholing to locate existing tie-in pipe, as required; asphalt/concrete sawcutting and removal; security fencing; excavation including all shoring; protection of existing pipelines; backfill and stabilization material; construction of dissipation structure; connections with existing structures; connection with existing pipeline, as indicated in contract drawings; furnishing and installing all pipe materials, fittings, valves, valve boxes insulating flanges, bonding for cathodic protection, appurtenances, miscellaneous metals; protective coatings and linings; restoration of parkstrip and public utility easement areas, and other

areas disturbed by the work, back to original conditions including irrigation system and any other items to complete the work as shown on the plans, Complete.

c. No payment for Rosecrest Pipeline and cleaning, disinfection and testing, as these are to be paid under separate bid items.

d. No Payment under this item for asphalt pavement restoration, this is to be paid under separate bid item.

23. Bid Item No. 23 – Not Used

24. Bid Item No. 24 – Fire Hydrant Relocation

a. Measurement: Payment for Fire Hydrant relocation shall be made on a per Each basis for each fire hydrant and shall meet Herriman City standards and specifications.

b. Payment: Payment shall constitute full compensation for site condition and construction progress surveys; asphalt sawcutting and removal; excavation including shoring; furnishing and installing new fire hydrant connected to Herriman City water line; furnishing and installing hydrant, pipe, fittings, miscellaneous fittings for connection to existing pipeline, valves, valve boxes; traffic lids, as required; thrust restraints; greasing and wrapping fittings with flanges and bolts; pipe wrap; pipe marking tape; parkstrip restoration; pipe zone and trench backfill materials; adjustment of hydrant to final grade; pipeline cleaning, disinfection and testing as required to meet Herriman City standards and specifications; and balance of all Work required for installation and commissioning of the fire hydrant as shown on the plans, Complete.

c. Payment: Payment shall include removal, salvage and abandonment of existing hydrant; blind flange at the connection to the JVWCD main with thrust block; abandon existing pipe by capping ends with concrete; removal of existing valve box(es); surface restoration to match the area adjacent to the abandoned fire hydrant; hauling equipment to the point of salvage and all items required to complete abandonment of each fire hydrant, Complete.

d. No Payment under this item for asphalt pavement restoration, this is to be paid under separate bid item.

25. Bid Item No. 25 – Trench Stabilization Material, As Directed

a. Measurement: Measurement of trench stabilization material will be based upon Unit Price per in place cubic yard measured from the dimensions of the trench prior to installation of the material.

b. Payment: Payment for trench stabilization material will include stabilization material with geotextile; additional over excavation of the trench; dewatering; furnishing, transporting, and installing trench stabilization in accordance with the specifications. Trench stabilization must be authorized in advance by the Engineer.

26. Bid Item No. 26 – Cathodic Protection, Complete

a. Measurement: Payment for the cathodic protection work will be made on a Lump Sum basis.

b. Payment: Payment will be made on the basis of the Contractor's lump sum bid for furnishing and installing all cathodic protection materials for the project. Including isolation flange kits; test stations and all test station components, wires, connections, terminal boards, post mounts, anode beds, reference electrodes, coupons, DC blockers, concrete test station pads, labels, and fittings to install a complete system; restoration of the parkstrip or area where test

station is installed back to original condition, including all area outside pavement restoration.

c. No payment for asphalt pavement restoration, to be paid under separate bid item.

27. Bid Item No. 27 – Waterline Loop

a. Measurement: Payment for looping of waterline (culinary or irrigation) under the Rosecrest Pipeline will be made on a per Each basis for each loop.

b. Payment: Payment shall constitute full compensation for installation of water main loops of the size and type indicated, complete, including but not limited to; site conditions and construction progress surveys; coordination with utility owner; furnishing and installing pipe, fittings, valves, couplings, adapters, and all miscellaneous materials; concrete or mechanical thrust restraint; additional excavation required; cleaning, disinfection, testing and commissioning of the loop; surface restoration specific to looping work and all other work necessary to furnish and install a complete loop in accordance with Herriman City standards.

c. No payment for over excavation unless approved in writing by Engineer.

d. This bid item is intended for use where an existing water main (culinary or pressurized) is in vertical conflict with the Rosecrest Pipeline and requires looping. This bid item shall not be used for looping required as a result of the Contractor's failure to pothole in accordance with project requirements. Payment under this bid item will only be made for loops approved in advance in writing by Engineer.

28. Bid Item No. 28 – Service Line Loop

a. Measurement: Payment for looping of service line (culinary or irrigation) over the Rosecrest Pipeline will be made on a per Each basis for each loop.

b. Payment: Payment shall constitute full compensation for installation of service loops of the size and type indicated to meet Herriman City standards, complete, including but not limited to; site conditions and construction progress surveys; coordination with utility owner and resident; furnishing and installing pipe, clamps, corporation stops, saddles and other materials as required; additional excavation required; flushing, cleaning, disinfection, and commissioning of the loop; backfilling of the loop; surface restoration specific to looping work and all other work necessary to furnish and install a complete loop in accordance with Herriman City standards.

c. No payment for over excavation unless approved in writing by Engineer.

d. This bid item is intended for use where an existing service (culinary or pressurized) is in vertical conflict with the Rosecrest Pipeline and requires looping. This bid item shall not be used for looping required as a result of the Contractor's failure to pothole in accordance with project requirements. Payment under this bid item will only be made for loops approved in advance in writing by Engineer.

29. Bid Item No. 29 – Curb and Gutter Replacement

a. Measurement: Payment for replacement of curb and gutter will be made along top back of curb, paid for by the Linear Foot, but exclusive of storm drain inlets and outlets. Curb and gutter shall be replaced from construction joint to construction joint.

b. Payment: Payment includes all work associated with installation of new curb and gutter as shown in Herriman City Standard Plans, but not limited to: concrete saw cutting if required, excavation, removal and disposal of the

existing curb and gutter and other waste materials; furnishing, installation and compaction of untreated base course; expansion joints where required; forming, placing, finishing, curing, protecting and testing of the concrete curb and gutter; and matching existing curb and gutter via transitions, if necessary.

c. Testing associated with Pipeline project will have material testing provided by Owner.

d. Testing associated with Roadway project will require testing and cost is to be included with bid.

e. This item to be used for replacement of curb and gutter disturbed or damaged where protection of and maintaining the existing curb and gutter is not possible or reasonable in the opinion of the Engineer.

30. Bid Item No. 30 – Sidewalk Replacement

a. Measurement: Payment for replacement of sidewalk will be made on a Square Foot basis for each section of sidewalk between joints that is damaged during construction. Replace sidewalk to match existing width and shall be replaced from construction joint to construction joint.

b. Payment: Payment includes all work associated with installation of new sidewalk per Herriman City standards, but not limited to: concrete saw cutting if required, excavation, removal and disposal of the existing sidewalk and other waste materials; furnishing, installation and compaction of untreated base course; expansion joints where required; contraction joints as required; forming, placing, finishing, curing, protecting of the concrete sidewalk; and matching existing sidewalk via transitions, if necessary, to meet trip hazard requirements.

c. This item to be used for replacement of sidewalk disturbed or damaged during construction where protection of and maintaining the existing sidewalk is not possible or reasonable in the opinion of the engineer.

31. Bid Item No. 31 – Driveway Approach Replacement

a. Measurement: Payment for replacement of driveway approach will be made on a Lump Sum basis for each location identified in the bid schedule.

b. Payment: Payment for the replacement of concrete driveway approach includes installation to Herriman City standards, but not limited to: concrete sawcutting; excavation; removal and disposal of existing driveway approach and waste materials; furnishing, installation and compaction of untreated base course; reinforcement; concrete; expansion joints and contraction joints; forming, placing, finishing, curing, protecting of concrete; sloping to meet sidewalk, driveway asphalt and curb and gutter and all transitions to meet trip hazard requirements.

32. Bid Item No. 32 – Contractor Coordination to Support Utility Relocation, Enbridge Gas

a. Measurement: Lump Sum Payment for the excavation, backfill and coordination efforts for relocation of existing natural gas utility.

b. Payment: Payment for coordination with utility company for them to provide relocation of utility conflicts at 13400 South intersection and Rocky Point Drive intersections with Rosecrest Road, shall be based upon actual costs of relocations provided by Enbridge Gas as submitted by the Contractor, including allowable markup for administration of Work. Contractor shall be responsible for coordinating and scheduling work with utility company, including temporary and final relocations of the utility. Contractor is to provide coordination, excavation for installation of the final utility relocation,

backfill, compaction, and restoration of surface areas disturbed due to relocation that are not already covered with other items.

c. This item does not include a direct payment to Enbridge for their utility relocation work. JVWCD will directly pay Enbridge for their portion of the relocation work. This bid item is for payment of the excavation, backfill and coordination efforts required to facilitate the utility relocations at the locations identified.

33. Bid Item No. 33 – Permit Allowance

a. Measurement: Include Bid Allowance provided to eliminate uncertainty during bid, final payment will be based upon actual costs.

b. Payment: Payment for permits shall be based upon actual costs as submitted by the Contractor, markup for administration work is not allowed. Bid item reimbursement will be paid upon proof of Contractor's permit fee payment has been submitted. Contractor shall be responsible for coordinating all work for the permits and complying with the permit requirements.

34. Bid Item No. 34 – Untreated Base Course (UTBC)

a. Measurement: Measurement for UTBC placed under asphalt for roadway restoration shall be made on unit price by Ton.

b. Payment: Payment shall constitute full compensation for furnishing, placing, and compacting to thickness indicated in the drawings, below asphalt roadway restoration and in accordance with Herriman City and/or Riverton City requirements.

c. UTBC associated with Pipeline project will have material testing provided by Owner.

d. Unit price is independent of the quantity used. No adjustments in unit price will be allowed for quantities that are significantly more or less than quantity listed in the Bid Schedule.

35. Bid Item No. 35 – Temporary Asphalt

a. Measurement: Payment for Temporary Asphalt will be made on a Tonnage basis for temporary asphalt to be removed and replaced with permanent asphalt due to scheduling restrictions with Schedule B or temperature restrictions.

b. Payment: Payment shall be made for furnishing, placing and compacting temporary asphalt including but not limited to; tack coat, asphalt with aggregates; temporary adjustments to street fixtures where necessary; maintaining temporary asphalt until permanent asphalt is available and removal of the temporary asphalt when permanent asphalt replacement is available.

c. Measurement shall be based on a maximum width of 8 feet for pipeline trench restoration. Measurement shall be based on a maximum amount of an additional 3 feet outside vault dimensions that extend into the roadway.

d. No Payment for use of temporary asphalt unless approved in writing by the Engineer prior to use. Where possible, coordination and scheduling should occur to minimize the use of temporary asphalt.

e. Unit price is independent of the quantity used. No adjustments in unit price will be allowed for quantities that are significantly more or less than quantity listed in the Bid Schedule.

36. Bid Item No. 36 – Asphalt Restoration (T-Patch) and Reservoir Driveway and Site Asphalt Reconstruction (Lower Traffic Class, Class I)

a. Measurement: Payment for the restoration and of the asphalt surface and the reconstruction of the asphalt surface for the Reservoir Site and Reservoir Driveway will be made on a Tonnage basis at the thickness and type of asphalt indicated in the drawings.

b. Payment: Payment for asphalt restoration (T-Patch) includes all Work associated with restoration of the asphalt road surface to comply with Herriman City standards and specifications, Detail CW-02 and APWA Plan 255 T-Patch; restoration is for the width of the trench, limited at 8 feet wide, and including a 2 feet second cut either side of the trench; work will include, but not be limited to, sawcutting; full depth removal of all existing asphalt pavement to repair extents, including proximity restraints regarding the curb and gutter, patches, edges of pavement and travel lanes; excavation and hauling of unsuitable materials; tack coat; furnishing and installing type and grade of asphalt indicated on drawings at thickness indicated; subgrade preparation and grading; installation of asphalt; compaction; grade adjustment and replacement of utility manholes, valve boxes and survey monument concrete collars; striping and marking of the new pavement surface; and all other work shown and specified within the pay limits.

c. Payment for Reservoir Driveway and Site Asphalt Reconstruction (Lower Traffic Class, Class I) includes all Work associated with reconstruction of the asphalt road surface, extending from Emmeline Drive to the extents of the Reservoir Site Restoration, as shown on the plans; extending for full width of driveway, estimate at 18 feet wide; from edge of asphalt to edge of asphalt or lip of curb and gutter; to comply with Herriman City standards and specifications. Work will include, but not be limited to, sawcutting; full depth removal of all existing asphalt pavement; excavation and hauling of unsuitable materials; tack coat; furnishing and installing asphalt at thickness indicated on drawings; subgrade preparation and grading; compaction; grade adjustment and replacement of utility manholes and valve box concrete collars; and all other work shown and specified within the pay limits for reconstruction of the driveway and site extents identified on the drawings; and all other work shown and specified within the pay limits.

d. Restoration work is to be coordinated with Mill and Overlay requirements which differ for Rosecrest Roadway, 13400 South and other roads, see Schedule B requirements.

e. Unit price is independent of the quantity used. No adjustments in unit price will be allowed for quantities that are significantly more or less than quantity listed in the Bid Schedule.

f. No Payment for driveway approach, UTBC or mill and overlay on either side of the trench as these are to be paid under separate bid items.

37. Bid Item No. 37 – Not Used

38. Bid Item No. 38 – 5" Asphalt Pavement: Rosecrest Roadway, 13400 South to Rocky Point Drive (High Traffic, Class III)

a. Measurement: Payment for the reconstruction of the asphalt surface for Rosecrest Road will be made on a Square Yard basis.

b. Payment: Payment includes all Work associated with placing new asphalt to extents as shown on the plans. Work will include, but not be limited to, tack coat; furnishing and installing asphalt at thicknesses indicated on drawings; testing and compaction; and work to be accomplished in accordance with

Herriman City Standards; striping and marking of the new pavement surface; and all other work shown and specified within the pay limits.

c. Unit price is independent of the quantity used. No adjustments in unit price will be allowed for quantities that are significantly more or less than quantity listed in the Bid Schedule.

d. No Payment for UTBC and adjustments to utilities and concrete collars as these are to be paid under separate bid items.

39. Bid Item No. 39 – 2" Mill & Overlay: Roads other than Rosecrest Road

a. Measurement: Measurement for asphalt pavement mill and overlay Work shall be made on a Tonnage basis and in conjunction with areas receiving T-Patch repairs.

b. Payment: Payment shall constitute full compensation for sawcutting, removal and disposal of additional existing pavement, as required; furnishing, placing, and compacting asphalt overlay in accordance with Herriman City Standards including, but not limited to asphalt milling and removal; edge grinding; asphalt; tack coat; crack seal; adjusting all street fixtures not specified elsewhere to final grade; concrete; restriping; and marking of the new pavement.

c. Unit price is independent of the quantity used. No adjustments in unit price will be allowed for quantities that are significantly more or less than quantity listed in the Bid Schedule.

d. Fiber to be included in asphalt associated with Bid Schedule B. No fiber to be included in asphalt associated with Bid Schedule A.

40. Bid Item 40 – 3" Mill and 8" Full Depth Reclamation

a. Measurement: Measurement for removal and disposal of existing asphalt and full depth reclamation will be made on a Square Yard basis.

b. Payment covers all costs for labor, materials, equipment and appurtenances required to mill, remove, and dispose of existing asphalt pavement and perform full depth reclamation by pulverizing and mixing an existing asphalt pavement and road base with a hydraulic cement, stabilizer in-place to produce a stabilized base course mix. This includes, but is not limited to, protection of existing utilities, dust control, pulverization, grading, compaction, stabilization, and curing. Depth of pulverization and thickness of finished based should be as described in bid drawings plans and specifications. All work to be completed in accordance with Specification 32 11 24M.

c. Unit price is independent of the quantity used. No adjustments in unit price will be allowed for quantities that are significantly more or less than quantity listed in the Bid Schedule.

41. Bid Item No. 41 – 3" Mill & Overlay

a. Measurement: Payment for the milling and overlay of the asphalt surface for Rosecrest Road will be made on a Square Yard basis.

b. Payment: Payment shall constitute full compensation for sawcutting, removal and disposal of additional existing pavement, as required; furnishing, placing, and compacting asphalt overlay in accordance with Herriman City Standards including, but not limited to asphalt milling and removal; edge grinding; asphalt; tack coat; crack seal; adjusting all street fixtures not specified elsewhere to final grade; concrete; restriping; and marking of the new pavement.

c. Unit price is independent of the quantity used. No adjustments in unit price will be allowed for quantities that are significantly more or less than quantity listed in the Bid Schedule.

42. Bid Item No. 42 – Over Excavation, Rough Grading, and Subgrade Preparation

a. Measurement: Measured and paid for on a lump sum basis as noted in the cut/fill quantities on drawing G-07.

b. Payment: Payment includes all costs associated with all labor, materials, and equipment required to grade Rosecrest Roadway in the areas of the full depth replacement; placing, preparing, grading, scarifying, and compacting subbase material; compaction density testing; excavation; haul off; work to prepare for grade adjustment and replacement of utility manholes, valve boxes and survey monuments in accordance with the specifications and Herriman City standards.

c. Excavation of soft spots is paid under a separate bid item.

43. Bid Item No. 43 – Excavate and Backfill Soft Spots

a. Measurement: Measurement of stabilization material in soft spots will be based upon Unit Price per in place cubic yard measured from the dimensions of the repair by the Engineer.

b. Payment: Payment for stabilization material will include additional over excavation; haul off; dewatering; furnishing, transporting, and installing stabilization material in accordance with the specifications.

c. This item is to be used only at the discretion of the Engineer.

d. The bid price listed in the bid schedule will be used to compensate the contractor for the stabilization material placed, regardless of the amount used in this project.

44. Bid Item No. 44 – Concrete Waterway Replacement

a. Measurement: Payment for replacement of concrete waterway will be made on a Linear Foot basis for each location identified in the bid schedule.

b. Payment: Payment includes costs associated will all labor, materials, and equipment required to sawcut, remove and dispose of existing concrete waterway; purchase and install concrete waterway; connection of waterway to existing; base course materials below waterway; compaction density testing; and all other work shown and specified within the pay limits.

Unit price is independent of the quantity used. No adjustments in unit price will be allowed for quantities that are significantly more or less than quantity listed in the Bid Schedule.

45. Bid Item No. 45 – ADA Ramp Replacement

a. Measurement: Payment for replacement ADA ramps will be made on a per Each basis for each location identified in the bid schedule and includes replacement of adjacent curb, gutter and sidewalk required in order for new ADA ramp to meet slope requirements of Herriman City standard details RD-10 and RD-11 up to a maximum of 15 feet away from ADA ramp in both directions.

b. Payment: Payment includes costs associated will all labor, materials, and equipment required to sawcut, remove and dispose of existing concrete ADA ramps and adjacent curb, gutter, and sidewalk as necessary; purchase and install new concrete ADA ramps; connection of ramps to sidewalk and curb and gutter; truncated domes; base course materials below ramps; compaction density testing; and all other work shown and specified within the pay limits.

46. Bid Item No. 46 – Concrete Collar Replacement

a. Measurement: Payment for concrete collar replacement shall be made on a per Each basis for each type of collar indicated in the drawings and shall meet Herriman City standards and specifications.
b. Payment: Payment includes costs associated with all labor, materials and equipment required to remove existing concrete collars, adjust the structure to grade; place and install new concrete collar and reinforcement; and all other work necessary to replace concrete collars as described in the contract documents.

47. Bid Item No. 47 – Monument Relocation

a. Measurement: Payment for roadway monuments shall be made on a per Each basis and shall meet Salt Lake County standards and specifications.
b. Payment: Payment includes applying for a monument preservation permit and associated fee; work, materials and labor required to install new monument; coordination with county surveyor.
c. Unit price is independent of the quantity used. No adjustments in unit price will be allowed for quantities that are significantly more or less than quantity listed in the Bid Schedule.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 25 10
PRODUCTS, MATERIALS, EQUIPMENT, AND SUBSTITUTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for delivery and storage of products and materials specified for use in the Project. It also includes requirements for handling requests for equals and substitutions made after award of the Contract.

1.2 DEFINITIONS

A. Definitions in this Article are not intended to negate the meaning of other terms used in the Contract Documents, including "specialties," "systems," "structure," "finishes," "accessories," "furnishings," “special construction," and similar terms, which are self-explanatory and have recognized meanings in the construction industry.

B. The word "Products," as used herein, is defined to include purchased items for incorporation into the Work, regardless of whether specifically purchased for the Project or taken from stock of previously purchased products.

C. The word "Materials," is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, installed, or applied to form units of work.

D. The word "Equipment" is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, and other like items).

E. Neither "Products" nor "Materials" nor "Equipment" includes machinery and equipment used for preparation, fabrication, conveying and erection of the Work.

1.3 QUALITY ASSURANCE

A. Source Limitations: To the greatest extent possible for each unit of work, provide products, materials, and equipment of a singular generic kind from a single source.

B. Compatibility of Options: Where more than one choice is available as options for selection of a product, material, or equipment, select an option, which is compatible with other products, materials, or equipment. Compatibility is a basic general requirement of product, material, and equipment selections.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance
   1. Deliver and store products, materials, and equipment in accordance with manufacturer's written recommendations and by methods and means which will prevent damage, deterioration, and loss including theft.
   2. Manage delivery schedules to minimize long-term storage of products at Site and overcrowding of construction spaces. Ensure coordination to minimize holding or

storage times for flammable, hazardous, easily damaged, or sensitive materials to deterioration, theft, and other sources of loss.

B. Transportation and Handling
   1. Transport products by methods to avoid damage. Deliver in undamaged condition in manufacturer's unopened containers and packaging.
   2. Furnish equipment and personnel to handle products, materials, and equipment, including those provided by Owner, by methods to prevent soiling and damage.
   3. Provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.

C. Storage and Protection
   1. Products shall be stored in accordance with manufacturer's written instructions and with seals and labels intact and legible. Sensitive products shall be stored in weather-tight climate-controlled enclosures and temperature and humidity ranges shall be maintained within tolerances required by manufacturer's recommendations.
   2. For exterior storage of fabricated products, products shall be placed on sloped supports above ground. Products subject to deterioration shall be covered with impervious sheet covering and ventilation shall be provided to avoid condensation.
   3. Loose granular materials shall be stored on solid flat surfaces in a well-drained area and shall be prevented from mixing with foreign matter.
   4. Storage shall be arranged to provide access for inspection. Periodically inspect to assure products are undamaged and are maintained under required conditions.
   5. Storage shall be arranged in a manner to provide access for maintenance of stored items and for inspection.

D. Maintenance of Storage
   1. Periodically inspect stored products on a scheduled basis. Maintain a log of inspections and make the log available on request.
   2. Comply with manufacturer's product storage requirements and recommendations.
   3. Maintain manufacturer-required environmental conditions continually.
   4. Ensure that surfaces of products exposed to the elements are not adversely affected and that weathering of finishes does not occur.
   5. For mechanical and electrical equipment, provide a copy of the manufacturer's service instructions with each item and the exterior of the package shall contain notice that instructions are included.
   6. Service products on a regularly scheduled basis. Maintain a log of services and submit as a record document prior to acceptance by Owner in accordance with the Contract Documents.

1.5 PROPOSED SUBSTITUTIONS AND "OR EQUAL" ITEMS

A. Substitution and “or equal” determination shall be submitted and evaluated per the General Conditions included in the Contract Documents.

B. When proposing a substitution, make written application to Engineer on the "Substitution Request Form."

C. Unless otherwise provided by law or authorized in writing by Engineer, submit the "Substitution Request Form(s)" within 35 days after award of the Contract.

D. Whenever products, materials, or equipment are indicated in the Contract Documents by using the name of a proprietary item or the name of a particular supplier, the naming of the manufacturer is intended to establish the type, function, and quality required. The Contract Price is understood to be based upon furnishing the item specified.

E. If a named item is not available or a supplier is no longer doing business, the following shall apply:
   1. When a named supplier is no longer doing business under the name indicated, furnish the specified product from the legal successors to the named supplier.
   2. When a named product is no longer available from the named supplier due to acquisition or sale of the given product line, but the product is available from another supplier, provide the named product. In such cases, submit a substitution request form and include certification from the supplier that the product being supplied is materially and functionally identical to the product named in the Contract Documents.
   3. When the named product is no longer available from the named supplier or any other supplier, notify Owner in writing and Owner will direct Engineer to identify suitable substitute products. Provide one of the suitable substitute products.

F. The procedure for review by the Engineer will include the following:
   1. Wherever a proposed substitution has not been submitted within said 35-day period, or wherever the submission of a proposed substitution material or equipment has been judged to be unacceptable by Engineer, provide the product, material, or equipment indicated in the Contract Documents.
   2. Certify that the proposed substitution will adequately perform the functions and achieve the results called for by the general design and be similar and of equal substance to that indicated and be suited to the same use as that indicated.
   3. Engineer will evaluate each proposed substitution within a reasonable period.
   4. As applicable, do not make shop drawing submittals for a substitution without Engineer's prior written acceptance of the request for substitution. Do not order, install, or utilize any substitution item prior to written acceptance of the request for substitution.
   5. Engineer will record the time required by Engineer in evaluating substitutions and in making changes by Contractor in the Contract Documents occasioned thereby.

G. Application for substitution must contain the following statements and information, which will be considered by Engineer in evaluating the proposed substitution:
   1. Submit "Substitution Request Form," at end of this Section, fully executed.
   2. The evaluation and acceptance of the proposed substitution shall not prejudice the achievement of substantial completion on time.
   3. Whether or not acceptance of the substitution for use in the Work will require a change in any of the Contract Documents to adapt the design to the proposed substitution.
   4. Whether or not incorporation or use of the substitution in connection with the Work is subject to payment of any license fee or royalty.
   5. All variations of the proposed substitution from the items originally specified shall be identified.
   6. Available maintenance, repair, and replacement service shall be indicated. The manufacturer shall have a local service agency (within 50 miles of the site) which

maintains properly trained personnel and adequate spare parts and is able to respond and complete repairs within 24 hours.

7. Itemized estimate of all costs that will result directly or indirectly from acceptance of such substitution, including cost of redesign and claims of other contractors affected by the resulting change.

H. Without any increase in cost to Owner, be responsible for, and pay all costs in connection with proposed substitutions and costs of inspections and testing of equipment or materials submitted for review prior to purchase thereof for incorporation in the Work, whether or not Engineer accepts the proposed product, equipment, or material. Reimburse Owner for the charges of Engineer and other authorized representatives for evaluating each proposed substitution.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

BOWEN COLLINS & ASSOCIATES

SUBSTITUTION REQUEST FORM

To: _____ Project: _____

_____ Date: _____

_____ Owner: _____

Specified Item:

Section	Page	Paragraph	Description

The undersigned requests consideration of the following:

Proposed Substitution: _____

Attached data includes product description, specifications, drawings, photographs, performance and test data adequate for evaluation of the request. Applicable portions of the data are clearly identified.

The undersigned states that the following paragraphs, unless modified on attachments, are correct:

1. The proposed substitution does not affect dimensions shown on Drawings and will not require a change in any of the Contract Documents.
2. The undersigned will pay for changes to the design, including engineering design, detailing, and construction costs caused by the request substitution which is estimated to be $_____.
3. The proposed substitution will have no adverse effect on other contractors, the construction schedule (specifically the date of substantial completion), or specified warranty requirements.
4. Maintenance and service parts will be locally available for the proposed substitution.
5. The incorporation or use of the substitute in connection with the work is not subject to payment of any license fee or royalty.

The undersigned further states that the function, appearance, and quality of the proposed substitution are equivalent or superior to the specified item.

Submitted by **Contractor:**		Reviewed by **Engineer:**	
Firm:		☐ Accepted as Submitted	☐ Accepted as Noted
By:		☐ Not Accepted	☐ Received too Late
Signature:		By:	
Telephone:		Title:	
Attachments:		Date:	
Comments:		Comments:	

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SECTION 01 26 13
REQUESTS FOR INTERPRETATION (RFI)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes procedures for submitting Requests for Interpretation (RFI) and limitations on use of RFI to obtain interpretation and clarification.

1.2 RELATED SECTIONS

A. Section 01 25 10 – Products, Materials, Equipment, and Substitutions.

B. Section 01 33 20 – Submittal Procedures.

1.3 DEFINITIONS

A. Request for Interpretation: A document submitted to Engineer by Contractor, requesting clarification of a portion of the Contract Documents, hereinafter referred to as an RFI.

1.4 CONTRACTOR'S REQUESTS FOR INTERPRETATION (RFI)

A. Contractor's Requests for Interpretation (RFI): Should Contractor be unable to determine from the Contract Documents, the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of Work is described differently at more than one place in the Contract Documents; request that Engineer make an interpretation of the requirements of the Contract Documents to resolve such matters. Comply with procedures specified herein to make Requests for Interpretation (RFI).

B. Submission of RFI: Prepare RFI and submit electronically utilizing the Electronic Project Management System. Refer to Section 01 33 20 – Submittal Procedures.
   1. Fill in transmittal form completely, and if supplemental drawings or other information is prepared by hand, it shall be fully legible and attached with the transmittal form.
   2. The Project Management System will automatically assign each RFI a discrete, consecutive number. Include this number in the title of the RFI. For instance, Revision #1 to RFI 029 should be noted in the title as "original title name, Rev 1".
   3. Each page of the RFI and each attachment to the RFI shall bear Owner's project name, project number, date, RFI number and a descriptive title. Merge all into a single PDF document for attachment in the system.
   4. Clearly and concisely set forth the issue for which clarification or interpretation is sought and why a response is needed. In the RFI, indicate presumed interpretation or understanding of the requirement along with reasons for such understanding. Include proposed solutions that may be set forth to complete the Work with associated cost and schedule impact, if any.
   5. Engineer will review all RFI to determine whether they are RFI within the meaning of the term. If Engineer determines that the transmittal is not an RFI, it will be returned, unreviewed as to content, for resubmittal in the proper manner.

6. Frivolous RFI or simply passing on the RFI without first vetting the RFI will be subject to reimbursement from Contractor to Owner for fees charged by Engineer and other design professionals engaged by Owner.

C. Subcontractor-Initiated and Supplier-Initiated RFI: RFI from subcontractors and material suppliers shall be submitted through, be reviewed by, and be attached to an RFI prepared, signed, and submitted by Contractor. RFI submitted directly by subcontractors or material suppliers will be returned unanswered to Contractor.
   1. Review all subcontractor- and supplier-initiated RFI and take actions to resolve issues of coordination, sequencing, and layout of the Work. Coordination of the work, sequence, and layout are not the responsibility of Owner or Engineer.
   2. RFI submitted to request clarification of issues related to means, methods, techniques, and sequences of construction or for establishing trade jurisdictions and scopes of subcontracts will be returned without interpretation. Such issues are solely Contractor's responsibility.

D. Requested Interpretation: Carefully study the Contract Documents to ensure that information sufficient for interpretation of requirements of the Contract Documents is not included therein. RFI that request interpretation of requirements clearly indicated in the Contract Documents will be returned without interpretation.
   1. In all cases in which RFI are issued to request clarification of issues related to means, methods, techniques and sequences of construction; for example, pipe and duct routing, clearances, specific locations of Work shown diagrammatically, apparent interferences and similar items, furnish all information required for Engineer or Owner to analyze and/or understand the circumstances causing the RFI and prepare a clarification or direction as to how to proceed.
   2. If information included with this type of RFI is insufficient, the RFI will be returned unanswered.

E. Unacceptable Uses for RFI: RFI shall not be used to request the following:
   1. Approval of submittals (use procedure specified in Section 01 33 20 - Submittal Procedures).
   2. Approval of substitutions (refer to Section 01 25 10 – Products, Materials, Equipment and Substitutions).
   3. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Contract General Conditions).
   4. Different methods of performing Work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Contract General Conditions).

F. Disputed Requirements: If Engineer’s response to an RFI is believed to cause a change to the requirements of the Contract Documents, immediately give written notice to Engineer stating why this is believed to be true. Failure to give such written notice immediately shall waive any right to seek additional time or compensation under the Contract.

PART 2 - PRODUCTS

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 29 73
SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 GENERAL

A. This Section defines the process whereby the Schedule of Values shall be developed and incorporated into the Construction Progress Schedule as specified in Section 01 32 16 – Construction Progress Schedule. Monthly progress payment amounts shall be determined from the weekly progress updates of the scheduled activities. The schedule of values shall, as a minimum, list the value of every activity on the schedule, and shall include such additional breakdowns as required herein. The values in the Schedule of Values do not establish a commitment by either Contractor or Owner when negotiating changes to the Contract Documents.

1.2 DETAILED SCHEDULE OF VALUES

A. Prepare and submit a detailed Schedule of Values to Engineer as part of the Construction Progress Schedule submittal. Because the ultimate requirement is to develop a detailed Schedule of Values sufficient to determine appropriate monthly progress payment amounts, sufficient detailed breakdown shall be provided to meet this requirement. The Schedule of Values shall have a one-to-one relationship to the work activities of the Construction Progress Schedule even though additional detailed breakdowns for the Schedule of Values may be required. Engineer will be the sole judge of acceptable breakdowns, details, and descriptions of the values established. If, in the opinion of Engineer, a greater number of Schedule of Values items than proposed is necessary, add the additional items so identified.

B. The minimum details of a breakdown of the major Work components are indicated below. Provide greater detail when directed by Engineer.
   1. Mobilization: Mobilization shall be broken down by each principal item as described in Section 01 71 00 – Mobilization.
   2. Construction Progress Schedule shall be broken down by initial submittal and monthly updates.
   3. Break down Civil site Work into roadways, individual drainage systems, individual flood control structures, site concrete, soil cement, paving, excavation cut and fill, clearing and grubbing and any other items determined to be necessary for the establishment of pay and activity items.
   4. Break down concrete structures into excavation, subgrade preparation, and appurtenant pre-foundation Work, concrete foundation construction, slabs on grade, walls, columns, suspended slabs, etc. (provide sufficient breakdown to accommodate necessary schedule detail.
   5. Break down mechanical Work within each structure to identify individual piping systems, equipment installation by equipment name and number, and equipment testing and checkout.
   6. Break down electrical and Instrumentation Work within each structure to identify individual systems, equipment installation by equipment name and number, and equipment testing and checkout.
      a. Break down fiber optic conduit Work into conduit installation and pullboxes.

b. Break down cathodic protection Work by ribbon anode and appurtenances, test station types, rectifiers, and insulating flanges.

7. Break down protective coating Work by system. Where specific coating Work may be critical to performing the Work to meet milestone and schedule dates, such Work shall be included as individual pay and activity items.
8. Break down utility relocation Work into individual pipelines running from and to termination points. Each pipeline shall be an individual pay item unless otherwise allowed by the Engineer.
9. Break down pipeline Work into individual items including pipe materials, pipe installation, backfill, surface restoration, and hydrostatic testing; utility crossings; pipeline interconnections; and any other items determined necessary for the establishment and pay and schedule activities.
10. Provide breakdown for disinfection, testing, and commissioning of pipelines and reservoirs.
11. Operations and Maintenance (O & M) Manuals shall be broken down into one O & M Manual per piece of equipment or one O & M Manual per group of like-kind pieces of equipment for establishment of pay and schedule activity items.
12. Break down all other Work not specifically included in the above items as necessary for establishment of pay and schedule activity items.

C. After submittal of the Schedule of Values, as part of the Construction Progress Schedule submittal, meet with Engineer and jointly review the schedules. Review the value allocations and extent of detail to determine any necessary adjustments to the values and to determine if sufficient detail has been proposed. Make adjustments deemed necessary to the value allocation or level of detail and submit a revised detailed Schedule of Values within 5 work days from receipt of comments from Engineer.

1.3 CHANGES TO SCHEDULE OF VALUES

A. Assign values, approved by Engineer, for changes to the Construction Schedule which add activities not included in the original Construction Schedule but are included in the original Work (schedule omissions). Reduce other activity values to provide equal value adjustment increases for added activities as approved by Engineer.

B. If Contractor and Engineer agree to adjust the original Schedule of Values because of inequities discovered in the original accepted detailed Schedule of Values, increases, and equal decreases to values for activities may be made. Engineer may direct changes to the schedule when inequities are discovered and agreement on the reallocation cannot be achieved.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 31 30
SAFETY

PART 1 - GENERAL

1.1 SUMMARY

A. Contractor's safety program shall conform to the requirements specified in the General Conditions and Supplementary Conditions.

1.2 DEFINITIONS

A. For the purposes of this Section, an "active construction area" is any area where construction activities are occurring, or construction activities could be considered a potential hazard to people.

B. A "Designated Safety Officer" or "Safety Representative" for the purposes of this Contract, means anyone who can identify the existing and predictable hazards in the areas surrounding a construction project or those working conditions at a construction project that are unsanitary or dangerous to employees. A "Designated Safety Officer" has the authority to make prompt corrective measures to eliminate those hazards.

1.3 SUBMITTALS

A. Demonstrate compliance action with the stipulations of Utah Occupational Safety and Health Administration (OSHA), Mine Safety and Health Administration (MSHA), and other applicable local, state, and federal safety requirements by submitting to Engineer a copy of all safety plans, programs, and permits. Such plans and programs shall include, but are not limited to:
   1. Hazard Analysis Prior to Major Activities (job safety analysis, JSA).
   2. Emergency Plan.
   3. Rigging and Hoisting Plans.
   4. Excavation and Trenching Plans.
   5. Respiratory Protection Program.
   6. Fire Protection Plan.
   7. Confined Space Entry Program.
   8. Explosives Handling and Storage.
   9. Confined Space Entry Program.
   10. Electrical Safety (drop cords, temporary power, GFCI's, etc.)
   11. Lock Out/Tag Out.
   12. Fall Protection.
   13. Heavy Equipment Operations.
   14. Burning and Welding Operations.
   15. Training Plan.
   16. Tunneling/Underground/Jacking/Boring Operations.
   17. Project Site Rules and Regulations (hazard protection plan).
   18. Material Handling (storage-disposal).
   19. Fuel Storage and Refueling.
   20. Hazard Communication/Right to Know.
   21. Subcontractor Requirements.
   22. Ventilation.

23. Personal Protective Equipment (hearing, eye, face).
24. Power Transmission/Distribution (temporary and/or permanent).
25. Traffic Control.
26. Environmental Controls.
27. Safety Meetings.
28. Spill Control Plan.
29. First Aid Facilities.

B. Engineer's receipt of safety plans or programs will not relieve Contractor in any way from the full and complete responsibility for safety and training of its personnel, and the onsite personnel of Owner, Engineer, and other visitors to areas of active construction areas. Daily, inform Engineer of changes to the boundaries of the active construction areas.

C. Be responsible for safety training all personnel who will have access to the active construction areas to meet state, federal, local and Contractor requirements. Maintain reasonable, regularly scheduled training sessions in mutually accessible facilities through entire Contract. Training costs for all personnel and visitors, except those costs associated with training personnel of Contractor, subcontractors, suppliers, and visitors will be considered incidental to other lump-sum portions of the Work and no additional compensation for such training will be provided.

D. Safety Program Requirements:
   1. Safety Representative Requirements:
      a. Assign a full-time Safety Representative as defined in the General Conditions of the Contract.
      b. The Safety Representative's duties and responsibilities will be hazard recognition, accidents prevention, new employee orientation (including subcontractors), and the maintaining and supervising of safety precautions and program. The Safety Representative or a qualified and approved deputy shall be onsite at all times while Work is ongoing.
      c. Qualifications of the Safety Representative and assigned deputies shall be submitted to Engineer for review. Acceptance of their qualifications by Engineer is required prior to the start of any activity on the Project. The Safety Representative will, as a minimum, meet the requirements of regulations for the Utah Occupational Safety & Health Enforcement Program.
   2. Hazardous Substances:
      a. Provide Engineer with a list of all hazardous substances anticipated to be brought on-site.
      b. Maintain on site Material Safety Data Sheets (MSDS) prior to arrival of any hazardous substances on the Project.
      c. Use storage area(s) as outlined in the spill control plan.
   3. Job Safety Analysis (JSA):
      a. Outline the sequence of the Work, equipment to be used, identify hazards that may exist or may be created and what procedures and/or safety equipment will be used to eliminate or reduce these hazards. A Scope of Work JSA shall be prepared and provided to the Engineer prior to the start of unusual, hazardous, or have risk potential activities on the Project. The name of the competent person assigned to this activity will be included on the JSA.
      b. Complete a JSA for any activity, which may be of an unusual nature or involves unique hazards.
   4. Reports

a. Provide to Engineer copies of Contractor's and subcontractor's:
   1) First aid, recordable, lost time and near miss, monthly logs.
   2) OSHA 200 injury log (annually).
   3) Safety meeting reports and topics (weekly).
   4) List of competent persons as required by OSHA and the Project Health and Safety Manual for each required task and their qualification as such.
   5) Injury and accident reports will be submitted to Engineer within 24 hours of any incident. **Immediate** notification to Engineer of an accident is **required**. Full cooperation with Engineer in accident investigation is required.

b. Conduct weekly safety inspections. Corrective actions shall be taken within 24 hours to address all deficiencies identified during inspections. Deficiency reports shall be prepared and submitted to Engineer within 48 hours indicating corrective actions taken. Failure to comply with required corrective measures identified in the safety inspection will result in the delayed signing of the monthly application for progress payment by Engineer.

c. Provide Engineer with a report of any periodic audit of Contractor's safety performance and/or records.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 32 16
CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 GENERAL

A. Employ a bar chart schedule for the planning and scheduling of all Work required under the Contract Documents.

B. In addition to the scheduling aspect, the same chart shall show an "S" curve for scheduled dollar expenditures versus time.

C. In the process of preparing baseline schedule and monthly updates, consult with all key subcontractors and suppliers to assure concurrence with the feasibility and achievability of planned start dates, sequencing, durations, and completion dates.

1.2 RELATED SECTIONS

A. Section 01 20 00 – Measurement and Payment

1.3 QUALIFICATIONS

A. Demonstrate competence through the submission of a fully compliant Construction Progress Schedule with the initial schedule submission. Upon failure to so demonstrate competence in scheduling, Engineer may direct Contractor to employ the services of a scheduler that can demonstrate competence. Comply with such directives.

1.4 SUBMITTAL PROCEDURES

A. Submittal Requirements
   1. Submit Construction Progress Schedule Digitally.
   2. The time scale (horizontal) shall be in weeks. The activities shall be listed on the left-hand side (vertical).
   3. Break down activities into sufficient detail to show all work activities. The listing from top to bottom shall be in a logical manner of which the Work will be accomplished. Provide space between activities or within bars to allow for marking of actual progress.
   4. Provide a written narrative of the planning logic along with a description of Work and quantities included in each activity of the bar chart schedule.
   5. Duration: The duration indicated for each activity shall be in units of whole working days and shall represent the single best time considering the scope of the Work and resources planned for the activity, including time for holidays and inclement weather. The calendar for the network shall be in calendar days. Except for certain non-labor activities, such as curing concrete or delivering materials, activity durations shall not exceed 14 days, be less than one day, nor exceed $ 50,000 in value unless otherwise accepted by Engineer.

B. Time of Submittals

1. Submit the bar chart schedule with "S" curves and narrative within fifteen (15) working days after Notice to Proceed for review by Engineer. The schedule submitted shall indicate a project completion date the same as the contract completion date.
2. Submit a copy of the schedule, clearly showing progress made and actual "S" curves, on a two or four week basis depending on the duration of the project and reporting time agreed to in the preconstruction meeting.

C. Acceptance
1. The bar chart schedule and "S" curves, when accepted by Engineer, constitute the Construction Progress Schedule unless a revised schedule is required due to one or more of the following:
   a. Substantial changes in the Work scope.
   b. A change in Contract time.
   c. Delinquency by Contractor that requires a recovery schedule.
2. Owner's review and acceptance of the Construction Progress Schedule is for conformance to the requirements of the Contract Documents only. Review and acceptance by Owner of Contractor's Construction Progress Schedule does not relieve Contractor of any of its responsibility whatsoever for the accuracy or feasibility of the Construction Progress Schedule, or of Contractor's ability to meet interim milestone dates and the Contract completion date, nor does such review and acceptance expressly or impliedly warrant, acknowledge, or admit the reasonableness of the logic and durations of the Construction Progress Schedule.

1.5 SCHEDULE UPDATES

A. The Construction Progress Schedule shall be updated to reflect the as-built conditions of the Work and to accurately forecast the status of incomplete activities. Provide progress reports at each weekly progress meeting, stating actual percent earned versus percent planned. Submit Construction Progress Schedule updates to Engineer with each payment request, including approved changes in the Work and accurately depicting the current status and sequence of all activities.

B. Submit the updated Construction Progress Schedule in the form, sequence, and number of copies requested for the initial schedule.

C. Engineer will review each submitted Construction Progress Schedule update and provide comments within seven days of the submittal. Revise and resubmit the schedule within five days of receipt of comments from Engineer. Engineer will review the re-submittal within five days and provide comments if the schedule update is still unacceptable. Revise and resubmit the schedule within five days of receipt of comments from Engineer.

1.6 PROGRESS MEETINGS AND LOOK-AHEAD SCHEDULES

A. For the weekly progress meetings, submit a look-ahead schedule. This schedule will cover four weeks: the immediate past week, the current week, and the forthcoming two weeks. List all activities from the accepted Construction Progress Schedule, which are complete, are scheduled for Work during the period, are currently planned to be worked, even if out of sequence, and Work which is unfinished but scheduled to be finished. Provide actual start and completion dates for the Work that has been completed the prior week. Forecast early start and early finish dates for the Work that is in process or upcoming.

B. Identify each activity noted above by activity number corresponding to the accepted Construction Progress Schedule and detailed description of the activity.

C. Deliver the look-ahead schedule to Engineer 24 hours prior to the weekly progress meeting in a format approved by Engineer.

1.7 CONSTRUCTION SCHEDULE REVISIONS

A. Engineer may direct and, if so directed, Contractor shall propose, revisions to the Construction Progress Schedule upon occurrence of any of the following instances:
   1. The actual physical progress of the Work falls more than five percent (5%) behind the accepted Construction Progress Schedule, as demonstrated by comparison to the accepted monthly Construction Progress Schedule updates or as determined by Engineer if a current accepted Construction Progress Schedule does not exist.
   2. Engineer considers milestone or completion dates to be in jeopardy because of "activities behind schedule". "Activities behind schedule" are all activities that have not or cannot be started or completed by the dates shown in the Construction Progress Schedule.
   3. A Change Order has been issued that changes, ads, or deletes scheduled activities, or affects the time for completion of scheduled activities.

B. When instances requiring revision to the Construction Progress Schedule occur, submit the proposed revised Construction Progress Schedule within ten (10) working days after receiving direction from Engineer to provide such schedule. No additional payment will be made for preparation and submittal of proposed revised Construction Progress Schedules. However, if Engineer accepts the proposed revised Construction Progress Schedule, it shall replace and supersede all previous Construction Progress Schedules and substitute for the next monthly Construction Progress Schedule update that would otherwise be required.

C. Revisions to the Construction Progress Schedule shall comply with all the same requirements applicable to the original schedule.

1.8 SCHEDULE RECOVERY

A. If a revised Construction Progress Schedule accepted by Engineer requires additional manpower, equipment, hours of work or work shifts, or to accelerate procurement of materials or equipment, or any combination thereof, as schedule recovery measures to meet Contract milestones, implement such schedule recovery measures without additional charge to Owner.

1.9 EARLY COMPLETION SCHEDULES

A. Early completion schedules are generally not acceptable to Owner but may be accepted as a convenience to Contractor and under the following conditions.
   1. Submit a specific written request outlining the specific reasons for using the early completion schedule.
   2. Acknowledge and agree in writing that the proposed reduction in time represents Project time already paid for by Owner as part of the Bid Price, and available to both Contractor and Owner for the mitigation of impacts to the Project from any source. Contractor is not entitled to any increase in Contract price for failure to achieve the early completion and waives all claim to same.

3. Early completion schedules shall not be based upon or rely on expedited approvals by Owner or Engineer.
4. Early completion schedules must meet all other requirements of the Contract.

B. Revise early completion schedules, which have activities behind schedule, when and as requested by Engineer.

1.10 BASIS OF SCHEDULE NARRATIVES

A. Furnish a basis of schedule narrative to Engineer with each Application for Payment. If the Work falls behind schedule, submit additional narrative at such intervals as Engineer may request.

B. In each narrative, include a summary of progress for the month, description of any current and anticipated delaying factors, a variance analysis for varying activities, impacts on the construction schedule, and proposed corrective actions. Any Work reported complete, but which is not readily apparent to Engineer, must be substantiated with satisfactory evidence.

C. In each narrative, include a list of the activities completed during the preceding month and a list of the activities started during the month but not yet completed.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 20
SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for submittals required in performance of the Work, including shop drawings, schedules, surveys, reports, samples, plans, lists, drawings, documents, warranties, certifications, findings, programs, manuals, data sheets, or any other item of information required by the Contract Documents to be submitted in accomplishing the Work.

1.2 DEFINITIONS

A. Action Submittal: Written and graphic information submitted by Contractor that requires Engineer's approval for inclusion in the Work.

B. Deferred Submittal: Information in accordance with the applicable Building Code, submitted by Contractor for portions of the design that are to be submitted to permitting agency after the time of permit application and prior to installation of that portion of Work. Deferred Submittals must include Engineer's review documentation stating that submittal has been found to be in general conformance with overall Project design.

C. Informational Submittal: Information submitted by Contractor to represent compliance with Contract Requirements included in the Work, but which are not part of the Work itself. Informational Submittals must be submitted to Engineer for information and for determination that submitted information is in accordance with Contract requirements.

D. Shop Drawing: The term "Shop Drawing" as used herein shall be understood to include detail design calculations, shop drawings, fabrication and installation drawings, erection drawings, lists, graphs, and similar items.

E. PDF: Abbreviation for "Portable Document Format", used for transmittal of electronic documents.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Whenever submittals are required hereunder, transmit all documents to Engineer in electronic format, via web-based construction management software as specified in Section 00 73 00 – Supplementary Conditions. Contact information for the web-based project management software is as follows:

Brian Mecham, P.E.
Bowen Collins & Associates
154 E 14075 S
Draper, Ut 84020
Email: bmecham@bowencollins.com
Office 801-495-2224
Cell 801-828-7584

B. Be responsible for the accuracy, completeness, and coordination of all submittals. Do not delegate this responsibility in whole or in part to any subcontractor. Submittals may be prepared by Contractor, subcontractor, or supplier, but Contractor shall ascertain that each submittal meets the requirements of the Contract and the Project. Ensure that there is no conflict with other submittals and notify Engineer in each case where a submittal may affect the work of another contractor or Owner.

C. Coordination
   1. Ensure coordination of submittals of related crafts and subcontractors.
   2. Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently ahead of performance of related construction activities to avoid delay.
   3. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
   4. Carefully review all submittals prior to submission. Sign and date each transmittal with a direct statement acknowledging that the equipment or material in the submittal meets all the requirements specified or shown in the Contract Documents without exception. No consideration or review of any submittals will be made for any items, which have not been so certified. All non-certified submittals will be returned without action taken, and any delays caused thereby shall be the total responsibility of Contractor. Submittals which cannot bear this certification because they contain an exception or deviation to the Contract Documents shall be so noted in the electronic transmittal and shall only be submitted in accordance with Section 01 25 10 – Products, Materials, Equipment and Substitutions.

D. Processing: Allow sufficient review time so that installation will not be delayed because of the time required to process submittals, including time for resubmittals.
   1. Except as may otherwise be indicated herein, Engineer will return each submittal, with comments noted thereon, within 21 calendar days following receipt by Engineer.
   2. For resubmittal, Engineer will be allowed the same review period as for the original submittal.
   3. It is considered reasonable that Contractor will make a complete and acceptable submittal to Engineer by the second submission of an item. Owner reserves the right to withhold monies due Contractor to cover additional costs of any review beyond the second submittal.
   4. Allow additional time if processing must be delayed for coordination with subsequent submittals. Engineer will promptly advise Contractor when a submittal being processed must be delayed for coordination.
   5. If an intermediate submittal is necessary, process the same as the initial submittal.
   6. No extension of Contract Time will be authorized resulting from non-compliant submittals or failure to transmit submittals to Engineer sufficiently in advance of the Work to permit processing.
   7. If an incomplete submittal is made, the submittal may be returned without review. A complete submittal will contain sufficient data to demonstrate that the items contained therein comply with the Contract Documents, meet the minimum requirements for submittals as described in the Contract Documents, and include all corrections as required from previous submittals.

E. Submittal Schedule

1. Within 30 days of the Notice to Proceed, submit a complete list of anticipated submittals, which includes Specification and Drawing references.
    a. Coordinate submittal schedule with any subcontracts, schedule of values, the list of products, and Contractor's construction schedule.
    b. Prepare schedule in chronological order.
    c. Update the list with "early start" submittal dates within 15 days of submittal of the Construction Progress Schedule.
    d. Update submittal dates whenever the schedule is updated and include any additional submittals identified after the initial submittal in the updates.

F. Unsolicited Submittals: Unsolicited submittals may be returned without being reviewed.

G. Changes in Work: Changes in the Work will not be authorized by submittal review actions. No review action, implicit or explicit, will be interpreted to authorize changes in the Work. Changes will only be authorized by separate written direction from Owner, in accordance with the General Conditions.

1.4 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS

A. Product Data:
1. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves. Where Product Data must be specially prepared because standard published data is not suitable for use, submit as "Shop Drawings."
2. Mark each data sheet to show applicable choices and options pertinent to the Project. Where printed Product Data includes information on several products, some of which are not required for the Project, mark the data sheets to indicate the applicable information. Include the following information:
    a. Manufacturer's printed recommendations.
    b. Compliance with recognized trade association standards.
    c. Compliance with recognized testing agency standards.
    d. Application of testing agency labels and seals.
    e. Notation of dimensions verified by field measurement.
    f. Notation of coordination requirements.
3. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.

B. Samples
1. Whenever in the Specifications, samples are required, submit not less than 3 samples of each item or material to Engineer for acceptance at no additional cost to Owner.
2. Submit full-size, fully fabricated Samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern.
3. Submit samples for acceptance, a minimum of 21 days prior to ordering such material for delivery to the jobsite. Submit in an orderly sequence so that dependent materials or equipment can be assembled and reviewed without causing delays in the Work.
4. Transmit a submittal as a single PDF document with list of samples via the web-based project management software.

5. Individually and indelibly label and tag all samples to indicate all specified physical characteristics and Manufacturer's name for identification. Upon receiving acceptance by Engineer, one set of the samples will be stamped, dated, and returned. One set of samples will be retained by Engineer, and one set of samples will remain at the Project site until completion of the Work.
6. Unless indicated otherwise, all colors and textures of specified items presented in sample submittals shall be from the manufacturer's standard colors and standard materials, products, or equipment lines. If the samples represent non-standard colors, materials, products, or equipment lines and their selection will require an increase in Contract time or Price, clearly indicate this information in the submittal.

C. Shop Drawings
1. Wherever called for in the Contract Documents, or where required by Engineer, transmit an electronic Shop Drawing Submittal to Engineer for review, using the web-based project management software. Whenever required to submit design calculations as part of a Submittal, such calculations shall bear the signature and seal of a professional engineer registered in the appropriate discipline in the state of Utah unless otherwise directed.
2. Organization
   a. Prepare a single shop drawing submittal for each item or class of material or equipment for which submittal is required. At a minimum, separate submittals are required for different Specification Sections except as follows. A single submittal covering multiple sections will not be accepted unless the primary specification references other sections for components. Example: If a pump section references other sections for the motor, protective coating, anchor bolts, local control panel, and variable frequency drive, a single submittal would be accepted; a single submittal covering vertical turbine pumps and horizontal split case pumps would not be acceptable.
   b. Index the components for the submittal and reference the specification sections and paragraph numbers for all components in the description field of the electronic submittal. Relate the submittal components to drawing number, detail number, schedule title, or room number and building name, as applicable.
   c. Unless indicated otherwise, terminology and equipment names and numbers used in submittals shall match the Contract Documents.
   d. Engineer will assign a single review action to each submittal, which action shall pertain to every part of the submittal as a whole.
   e. Disorganized submittals, which do not meet the requirements specified herein will be returned without review.
3. Format
   a. Assemble submittals into a single PDF file for each transmittal. Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on PDF sheets at least 8-1/2” x 11” and no larger than 36” X 48”
   b. Where product data from a manufacturer is submitted, clearly mark which model is proposed, with all pertinent data, capacities, dimensions, clearances, diagrams, controls, connections, anchorage, and supports. Present sufficient level of detail for assessment of compliance with the Contract Documents.
   c. Assign each Submittal a unique number, including the specification section under which it is submitted. Number all submittals sequentially within the applicable specification section. Original submittals will be assigned a

numeric submittal number. Resubmittals shall be numbered with a revision number in addition to the original submittal number.

D. Engineer's Action
   1. If submittal is returned to Contractor marked "NO ACTION TAKEN", indicating that the submittal has been received and is being retained for record-keeping purposes. Formal revision and resubmission of said submittal will not be required.
   2. If submittal is returned to Contractor marked "NO EXCEPTIONS TAKEN", formal revision and resubmission of said Submittal will not be required and construction may proceed.
   3. If submittal is returned to the Contractor marked "MAKE CORRECTIONS NOTED", formal revision and resubmission of said submittal will not be required but construction must proceed according to the review comments included with the submittal.
   4. If submittal is returned marked "REVISE AND RESUBMIT", revise said submittal and resubmit. Construction may not proceed.
   5. If submittal is returned marked "REJECTED-RESUBMIT", revise said submittal and resubmit. Construction may not proceed.
   6. Resubmittal of portions of multi-page or multi-drawing submittals will not be allowed. For example, if a Shop Drawing Submittal that consists of ten drawings contains only one drawing that needs to be amended and resubmitted, the submittal as a whole is deemed as "REVISE AND RESUBMIT", and all ten drawings included in the submittal are required to be resubmitted.
   7. On resubmittals, flag any changes made, other than those made or requested by Owner or Engineer.

E. Commence fabrication of an item only after Engineer has reviewed the pertinent submittals and Engineer has assigned action as either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED". Corrections indicated on submittals are considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis for changes to the Contract requirements.

F. Owner's and/or Engineer's review of shop drawing submittals does not relieve Contractor of the responsibility for correctness of details and dimensions and for compliance with the Contract Documents. Assume responsibility and risk for misfits due to errors in submittals. Be responsible for dimensions and design of adequate connections and details.

G. Deferred Design Submittals: Items noted on the Contract Documents as "Deferred Submittals" must be submitted to Engineer, who will review them and forward them to the building official with a notation indicating that the deferred submittal documents have been reviewed and found to be in general conformance with the design of the Project. Do not install Deferred Submittal items until the deferred submittal documents have been approved by the permitting agency.

H. Test and Evaluation Reports: Submit technical data, test reports, calculations, surveys, and certifications based on field tests and inspections by independent inspection and testing agency and by authorities having jurisdiction.
   1. Reports of results of inspections and tests will not be considered Contract Documents.
   2. Refer to Section 01 45 00 - Quality Control for additional requirements.

1.5 PRECONSTRUCTION CONFERENCE SUBMITTALS

A. At the preconstruction conference referred to in Section 01 11 00 - Summary of Work, submit the following items to Engineer for review:
   1. A preliminary schedule of Shop Drawings, Samples, and proposed Substitute ("Or-Equal") submittals listed in the Bid.
   2. A list of all permits and licenses to be obtained, indicating the agency required to grant the permit, the expected date of submittal for the permit, and required date for receipt of the permit.
   3. A preliminary Schedule of Values in accordance with Section 01 29 73 - Schedule of Values.
   4. A preliminary Construction Project Schedule in accordance with requirements of Section 01 32 16 - Construction Progress Schedule.
   5. The name and qualifications of the Designated Safety Representative in accordance with requirements of Section 01 31 30 - Safety.

1.6 NEIGHBORHOOD CONSTRUCTION PLAN

A. Provide for Engineer's review, a Neighborhood Construction Plan detailing the plan of operation for construction between 13400 South and Rosecrest Reservoir, including Rosecrest Road, Crown Rose Dr and Emmeline Dr. In preparing the plan, consider the public awareness factors listed in Section 01 71 40 - Public Information Program, and include, at minimum, the following:
   1. Pertinent elements of permits granted by governmental agencies.
   2. The planned work schedule, hours of operation, and plans for temporary and permanent pavement replacement.
   3. Material hauling routes for trench excavation material, pipe, and backfill material such that materials are not stored in the street right-of-way. Also, construction routes that avoid school zones or other areas of safety consideration.
   4. Plans for detours, access to each occupied property during the period of construction, and emergency vehicle access.
   5. Plans for barricades and neighborhood signage during construction.
   6. Safety measures to be taken to protect persons and private property in the vicinity of construction and including contingency or emergency plans for unplanned events such as excavation cave in or storm runoff.
   7. Identify neighborhood specific dust and noise control measures.
   8. Plans for public notices to adjacent property owners.
   9. Plans for maintaining access to private residences and businesses, including restoration procedures for temporary asphalt patching and the length of time restoration will be maintained.

B. Submit to Engineer upon receiving accepted permits per Section 01 41 26 - Permits, and at least 14 days prior to work beginning in the Project segments.

C. Engineer will use the Neighborhood Construction Plan to monitor the construction activities.

1.7 SITE CONDITION SURVEYS

A. Submit the site conditions survey data as required in Section 01 71 30 - Site Conditions Surveys.

1.8 CONSTRUCTION PROGRESS REPORTS

A. Transmit a progress report to Engineer with each Application for Payment. If the Work falls behind schedule, submit additional progress reports at such intervals as Engineer may request.

B. In each progress report, include sufficient narrative to describe any current and anticipated delaying factors, effect on the construction schedule, and proposed corrective actions. Any Work reported complete, but which is not readily apparent to Engineer, must be substantiated with satisfactory evidence.

C. In each progress report, include a list of the activities completed with their actual start and completion dates, a list of the activities currently in progress, and the number of working days required to complete each.

1.9 SURVEY DATA

A. Make available for examination throughout the construction period, all field books, notes, and other data developed while performing the surveys required by the Work and submit all such data to Engineer with documentation required for final acceptance of the Work.

1.10 UTILITY INVESTIGATION

A. Transmit the findings of the utility investigation in accordance with Section 01 71 50 - Protection and Restoration of Existing Facilities.

1.11 QUALITY ASSURANCE/QUALITY CONTROL PLAN

A. Prepare and submit a Quality Assurance/Quality Control Plan for the Work contained in the Contract in accordance with Section 01 45 00 - Quality Control.

1.12 CONTRACTOR DAILY REPORT

A. Submit to Engineer, or designee, a daily report. Upload report not later than 9:00 A.M. of the workday following the report date and include the following:
   1. Day of week, date, Contractor name and Report number.
   2. Summary of work in process (segregated by Contractor and Subcontractor).
   3. Details of work accomplished including quantities of Work installed.
   4. Summary of equipment working and where working.
   5. Summary of manpower by work element and Subcontractor.
   6. Receipt of major equipment or materials.
   7. All required testing performed and, if available, documented results.
   8. Notification of percent of Work delayed by abnormal weather conditions.
   9. Notification of percent of Work delayed by other utility conflicts or conditions.

1.13 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Manual
   1. Submit technical operation and maintenance information for each item of mechanical, electrical and instrumentation equipment in an organized manner in the *Operations*

and Maintenance Manual, written so that it can be used and understood by the Owner's operation and maintenance staff.

2. Furnish initial submittal of the *Operations and Maintenance Manual* to Engineer upon delivery of the respective equipment.
3. Subdivide the *Operations and Maintenance Manual* first by Specification Section number; second, by equipment item; and last, by "Part." Conform "Parts" to the following (as applicable):
    a. Part 1 – Equipment Summary:
        1) Summary: In a summary table, indicate the equipment name, equipment number, and process area in which the equipment is installed.
        2) Form: Furnish an Equipment Summary Form for each item of mechanical, electrical and instrumentation equipment in the Work. Fill in the relevant information on the form and include it in Part 1.
    b. Part 2 – Operational Procedures:
        1) Procedures: Include manufacturer-recommended procedures on the following in Part 2:
            a) Installation
            b) Adjustment
            c) Startup
            d) Location of controls, special tools, equipment required, or related instrumentation needed for operation
            e) Operation procedures
            f) Load changes
            g) Calibration
            h) Shutdown
            i) Troubleshooting
            j) Disassembly
            k) Reassembly
            l) Realignment
            m) Testing to determine performance efficiency
            n) Tabulation of proper settings for all pressure relief valves, low and high- pressure switches, and other protection devices
            o) List of all electrical relay settings including alarm and contact settings
            p) Lubrication.
    c. Part 3 – Preventive Maintenance Procedures:
        1) Procedures: Preventive maintenance procedures shall include all manufacturer-recommended procedures to be performed on a periodic basis, both by removing and replacing the equipment or component, and by leaving the equipment in place.
        2) Schedules: Include recommended frequency of preventive maintenance procedures. Cover lubrication schedules, including lubricant SAE grade, type, and temperature ranges.
    d. Part 4 – Parts List:
        1) Parts List: Furnish a complete parts list, including a generic description and manufacturer's identification number for each part. Include addresses and telephone numbers of the nearest supplier and parts warehouse.

2) Drawings: Include cross-sectional or exploded view drawings with the parts list.

e. Part 5 – Wiring Diagrams:
   1) Diagrams: In this part, include complete internal and connection wiring diagrams for electrical equipment items.

f. Part 6 – Shop Drawings:
   1) Drawings: In this part, include approved shop or fabrication drawings, complete with dimensions.

g. Part 7 – Safety:
   1) Procedures: This part describes the safety precautions to be taken when operating and maintaining the equipment or working near it.

h. Part 8 – Documentation:
   1) Place all equipment warranties, affidavits, and certifications required by the Technical Specifications in this part.

4. Transmit to Engineer, one copy of the *Operations and Maintenance Manual* in digital format. In addition to the digital copy, furnish Engineer with one hard copy of the *Operations and Maintenance Manual*. Each set shall consist of one or more volumes, each of which shall be bound in a standard size, 3-ring, loose-leaf, vinyl plastic hard cover binder suitable for bookshelf storage. Binder ring size shall not exceed 2.5 inches. Prepare a table of contents indicating all equipment in the manuals. Display the title of each volume on the cover and spine.
5. Submit *Operations and Maintenance Manuals* in final form, not later than the 75 percent of construction completion date. Correct all discrepancies found by Owner or Engineer in the *Operations and Maintenance Manual* within 30 days from the date of written notification.
6. Incomplete or unacceptable *Operations and Maintenance Manuals* at the 75 percent construction completion point constitute sufficient justification to withhold the amount stipulated in paragraph "*Operations and Maintenance Manual* Submittals" of Section 01 77 00 - Project Closeout, from any monies due.

B. Certificates
1. When specified in individual specification sections, submit manufacturers' certificates to Engineer for review as specified.
2. Submit in form of letter or company standard forms, signed by officer of manufacturer.
3. Include the following with each certification
   a. Project name and location.
   b. Contractor's name and address.
   c. Quantity and date or dates of shipment or delivery to which certificate applies.
   d. Manufacturer's name.
   e. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
   f. Certificates may be recent or previous test results on material or product but must be acceptable to Engineer.

C. Record Documents
1. Prepare and maintain one set of record documents at the Project Site per the requirements of Section 01 78 39 - Project Record Documents. Submit to Engineer at close of Project.

1.14 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts: Submit list of spare parts information for all mechanical, electrical, and instrumentation equipment. Include the current list price of each spare part. Limit the spare parts list to those spare parts which each manufacturer recommends be maintained by Owner in inventory at the plant site. Each manufacturer or supplier shall indicate the name, address, and telephone number of its nearest outlet of spare parts to facilitate Owner in ordering. Cross-reference all spare parts lists to the equipment numbers designated in the Contract Documents. In addition to electronic submittal, bind the spare parts lists in standard size, 3-ring, loose-leaf, vinyl plastic hard cover binders suitable for bookshelf storage. Binder ring size not to exceed 2.5 inches.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 35 53
SECURITY

PART 1 - GENERAL

1.1 SUMMARY

A. Protect the active construction areas of the Work, including all material, equipment, field office trailers, and their contents from theft, vandalism, and unauthorized entry.

1.2 DEFINITIONS

A. For the purposes of this Section, an "active construction area" is any area where construction activities are occurring, or construction activities could be considered a potential hazard to people.

1.3 RELATED SECTIONS

A. Section 01 57 19 – Temporary Environmental Controls

1.4 SUBMITTALS

A. Prior to performance of any work at the Project Site, submit to Engineer for record only, a copy of the security plan commensurate with the needs of the Project, signed by officer of Contractor. Be solely responsible for adequacy of the security plan.

B. Provide Engineer with drawing and data showing temporary fencing and gate locations, along with materials to be used.

C. Provide Engineer with a list of 24-hour emergency phone numbers for Contractor personnel.

D. Submit to Engineer an updated progressive inventory of materials and equipment received on-site.

E. Submit log of workmen and visitors to Project Site.

1.5 SECURITY PROGRAM

A. Protect Work and existing premises, including the field office trailers and their contents, from theft, vandalism, and unauthorized entry during working and non-working hours.

B. Accept sole responsibility for Project Site security and protection of the Work.

C. Initiate the security program at job mobilization and maintain the security program throughout construction period.

D. Limit lighting to basic safety and security requirements, and shield when possible.

E. Be responsible for the security of storage compound and lay down area, and for all plant material, equipment, and tools always.

F. Prohibit firearms for the Project Site.

G. Prohibit dogs from the Project Site.

H. Erect and maintain temporary security fencing as required to protect the Work, the Project Site, and existing facilities on the Project Site. The location of all temporary security fencing shall be approved in advance by Engineer.
   1. Fence Height: 6 feet
   2. Fence Material: Chain linked with privacy screening fabric

1.6 ENTRY CONTROL

A. Entry control shall not unreasonably limit the personnel of Owner, Engineer, and their operations and maintenance groups from performing assigned duties. Temporary access limitations will be identified to Engineer and the operations and maintenance groups at least 24 hours prior to such limitation.

B. Restrict entry of unauthorized persons and vehicles into Project Site.

C. Allow entry only to authorized persons with proper identification.

D. Maintain a log of workmen and visitors and make log available to Owner on request. This log shall be submitted to Engineer monthly or as necessary.

E. Require all visitors to sign the visitor log acknowledgment of the project rules included in this Section. A copy of the project rules shall be given to each visitor. Submit copies of these forms to Engineer biweekly.

F. Contractor has the right to refuse access to the Project Site or require that a person or vehicle be removed from the Project Site if found violating any of the project rules.

G. Give jobsite security orientation training to all affected employees, including subcontractor employees. Employee participation in the security orientation shall be acknowledged by their respective individual signatures affixed to an orientation roster.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 41 26
PERMITS

PART 1 - GENERAL

1.1 ADMINISTRATIVE REQUIREMENTS

A. Obtain permits required for the execution of Work in accordance with the Contract Documents. Provide copies of these permits to Owner.

B. The intent of this Section is to furnish the known list of required permits for the Work under the Contract Documents. Owner does not guarantee that this list is complete. Be responsible for determining and verifying the extent of all permits required and for obtaining such permits.

C. In the Bid Price, include costs for obtaining all necessary permits, including application fees and other costs, and the costs of complying with the conditions of all permits. Any fees listed in this section are estimates and are for information only. Verify and pay all actual fees.

D. Within 30 Days of the Limited Notice to Proceed, submit a list of all permits and licenses to be obtained, indicating the agency required to grant the permit, the expected date of submittal for the permit, and required date for receipt of the permit.

1.2 SUMMARY OF PERMITS TO BE OBTAINED BY CONTRACTOR

A. Obtain the following permits. Submit copies of these permits to Engineer and maintain copies on-site. Comply with all conditions of the permits.
   1. Utah Department of Environmental Quality, Division of Air Quality:
      a. Fugitive Dust Control Plan and Permit: Utah Admin. Code R307-309 requires a fugitive dust control plan. Plan should include procedures to minimize fugitive dust on-site and prevent fugitive dust capacities from exceeding allowable limits. Plan should be submitted prior to the start of clearing or construction.
         1) Agency: Utah Department of Environmental Quality, Division of Air Quality
         2) Contact: Division of Air Quality
         3) Telephone No.: (801) 536-4000
   2. Utah Department of Environmental Quality, Division of Water Quality:
      a. UPDES General Permit for Construction Dewatering/Hydrostatic Testing of Pipelines: Covers discharge waters associated with dewatering operations and hydrostatic testing of pipelines.
         1) Agency: Utah Department of Environmental Quality, Division of Water Quality
         2) Contact: Jeanne Riley
         3) Telephone No.: (801) 536-4369
         4) Email: jriley@utah.gov
      b. Notification of Chlorinated Water Discharge: This notification provides 30 days' notice prior to disinfection of pipeline and discharge of pipeline and discharge of chlorinated water.

c. Ground Water Discharge Permit: Necessary for any activity which causes or has the potential to cause a discharge of pollutants to ground water.
   1) Agency: Utah Department of Environmental Quality, Division of Water Quality
   2) Contact: Eleanor Divver
   3) Telephone No.: (801) 6536

3. Herriman City
   a. Traffic Control Permit: Required for any work done in public right-of-way that impedes traffic or pedestrian walkway.
      1) Agency: Herriman City
      2) Contact: Delinda Bodrero
      3) Address: 5355 W Herriman Main St
      4) Telephone No.: 801-446-5323
      5) Email: dbodrero@herriman.gov
   b. Land Disturbance Permit: Required for any activity disturbing one or more acres of land, requiring placement or stockpiling of materials, requiring work within public right-of-way, or involving grading, excavation, and/or backfilling.
      1) Agency: Herriman City
      2) Contact: Delinda Bodrero
      3) Address: 5355 W Herriman Main St
      4) Telephone No.: 801-446-5323
      5) Email: dbodrero@herriman.gov
   c. Tree Protection Plan: Required for any activity which may threaten existing trees or their root systems.
      1) Agency: Herriman City
      2) Contact: Trent Bristol
      3) Address: 5355 W Herriman Main St
      4) Telephone No.: 801-446-5323
      1) Email: tbristol@herriman.gov
   d. SWPPP Review and Checklist:
      1) Agency: Herriman City
      2) Contact: Jonathan Bowers
      3) Address: 5355 W Herriman Main St
      4) Telephone No.: 801-446-5323
      5) Email: jbowers@herriman.gov

4. Riverton City
   a. Right-of-Way Encroachment Permit: Required for work within City right-of-way. A Traffic Control Plan will be required with this permit.
      1) Agency: Riverton City
      2) Contact: Mike Bagshaw
      3) Address: 12526 South Redwood Rd.
      4) Telephone No.: 801-208-3162
      5) Email: ROWPERMITS@rivertonutah.gov
   b. Land Disturbance Permit: A separate land disturbance permit for Riverton City is not required so long as the construction area within Riverton City does not exceed 1 Acre. Provide a copy of approved Herriman City Land Disturbance Permit to verify that construction will incorporate stormwater controls and comply with the Utah Clean Water Act and the requirements of the Municipal Separate Storm Sewer System (MS4) Permit.

1) Agency: Riverton City
2) Contact: Jacob Kelsch
3) Address: 12830 South Redwood Rd.
4) Telephone No.: 801-208-3103
5) Email: stormwater@rivertonutah.gov

5. Salt Lake County
   a. Existing Monument Preservation Permit is required to verify compliance with County policies and ordinances regarding existing public survey monuments. It is estimated that approximately 12 existing survey monuments have the potential to be disturbed by Project construction activity.
      1) Agency: Salt Lake County
      2) Contact: Salt Lake County Surveyor
      3) Address: 2001 South State Street, Suite N1-400, PO Box 144575, Salt Lake City, UT 84114-4575
      4) Telephone No.: (385) 468-8250

1.3 SUMMARY OF PERMITS OBTAINED BY OWNER

A. The following permits have been or will be obtained by Owner for this Project. Verify and comply with conditions of said permits.
   1. Utah Department of Environmental Quality, Division of Drinking Water
      a. Project Notification and Plan Review/Construction Approval
         1) Agency: Utah Department of Environmental Quality, Division of Drinking Water
         2) Contact: Michael Newberry
         3) Telephone No.: (385) 515-1464
         4) Email: mnewberry@utah.gov
      b. Operating Permit
   2. Salt Lake County
      a. Flood Control Permit: For the use of Right-of-Way, Right-of-Entry, or Installation of Structures.
         1) Agency: Salt Lake County
         2) Contact: Chris Springer
         3) Address: 2001 South State Street, Salt Lake City, Utah 84190
         4) Telephone No.: (801) 468-2711
   3. Enbridge Gas
      a. Relocation Agreement: JVWCD and Enbridge Gas have agreed to relocate existing Enbridge Gas lines in two project locations. The Contractor is responsible to coordinate with Enbridge Gas, excavate and expose existing lines, and backfill the relocated lines. Enbridge Gas will perform the relocation. The relocations are preliminarily shown in the Drawings.
         1) Agency: Enbridge Gas
         2) Contact: Hannah Gillespie
         3) Telephone: (801) 572-8759
         4) Email: hannah.gillespie@enbridge.com
   4. Rocky Mountain Power
      a. Relocation Agreement: If a relocation of existing Rocky Mountain Power utilities becomes necessary during construction, JVWCD will coordinate a relocation agreement with Rocky Mountain Power. The Contractor will be responsible for coordinating with Rocky Mountain Power, excavating and exposing existing lines, and backfilling the relocated lines.

1) Agency: Rocky Mountain Power
2) Contact: John Langi Jr
3) Telephone: (801) 220-6102
4) Email: John.Langi@rockymounainpower.net

5. Comcast
   a. Relocation Agreement: If a relocation of existing Comcast utilities becomes necessary during construction, JVWCD will coordinate a relocation agreement with Comcast. The Contractor will be responsible for coordinating with Comcast, excavating and exposing existing lines, and backfilling the relocated lines.
      1) Agency: Comcast
      2) Contact: Dave Mascarenas
      3) Email: david_mascarenas@comcast.com

PART 2 - MATERIALS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 42 13
ABBREVIATIONS OF INSTITUTIONS

PART 1 - GENERAL

1.1 GENERAL

A. Wherever in the Contract Documents, references are made to the standards, specifications, or other published data of the various international, national, regional, or local organizations, such organizations may be referred to by their acronym or abbreviation only. As a guide to the reader, the following acronyms or abbreviations which may appear in the Contract Documents shall have the meanings indicated herein.

1.2 ABBREVIATIONS

AAMA	Architectural Aluminum Manufacturer's Association
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturer's Association, Inc.
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AI	The Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute, Inc.
APA	American Plywood Association
API	American Petroleum Institute
APWA	American Public Works Association
ASCE	American Society of Civil Engineers

ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASLE	American Society of Lubricating Engineers
ASME	American Society of Mechanical Engineers
ASQC	American Society for Quality Control
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturer's Association
CGA	Compressed Gas Association
CLFMI	Chain Link Fence Manufacturer's Institute
CLSI	Clinical and Laboratory Standards Institute
CRSI	Concrete Reinforcing Steel Institute
EIA	Electronic Industries Association
ETL	Electrical Test Laboratories
EPA	Environmental Protection Agency
FM	Factory Mutual System
FPL	Forest Products Laboratory
HI	Hydronics Institute
IAPMO	International Association of Plumbing and Mechanical Officials
IBC	International Building Code
ICC	International Code Council
ICEA	Insulated Power Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society

IP	Institute of Petroleum (London)
IPC	Institute of Printed Circuits
ISA	Instrument Society of America
ISO	International Organization for Standardization
ITE	Institute of Traffic Engineers
MBMA	Metal Building Manufacturer's Association
MPTA	Mechanical Power Transmission Association
MSS	Manufacturers Standardization Society
MTI	Marine Testing Institute
NAAMM	National Association of Architectural Metal Manufacturer's
NACE	National Association of Corrosion Engineers
NBS	National Bureau of Standards
NCMA	National Concrete Masonry Association
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NLGI	National Lubricating Grease Institute
NSF	National Sanitation Foundation International
NWMA	National Woodwork Manufacturers Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PPI	Plastics Pipe Institute
RWMA	Resistance Welder Manufacturer's Association
SAE	Society of Automotive Engineers
SAMA	Scientific Apparatus Makers Association

SMACCNA	Sheet Metal and Air Conditioning Contractors National Association
SPI	Society of the Plastics Industry, Inc.
SPR	Simplified Practice Recommendation
SSPC	Society for Protective Coatings
SSPWC	Standard Specifications for Public Works Construction
TIA	Telecommunications Industry Association
UL	Underwriters Laboratories, Inc.
WEF	Water Environment Federation
WRI	Wire Reinforcement Institute, Inc.
WWPA	Western Wood Products Association
WWPA	Western Wood Products Association (WWPA)

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 42 19
REFERENCE STANDARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Titles of Sections and Paragraphs: Captions accompanying Specification Sections and Paragraphs are for convenience of reference only, and do not form a part of the Specifications.

B. Applicable Publications: Whenever in these Specifications, references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies, which have been published as of the date that the Work is advertised for bids, shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth herein or shown on the Drawings shall be waived because of any provision of, or omission from, said standards or requirements.

C. Specialists, Assignments: In certain instances, Specification text requires (or implies) that specific Work is to be assigned to specialists or expert entities, who must be engaged for the performance of that Work. Such assignments shall be recognized as special requirements with no choice or option. These requirements shall not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the Work; also they are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of Work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, accept the final responsibility for fulfillment of the entire set of contract requirements.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all Work specified herein shall conform to or exceed the requirements of applicable codes and the applicable requirements of the following documents.

B. References herein to "Building Code", “Plumbing Code”, “Mechanical Code”, “Fuel Gas Code”, or “Fire Code” shall mean the latest adopted version of the International Building Code (IBC), the International Plumbing Code (IPC), the International Mechanical Code (IMC), the International Fuel Gas Code (IFGC), and the International Fire Code (IFC) as published by the International Code Council (ICC). Similarly, references to the "Uniform Mechanical Code" or the "Uniform Plumbing Code" shall mean the Uniform Mechanical Code or the Uniform Plumbing Code as published by the International Association of Plumbing and Mechanical Officials (IAPMO) References to the "Electric Code" or "National Electric Code (NEC)" shall mean the National Electric Code of the National Fire Protection Association (NFPA). The latest edition of any “building” code as approved by the Municipal Code and adopted by the authority having jurisdiction, shall apply to the Work herein, including all addenda, modifications, amendments, or other lawful changes thereto.

C. In case of conflict between codes, reference standards, Drawings and the other Contract Documents, the most stringent requirements shall govern. Bring all conflicts to the attention of Engineer for clarification and directions prior to ordering or providing any materials or furnishing labor. Bid the most stringent requirements.

D. Construct the Work indicated herein in accordance with the requirements of the Contract Documents and the referenced portions of those referenced codes, standards, and specifications listed herein.

E. Applicable Standard Specifications: References in the Contract Documents to the "Standard Specifications" shall mean the *Manual of Standard Specifications* (APWA), latest version.

F. References herein to "OSHA Regulations for Construction" shall mean *Title 29, Part 1926, Construction Safety and Health Regulations***,** Code of Federal Regulations (OSHA), including all changes and amendments thereto.

G. References herein to "OSHA Standards" shall mean *Title 29, Part 1910, Occupational Safety and Health Standards***,** Code of Federal Regulations (OSHA), including all changes and amendments thereto.

H. References herein to "UDOT Standards" shall mean *Standard Specifications for Road and Bridge Construction*.

I. References herein to "MSHA Standards" shall mean *Mine Safety and Health Administration Standards*, latest version.

1.3 REGULATIONS RELATED TO HAZARDOUS MATERIALS

A. Be responsible that all Work included in the Contract Documents, whether shown or not, complies with all EPA, OSHA, RCRA, NFPA, and any other Federal, State, and Local Regulations governing the storage and conveyance of hazardous materials, including petroleum products.

B. Where no specific regulations exist, all chemical, hazardous, and petroleum product piping and storage in underground locations must be installed with double containment piping and tanks, or in separate concrete trenches and vaults, or with an approved lining which cannot be penetrated by the chemicals, unless waived in writing by Owner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 45 00
QUALITY CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. The requirements of this Section apply to, and are a component part of, each Section of the Specifications.

1.2 REFERENCES

A. ASTM International (ASTM) standards, most recent editions:

ASTM C1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM D3740	Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM D3666	Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 20 – Submittal Procedures.

B. Submit Quality Control Plan.

C. Submit credentials for field Quality Control Representative showing experience acceptable to Engineer.

D. Submit credentials for testing laboratory showing compliance with Specifications and acceptable to Engineer.

E. Submit results of testing as specified below.

1.4 SITE INVESTIGATION AND CONTROL

A. Check and verify all dimensions and conditions in the field continuously during construction. Be solely responsible for any inaccuracies built into the Work due to Contractor's (including Subcontractor's) failure to comply with this requirement.

B. Inspect related and appurtenant Work and report in writing to Engineer, any conditions which will prevent proper completion of the Work. Failure to report any such conditions constitutes acceptance of all Site conditions. Required removal, repair, or replacement caused by unsuitable conditions shall be performed at no additional cost to Owner.

1.5 INSPECTION OF THE WORK

A. Inspect all Work performed by both Contractor and Subcontractors. Nonconforming Work and any safety hazards in the work area shall be noted and promptly corrected. Be responsible for the Work to be performed safely and in conformance with the Contract Documents.

B. The Work shall be conducted under the general observation of Engineer and is subject to inspection by representatives of Owner acting on behalf of Owner to ensure strict compliance with the requirements of the Contract Documents. Such inspection may include mill, plant, shop, or field inspection, as required. Owner, Engineer, or any inspector(s) shall be permitted access to all parts of the Work, including plants where materials or equipment are manufactured or fabricated.

C. The presence of Engineer, or any inspector(s), shall not relieve Contractor of responsibility for the proper execution of the Work in accordance with all requirements of the Contract Documents. Compliance is the responsibility of Contractor. No act or omission on the part of Engineer, or any inspector(s) shall be construed as relieving Contractor of this responsibility. Inspection of Work later determined to be nonconforming shall not be cause or excuse for acceptance of the nonconforming Work. Owner may accept nonconforming Work when adequate compensation is offered, and it is in Owner's best interest as determined solely by Owner.

D. All materials and articles furnished shall be subject to rigid documented inspection by qualified personnel. No materials or articles shall be used in the Work until they have been inspected and accepted by Contractor's Quality Control Representative and Engineer or other designated representative. No Work shall be backfilled, buried, cast in concrete, covered, or otherwise hidden until it has been inspected. Any Work covered in the absence of inspection shall be subject to uncovering. Where uninspected Work cannot be easily uncovered, such as in concrete cast over reinforcing steel, all such Work shall be subject to demolition, removal, and reconstruction under proper inspection.

E. All Owner furnished materials and articles shall be subject to rigid inspection by Contractor's Quality Control Representative before being used or placed in the Work. Inform Engineer, in writing, of the results of said inspections within one working day after completion of inspection. If any material or articles provided by Owner are considered to be of insufficient quality for use in the Work, immediately notify Engineer.

1.6 TIME OF INSPECTION AND TESTS

A. Furnish and prepare samples and test specimens required under these Specifications and for testing in ample time for the completion of the necessary tests and analyses before said articles or materials are to be used. Furnish and prepare all required test specimens without additional expense to Owner. As provided in the Contract Documents, performance of certain tests will be by Owner, and all costs therefore will be borne by Owner, except that the costs of any test, which shows unsatisfactory results shall be back charged to Contractor.

B. Notify Engineer at least three Workdays before being ready to backfill, bury, cast in concrete, hide, or otherwise cover any Work under this Contract and request inspection before beginning any such Work of covering. Failure to notify Engineer at least three Workdays in advance of any such inspections shall be reasonable cause for Engineer to order a sufficient

delay in scheduled operations to allow time for such inspection. Be responsible for costs of any remedial or corrective work required, and all costs of such delays, including its impact on other portions of the Work.

1.7 SAMPLING AND TESTING

A. Unless otherwise specified, all sampling and testing shall be in accordance with the methods prescribed in the current standards of the ASTM, as applicable to the class and nature of the article or materials considered. However, Engineer reserves the right to use any generally-accepted system of inspection which, in the opinion of Engineer, will ensure Engineer that the quality of the workmanship is in full accord with the Contract Documents.

B. Owner reserves the right to waive tests or quality control measures. However, waiver of any specific testing or other quality control measure, whether or not such waiver is accompanied by a guarantee of substantial performance as a relief from the specified testing or other quality control requirements as originally specified, and whether or not such guarantee is accompanied by a performance bond to assure execution of any necessary corrective or remedial work, shall not be construed as a waiver of any technical or qualitative requirements of the Contract Documents.

C. Notwithstanding the existence of such waiver, Owner reserves the right to make independent investigations and tests as specified in the following paragraph and failure of any portion of the Work to meet qualitative requirements of the Contract Documents shall be reasonable cause for Owner to require the removal or correction and reconstruction of any such Work.

D. In addition to any other inspection or quality control provisions that may be specified, Owner reserves the right to independently select, test, and analyze, at the expense of Owner, additional test specimens of any or all the materials to be used. Results of such additional tests and analyses shall be considered along with the tests or analyses made by the Contractor to determine compliance with the applicable specifications for the materials so tested or analyzed provided that wherever any portion of the Work is discovered, as a result of such independent testing or investigation by Engineer, which fails to meet the requirements of the Contract Documents, all costs of such independent inspection and investigation and all costs of removal, correction, reconstruction, or repair of any such Work shall be borne by Contractor.

1.8 RIGHT OF REJECTION

A. Engineer or designated representative, acting for Owner, always reserves the right to reject any articles or materials furnished hereunder which, in any respect, fail to meet the requirements of the Contract Documents, regardless of whether the defects in such articles or materials are detected at the point of manufacture or after completion of the Work at the Site. If Engineer or designated representative, through an oversight or otherwise, has accepted materials or Work which are defective or in any way contrary to the Contract Documents, such materials, no matter in what stage or condition of manufacture, delivery, or erection, may be rejected.

B. Promptly remove or replace rejected articles or materials from the Site of the Work after notification of rejection.

C. Bear all costs of removal and replacement of rejected articles or materials.

D. Failure to promptly remove and replace rejected Work shall be considered a breach of this Contract and Owner may, after 7 days' notice, terminate Contractor's right to proceed with the affected Work and remove and replace the Work and issue a back charge to cover the cost of the Work.

1.9 QUALITY CONTROL REQUIREMENTS

A. Establish and execute a Quality Control program for the services, which are being provided. The program shall provide adequate measures for verification and conformance to defined requirements of all personnel, including lower-tier subcontractors (including fabricators, suppliers, and sub-subcontractors). Prepare and submit a plan responsive to this Section for review by Engineer.

B. Furnish Engineer with a project specific Quality Control Plan. The plan shall contain a comprehensive account of quality control procedures applicable to this Project. The detailed requirements for this Plan are delineated in the following paragraphs. No progress payments will be made until the Quality Control Plan is fully accepted by Engineer.

C. Using the Quality Control Plan, describe and define the personnel requirements described herein. Provide personnel with assigned quality control functions reporting to a field Quality Control Representative. The field Quality Control Representative shall report to a senior manager of Contractor and shall not have supervisory or managerial responsibility over the work force. Persons performing quality control functions shall have sufficient qualifications, authority, and organizational freedom to identify quality problems and to initiate and recommend solutions. Contractor's Quality Control representative(s) shall be on-site as often as necessary (but not less than the daily hours specified in the Contract Documents) to remedy and demonstrate that Work is being performed properly and to make multiple observations of all Work in progress. The Quality Control Plan shall include a statement by the senior manager designating the Quality Control Representative and specifying authorities delegated to the Quality Control Representative to direct cessation or removal and replacement of defective Work.

D. The Quality Control Plan shall ensure the achievement of adequate quality throughout all applicable areas of the contract. In the Quality Control Plan, describe the program and include procedures, work instructions and records. In addition, describe methods relating to areas that require special testing and procedures as noted in the Specifications.

E. Identification and Control of Items and Materials: Describe procedures in the Quality Control Plan to ensure that items or materials that have been accepted at the site are properly used and installed. Provide procedures for proper identification and storage, and to prevent the use of incorrect or defective materials.

F. Inspection and Tests: Provide written procedures defining a program for control of inspections performed. These procedures shall be described in the Quality Control Plan.
   1. Inspections and tests shall be performed and documented by qualified individuals. At a minimum, "qualified" shall mean having performed similar quality control functions on similar type projects. Records of personnel experience, training and qualifications shall be maintained and made available for review by Engineer upon request.
   2. Maintain and provide to Engineer, within two working days of completion of each inspection and test, adequate records of all such inspections and tests. Inspection and

test results shall be documented and evaluated to ensure that requirements have been satisfied.

3. Procedures shall include:
   a. Specific instructions defining procedures for observing all Work in process and comparing this Work with the Contract requirements (organized by specification section).
   b. Maintaining and providing Daily Inspection Reports. Such reports shall, at a minimum, include the following:
      1) Item(s) inspected
      2) Quality characteristics in compliance
      3) Quality characteristics not in compliance
      4) Corrective/remedial actions taken
      5) Statement of certification
      6) QC Manager's signature
   c. Specific instructions for recording all observations and requirements for demonstrating through the reports that the Work observed complied, or a deficiency was noted and action to be taken.
   d. Procedures to preclude the covering of deficient or rejected Work.
   e. Procedures for halting or rejecting Work.
   f. Procedures for resolution of differences between the Quality Control Representative(s) and the production representative(s).
4. The Quality Control Plan shall identify all contractual hold/inspection points as well as any Contractor imposed hold/inspections points.
5. The Quality Control Plan shall include procedures to provide verification and control of all testing provided, including:
   a. Maintaining and providing to Engineer Daily Testing Records. Such records shall, at a minimum, contain the following:
      1) Item(s) tested
      2) Quality characteristics in compliance
      3) Statement of correctness & certification
      4) Quality characteristics not in compliance
      5) Corrective/remedial actions taken
      6) QC Manager's signature
   b. Individual test records will contain the following information:
      1) Item tested –item number and description
      2) Test results
      3) Test designation
      4) Test work sheet including location sample was obtained
      5) Acceptance or rejection
      6) Date sample was obtained
      7) Retest information, if applicable
      8) Control requirements
      9) Tester signature
      10) Testing QC staff initials
   c. Providing for location maps for all tests performed or location of Work covered by the tests.
   d. Maintaining copies of all test results.
   e. Ensuring Engineer receives independent copy of all tests.
   f. Ensuring testing lab(s) are functioning independently and in accordance with the specifications.

g. Ensuring re-tests are properly taken and documented.

G. Control of Measuring and Test Equipment: Measuring and/or testing instruments shall be adequately maintained, calibrated, and adjusted to maintain accuracy within prescribed limits. Perform calibration at specified periods against valid standards traceable to nationally recognized standards and documented.

H. Supplier Quality Assurance: The Quality Control Plan shall include procedures to ensure that procured products and services conform to the requirements of the Contract Documents. Requirements of these procedures shall be applied, as appropriate, to lower-tier suppliers and/or Subcontractors.

I. Deficient and Nonconforming Work and Corrective Action: The Quality Control Plan shall include procedures for handling of deficiencies and non-conformances. Deficiencies and non-conformances are defined as documentation, drawings, material, equipment, and Work not conforming to the specified requirements or procedures. The procedure shall prevent non-conformances by identification, documentation, evaluation, separation, disposition, and corrective action to prevent recurrence. Conditions having adverse effects on quality shall be promptly identified and reported to the senior level management. The cause of conditions adverse to quality shall be determined and documented and measures implemented to prevent recurrence. In addition, at a minimum, this procedure shall address:

1. Personnel responsible for identifying deficient and non-complying items within the work.
2. How and by whom deficient and non-compliant items are documented “in the field”.
3. The personnel and process utilized for logging deficient and non-compliant work at the end of each day onto a Deficiency Log.
4. Tracking processes and tracking documentation for deficient and non-compliant items.
5. Personnel responsible for achieving resolution of outstanding deficiencies.
6. Once resolved, how are the resolutions documented and by whom.

J. Special Processes and Personnel Qualifications

1. The Quality Control Plan shall include detailed procedures for the performance and control of special process (e.g., welding, soldering, heat treating, cleaning, plating, nondestructive examination, etc.).
2. Personnel performing special process tasks shall have the experience, training, and certifications commensurate with the scope, complexity, or nature of the activity. They shall be approved by Engineer before the start of Work on the Project.

K. Audits: The Quality Control Plan shall provide for documented audits to verify that quality control procedures are being fully implemented by Contractor as well as its subcontractors. Audit records shall be made available to Engineer upon request.

L. Documented Control/Quality Records

1. Establish methods for control of Contract Documents, which describe how Drawings and Specifications are received and distributed to assure the correct issue of the document being used. The methods shall also describe how as-built data are documented and furnished to Engineer.
2. Maintain evidence of activities affecting quality, including operating logs, records of inspections and tests, audit reports, material analyses, personnel qualification and certification records, procedures, and document review records.

3. Quality records shall be maintained in a manner that provides for timely retrieval, and traceability. Quality records shall be protected from deterioration, damage, and destruction.
4. Provide a list with specific records as specified in the Contract Documents, which will be furnished to Engineer at the completion of activities.

M. Acceptance of Quality Control Plan: Engineer's review and acceptance of the Quality Control Plan shall not relieve Contractor from any of its obligations for the performance of the Work. Contractor's quality control staffing is subject to Engineer's review and continued acceptance. Owner, at its sole option, without cause, may direct Contractor to remove and replace the Quality Control Representative. No Work covered by the Quality Control Plan shall start until Engineer's acceptance of the Quality Control Plan has been obtained.

N. Engineer may perform independent quality assurance audits to verify that actions specified in the Quality Control Plan have been implemented. No Engineer audit finding or report shall in any way remove any requirements of this Contract.

1.10 TESTING SERVICES

A. All tests which require the services of a laboratory to determine compliance with the Contract Documents shall be performed by an independent commercial testing firm acceptable to Engineer. The testing firm's laboratory shall be staffed with experienced technicians, properly equipped and fully qualified to perform the tests in accordance with the specified standards.

B. Independent testing laboratory shall be accredited by the American Association of State Highway and Transportation Officials (AASHTO) for the tests they will perform and as appropriate for the Work being performed. The laboratory shall also be accredited under ASTM C1077, ASTM D3740, and ASTM D3666.

C. Engineer shall have the right to inspect work performed by the independent testing laboratory both at the project and at the laboratory. This shall include inspection of the independent testing laboratory's internal quality assurance records (quality assurance manual, equipment calibrations, proficiency sample performance, etc.).

D. Obtain Engineer's acceptance of the testing firm before having services performed. Pay all costs for these testing services.

E. Testing services provided by Owner, if any, are for the sole benefit of Owner. However, test results shall be available to Contractor. Testing necessary to satisfy Contractor's internal quality control procedures shall be the sole responsibility of Contractor.

F. Testing Services furnished by Contractor: Unless otherwise specified, and in addition to all other specified testing requirements, provide all testing services in connection with the following materials as required for Engineer's review:
1. Concrete materials and mix designs.
2. Embankment, fill, and backfill materials.
3. Quality control testing of all precast concrete.
4. All other tests and engineering data required for Engineer's review of materials and equipment proposed to be used in the Work.
5. In addition, the following quality control tests shall be performed by Contractor:

a. Holiday testing of pipeline coatings.
b. Air testing of field-welded joints for steel pipe or pipe cylinders and fabricated specials.
c. All testing and inspection of welding work including, but not limited to, welding procedure qualifications, welder operator qualifications, all work performed by the certified welding inspector, all appropriate nondestructive testing of welds and all repair and retest of weld defects.

G. Testing Services furnished by Owner: Unless otherwise specified, Owner will provide quality control testing services in connection with the following materials and equipment incorporated in the Work.
1. Concrete and CLSM compressive strength tests.
2. Concrete slump, temperature, entrained air, shrinkage, and unit weight tests.
3. Moisture-density and relative density tests on embankment, fill, and backfill materials.
4. Asphalt quality control and density testing.
5. In-place field density test on embankments, fills, and backfill.
6. Other materials and equipment as specified herein.
7. Testing, including sampling, shall be performed by Engineer or testing firm's laboratory personnel, in general manner and frequency indicated in the Specifications.
8. Furnish all sample materials and cooperate in the testing activities, including sampling. Interrupt the Work when necessary to allow testing, including sampling to be performed. There shall be no claim for an increase in Contract Price or Contract Times due to such interruption. When testing activities, including sampling, are performed in the field by the testing firm's laboratory personnel, furnish personnel and facilities to assist in the activities.
9. The testing firm’s laboratory shall perform all laboratory tests within a reasonable time consistent with the specified standards and will furnish a written report of each test. Distribution of the reports shall be as directed by Engineer.

H. Transmittal of Test Reports: Written reports of tests and engineering data furnished for Engineer's review of materials and equipment proposed to be used in the Work shall be submitted per Section 01 33 20 - Submittal Procedures.

I. The testing firm retained for material field testing shall furnish an electronic copy of each test report. Transmit to Engineer within three Workdays after test is completed. Consecutively number each report for each type of test.

J. Testing firm shall furnish an electronic copy of each field and laboratory quality control test to Contractor, Owner and Engineer

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 50 10
SITE ACCESS AND STORAGE

PART 1 - GENERAL

1.1 REFERENCES

A. U.S. Dept. of Transportation, Federal Highway Administration (FHWA) standards.

MUTCD	Manual of Uniform Traffic Control Devices

B. U.S. Dept. of Labor, Occupational Safety and Health Administration (OSHA) standards.

Subpart G, Part 1926	Safety and Health Standards for Construction

1.2 SUBMITTALS

A. Provide design and engineering calculations for custom temporary bridges or steel plates to be employed.

B. Submit hazardous materials storage plan.

C. Submit the EPA issued number for wastes generated at the site.

1.3 ROADWAY AND TRAFFIC LIMITATIONS

A. Investigate the condition of available public and private roads and of clearances, restrictions, bridge load limits, and other limitations affecting transportation and ingress and egress to the site of the Work. Comply with the provisions specified in the Traffic Management Plan. Accept responsibility to construct and maintain any haul roads required for construction operations.

B. Maintain a maximum speed limit of 25 mph while on the Project Site.

C. Confine all vehicles to the designated construction area. Cross-country travel is prohibited.

1.4 TEMPORARY CROSSINGS

A. General: Provide continuous, unobstructed, safe, and adequate pedestrian and vehicular access to fire hydrants, commercial and industrial establishments, churches, schools, parking lots, service stations, motels, fire and police stations, and hospitals. Provide safe and adequate public transportation stops and pedestrian crossings at intervals not exceeding 300 feet. Cooperate with parties involved in the delivery of mail and removal of trash and garbage to maintain existing schedules for such services. Maintain vehicular access to residential driveways to the property line except when required construction precludes such access for reasonable periods of time.

B. Temporary Bridges: Wherever necessary, provide suitable temporary bridges or steel plates over unfilled excavations, except where written consent of the individuals or authorities concerned to omit such temporary bridges or steel plates has been secured. Any such obtained written consent shall be delivered to Engineer prior to excavation. Maintain all such

bridges or steel plates in service until access is provided across the backfilled excavation. Temporary bridges or steel plates for street and highway crossing shall conform to the requirements of the authority having jurisdiction in each case. Adopt designs furnished by said authority for such bridges or steel plates, or submit designs to said authority for approval, as may be required. New designs shall be stamped and signed by a professional engineer, licensed to practice in Utah.

C. Street Use: Nothing herein shall be construed to entitle Contractor to the exclusive use of any public street, alleyway, or parking area during the performance of the Work hereunder. Conduct operations so as not to interfere unnecessarily with the authorized work of utility companies or other agencies in such streets, alleyways, or parking areas. No street shall be closed to the public without first obtaining permission of Engineer and proper governmental authority. Where excavation is being performed in primary streets or highways, always maintain one lane in each direction open to traffic unless otherwise indicated. Provide toe boards to retain excavated material if required by Engineer or the agency having jurisdiction over the street or highway. Fire hydrants on or adjacent to the Work shall always be kept accessible to fire-fighting equipment. Temporary provisions shall be made to assure the use of sidewalks and the proper functioning of all gutters, storm drain inlets, and other drainage facilities.

D. Traffic Control: For the protection of traffic in public or private streets and ways, provide, place, and maintain all necessary barricades, traffic cones, warning signs, lights, and other safety devices in accordance with the requirements of the MUTCD, Part VI - Traffic Controls for Street and Highway Construction and Maintenance Operations."

E. Take all necessary precautions for the protection of the Work and the safety of the public. All barricades and obstructions shall be illuminated at night, and all lights shall be kept burning from sunset until sunrise. Station such guards or flaggers and conform to such special safety regulations relating to traffic control as may be required by the public authorities within their respective jurisdictions. All signs, signals, and barricades shall conform to OSHA Safety and Health Standards for Construction.

F. Temporary Street Closure: If closure of any street is required during construction, apply in writing to the authority having jurisdiction at least 30 days in advance of the required closure for signage and detour requirements.

G. Temporary Driveway Closure: Notify property owner or occupant (if not owner-occupied) of the closure of the driveways to be closed more than one eight-hour workday at least three working days prior to the closure. Minimize the inconvenience and minimize the time that the driveways will be closed. Fully explain to the owner/occupant how long the work will take and when closure is to start.

1.5 WORK AND STORAGE AREA

A. Owner will designate as indicated in the Contract Documents, and arrange for the Contractor's use, a portion of the property at the Rosecrest Reservoir site, 5601 West Emmeline Drive, Herriman City for use during the term of the Contract as a storage and shop area for construction operations on the Work. Provide a plan of intended storage/work area use to Engineer.

B. Make independent arrangements for any necessary off-site storage or shop areas necessary for the proper execution of the Work.

C. Lands to be furnished by Owner for construction operation and other purposes are indicated. Should it be necessary to use any additional land for staging or for other purposes during the construction of the Work, independently arrange for the use of such lands and pay any required rental or use fees. Unless otherwise shown, specified, or agreed, all sites shall be returned to their original condition or better upon completion of the Work.

D. Nothing herein shall imply granting an exclusive use of roadways or public and/or private land employed to perform the Work.

E. Temporary Storage Buildings and Enclosures
   1. Provide environmental control systems that meet recommendations of manufacturers of equipment and materials to be stored therein.
   2. Arrange and partition to provide security of contents and ready access for inspection and inventory.

F. Construct and use a separate storage area with adequate spill containment for hazardous materials used in constructing the Work.
   1. For the purpose of this paragraph, hazardous materials to be stored in the separate area are all products labeled with any of the following terms: Warning, Caution, Poisonous, Toxic, flammable, Corrosive, Reactive, or Explosive. In addition, whether or not so labeled, the following materials shall be stored in the separate area: diesel fuel, gasoline, new and used motor oil, hydraulic fluid, cement, paints and paint thinners, two-part epoxy coatings, sealants, asphaltic products, glues, solvents, wood preservatives, sand blast materials, and spill absorbent.
   2. Hazardous materials shall be stored in groupings according to the Material Safety Data Sheets.
   3. Develop and submit to Engineer a plan for storing and disposing of the materials above.
   4. The separate storage area shall meet the requirements of authorities having jurisdiction over the storage of hazardous materials.
   5. Hazardous materials which are delivered in containers, shall be stored in the original containers until use. Hazardous materials which are delivered in bulk, shall be stored in containers which meet the requirements of authorities having jurisdiction.
   6. Obtain and submit to Engineer a single EPA number for wastes generated at the site.
   7. The separate storage area shall be inspected by the proper authorities prior to construction of the area, upon completion of construction of the area, and upon cleanup and removal of the area.

G. In the event machinery and equipment need servicing on site, be responsible to clean environmentally hazardous materials from the site immediately.

1.6 PARKING

A. Traffic and parking areas shall be maintained in a sound condition, free of excavated material, construction equipment, mud, and construction materials. Repair breaks, potholes, low areas, which collect standing water, and other deficiencies.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 55 26
TRAFFIC CONTROL

PART 1 – GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. AASHTO Roadside Design Guide, Current Edition
   2. Manual on Uniform Traffic Control Devices (MUTCD), Current Edition
   3. Federal Highway Administration. Standard Highway Signs
   4. ATSSA: American Traffic Safety Services Association. Quality Standards for Work Zone Traffic Control Devices
   5. NCHRP – Report 350 Recommended Procedures for the Safety Performance Evaluation of Highway Features
   6. 2010 ADA Standards for Accessible Design
   7. Utah Department of Transportation (UDOT), Standard Specifications
   8. Herriman City Standard & Specifications Manual
   9. Riverton City Standard Specifications and Plans Manual
   10. APWA Manual of Standard Plans, 2025
   11. UDOT's "Flagger Training Handbook"

1.2 SUBMITTALS

A. Administrative Submittals: Copies of permits, licenses, and approvals for construction as required by Laws and Regulations and governing agencies.

B. Shop Drawings:
   1. Approved Traffic Control and Routing Plans: As specified herein.

C. Traffic Control Supervisor(s) Qualifications: Qualifications of proposed traffic control supervisor(s) and traffic control plan signatory.

1.3 TRAFFIC CONTROL SUPERVISOR

A. The traffic control supervisor shall be responsible for initiating, installing, and maintaining all traffic control devices as shown on the Traffic Control and Routing Plans, and as specified in the MUTCD and these specifications, or as directed. The traffic control supervisor shall be an employee of the CONTRACTOR and shall be assigned full time to the Project while work is underway on public roadways. The traffic control supervisor shall work exclusively on traffic control services. The designated traffic control supervisor shall also be available to be contacted by the PROJECT REPRESENTATIVE 24 hours a day for the life of this contract. The persons so designated shall have at least one year of experience directly related to work site traffic control in a supervisory capacity and shall be certified as a work site traffic control supervisor by ATSSA. Submit the name and qualifications of this person for review 7 days in advance of the date set for the preconstruction conference. The traffic control supervisor shall be capable of being onsite within 45 minutes of notification. The traffic control supervisor shall make at least four inspections of all traffic control devices each day as follows:

1. Before beginning work.
2. At mid-shift.
3. Half an hour after the end of the shift.
4. Once during the period of nonworking hours.

B. The traffic control supervisor shall make a daily record of traffic control activities using a form provided to and approved by the PROJECT REPRESENTATIVE. Submit completed forms within 24 hours.

C. The traffic control supervisor shall oversee the security of the message boards to be implemented by the CONTRACTOR's field staff. Security measures shall be implemented daily and shall include locking the programming consoles, removing the tires, locking the tires to the message boards, chaining the message boards to a fixed item, and other measures to prevent theft.

D. Each day the traffic control supervisor shall develop the messages for the message boards, determine the locations of the message boards, coordinate with field labor to locate the message boards, and program the message boards.

E. The traffic control supervisor shall oversee the flagging operations. For road closures, the traffic control supervisor shall prepare informational handouts showing schedules and maps of the crew locations. The traffic control supervisor shall keep the handouts updated and furnish copies to the flaggers for distribution to drivers approaching closure barricades and drivers waiting to drive through single-lane zones. The traffic control supervisor shall manage the distribution of radios to flaggers and oversee the proper functioning of radios.

F. Each evening and morning, signs shall be covered and uncovered as needed to inform the public of roadway closures, detours, work zones, and other traffic information. Each evening just before crews leave, all signs not required shall be covered and all signs required shall be uncovered. Each morning before start of construction, all signs not required shall be covered and all signs required shall be uncovered. The traffic control supervisor shall oversee the covering and uncovering of signs each evening and morning.

G. Traffic control supervisor shall oversee storage of materials and construction equipment along right-of-way, as needed to ensure compliance with the Contract Documents.

H. Traffic control supervisor shall be responsible for verifying that property owner notifications are made in accordance with Contract requirements.

1.4 FLAGGER

A. Flaggers must have a current flagging certificate and must present proof of the following certifications upon request by the Department.
1. Acceptable certifications.
2. UDOT Contractor Certification.
3. American Traffic Safety Services Association (ATSSA).

1.5 TRAFFIC CONTROL AND ROUTING PLANS - PIPELINE WORK (SCHEDULE A)

A. The Traffic Control and Routing Plans shall be prepared and/or certified as to conformance with these Specifications by a Professional Traffic Operation Engineer (PTOE) or an ATSSA certified Work Site Traffic Control Supervisor and shall include the PTOE registration number or ATSSA certification number of the certifying person.

B. Submit the initial phase Traffic Control and Routing Plans at the preconstruction conference. Submit plans for future phases of construction a minimum of 28 days before start of that construction phase to allow review and resubmittal, if necessary, and public notification. Meet with the PROJECT REPRESENTATIVE and affected agency having jurisdiction to review each of the Traffic Control and Routing Plans for each phase of construction. Do not begin construction on any given phase before receiving written acceptance or signed permit, where acceptable by Riverton City and/or South Jordan City Traffic Division of the Traffic Control and Routing Plans for that phase.

C. Failure to submit the Traffic Control and Routing Plans within the specified time frames will not be justification for additional working days. Failure to adequately address comments in any required resubmittal also will not justify additional working days.

D. Changes to this plan shall be made only by written approval of PROJECT REPRESENTATIVE. Secure approvals for necessary changes so as not to delay progress of the work.

E. If multiple road closures are desired simultaneously, detours must be coordinated and approved in advance by the PROJECT REPRESENTATIVE and the agency or agencies having jurisdiction. Allow a minimum of 7 working days for the PROJECT REPRESENTATIVE and the agency or agencies having jurisdiction review followed by 14 days of prior notification of residents. Multiple simultaneous road closures will require additional message boards (at each end of the closure) which shall be provided by CONTRACTOR at no additional cost for duration of simultaneous closures.

F. Traffic Routing Plan: Show sequences of construction affecting the use of roadways, time required for each phase of the work, provisions for decking over excavations and phasing of operations to provide necessary access, and plans for signing, barricading, and striping to provide passages for pedestrians, bicycles, and vehicles. Include schedule for covering traffic control signs (including detour signs) when not in use and uncovering just prior to use.

G. The provided Traffic Control Plans in the Contract Documents are guidelines only, and shall not be used in lieu of detailed CONTRACTOR-prepared plans. Detailed Traffic Control Plans shall show the locations of traffic cones, barrier rail, construction zones, flaggers, stored pipe and materials, construction truck access, barricades, detours, signs, message boards, and other traffic control facilities.

H. On a time and day agreed upon between the CONTRACTOR and PROJECT REPRESENTATIVE, meet weekly with the PROJECT REPRESENTATIVE to describe the following week's construction operations and the traffic control provisions. At each meeting, submit a detailed update of traffic control provisions and construction crew locations. This shall be submitted in hardcopy and electronic form using a Word file. The update shall contain a list of signs and the time and location for covering and uncovering signs. The update shall include the location and wording of message control boards.

I. Any days lost due to improper traffic control will be charged against the allowable working days.

PART 2 – PRODUCTS

2.1 CERTIFICATIONS

A. Use devices and systems which meet NCHRP-350 Report crash test requirements as defined in the four categories by the Federal Highway Administration. Some exceptions will be acceptable as stated below.

1. Category 1: Cones, tubular marker, delineators, and drums without lights must be certified by the manufacturer as meeting NCHRP-350 Report requirements.
2. Category 2: Portable sign stands with signs, Type I, II and III barricades, vertical panels, Category 1 devices with light attachments and devices not expected to cause significant vehicle velocity change. These devices and systems must be certified by FHWA as meeting NCHRP-350 Report test requirements.
3. Category 3: Portable/Temporary pre-cast concrete barrier manufactured after October 1, 2002 must be certified as meeting NCHRP-350 Report test requirements.
    a. Manufactured date to be stamped into top of each barrier section using a numeric format (ex: 10/2002) with 2 inch x 2 inch numerals, 1/4 inch deep. See Standard Drawing BA 1A and BA 2.
    b. Portable/Temporary pre-cast concrete barrier manufactured prior to October 1, 2002 and meeting NCHRP 230 may be used until they are no longer serviceable.
4. Category 3: Crash Cushions and Truck Mounted Attenuators must be certified by FHWA as meeting NCHRP-350 Report test requirements.
5. Category 4: Advanced Warning Arrow Panels and portable changeable message signs do not have to meet NCHRP-350 Report test requirements.

2.2 FLAGGER EQUIPMENT AND CLOTHING

A. Comply with UDOT's "Flagger Training Handbook."

B. Comply with approved Traffic Control Drawings.

C. Paddle: Use a combination "STOP" and "SLOW" sign paddle. The paddles shall be a minimum of 18 inches wide with 6 inch series "C" letters and have a rigid fixed handle approximately 5 feet in length, from the bottom of the paddle to ground level. Fabricate the combination sign paddle from sheet metal or other light semirigid material. The background of the "stop" face shall be red with white letters and border. The background of the "SLOW" face shall be orange with black letters and border. Use Type II reflective sheeting for the background, letters, and border on the faces of the Stop/Slow paddles.

D. Clothing:

1. Flagger vest and hard hat: Orange, red-orange, or fluorescent version of these colors:
    a. Safety vest with a minimum of 775 inches of background material. Night work requires a minimum of 201 inches of reflective material (100 inches on the front and 100 inches on the back). Reflective material will be white and/or strong yellow-green.

b. Hard hat with 10 inches of white or strong yellow-green reflective tape placed around the base of the hard hat and visible to traffic from all directions.

2.3 TRAFFIC CONTROL SIGNING AND DEVICES

A. Signs, Channelizing Devices, Fences, Barricades:
1. Comply with this section, Article 2.1.
2. Comply with Standard Drawings and specifications of applicable jurisdiction.
3. Comply with Contract Traffic Control and Routing Plans.
4. Do not use rocks, asphalt , or concrete pieces, construction materials, and other debris as weighting devices for barricades. Sand bags will be permitted as long as a low center of gravity is maintained as approved.
5. Use a construction zone attenuator when approach ends of temporary precast barrier are within AASHTO clear zone.
   a. Use AASHTO Roadside Design Guide to determine proper clear zone distance requirements.
   b. Install crash cushions as per manufacturer's recommendations.

2.4 ADVANCE WARNING ARROW PANEL

A. Meet all standards as specified in the MUTCD, Section 6F.53 Arrow Panels. Perform all functions as specified in contract traffic control plan sheets and the MUTCD.

2.5 PORTABLE CHANGEABLE MESSAGE SIGNS

A. Portable changeable message signs (PCMS) shall conform to the provisions in Section 12-3.12, "Portable Changeable Message Signs," of the UDOT Standard Specifications and these Technical Specifications.

PART 3 – EXECUTION

3.1 LIMITATIONS OF OPERATIONS

A. Open trench limits for sections located within public streets:
1. Maximum allowable length of open trench at any given time is defined in Section 31 23 00.
2. Use and placement of all signs, channelizing devices, and barrier must comply with applicable city and/or DOT standards and specifications.
3. Maintain one-lane two-way traffic within the open trench section at all times. Setup shall conform to TA 12 of the Utah MUTCD with the following exceptions and limitations:
   a. Temporary pavement markings shall not be installed.
   b. The maximum allowable length of temporary signal at any given time is limited to 1000 feet measured between "Stop Here on Red" signs.
4. On street parking may be temporarily prohibited along within this section. All appropriate and applicable signing must be in place and visible and notification must be provided to all affected residents 48 hours in advance of restriction. The maximum length of the parking restriction shall not exceed 1200 feet in length at any given time.
5. Whenever it is necessary to cross, close, or obstruct driveways, sidewalks, or other

accesses, whether public or private, notification must be provided to all affected residents 48 hours in advance of restriction. Give notification in writing and include the estimated duration of the closure.

6. No individual driveway is allowed to be closed for longer than 7 days.
7. Access to cul-de-sacs must be maintained at all times.
8. One lane-two way flagging is allowed at the following locations between 7 AM to 7 PM so long as the flagging setup conforms to TA 10 of the Utah MUTCD.
    c. Flagging operations at the Mirabella Drive and Rosecrest Road intersection shall not occur while Black Ridge Elementary school is in session. During flagging operation, the existing signal at this intersection shall be set to flashing.

B. No Full Closures are allowed within the project limits except as specified below:
1. Full Closure of Emmeline Drive between Arcadia Rose Lane and Crown Rose Drive is allowed for 14 days. Residential access within this section must be maintained at all times. A marked detour is required as detailed in DTR-02.
2. Full Closure of Crown Rose Drive between Emmeline Drive and Morning Light Drive is allowed for 14 days. Residential access within this section must be maintained at all times. A marked detour is required as detailed in DTR-03.
3. Full Closure of Morning Light Drive between Rosaleen Lane and Crown Rose Drive is allowed for 14 days. Residential access within this section must be maintained at all times. A marked detour is required as detailed in DTR-04.
4. Full Closure of Crown Rose Drive between Morning Light Drive and Rosecrest Road is allowed for 14 days. Residential access within this section must be maintained at all times. Closure shall not be in place while Black Ridge Elementary school is in session. A marked detour is required as detailed in DTR-05.
5. Full Closure of Prospero Lane between Rosecrest Road and Rosaleen Lane is allowed for 14 days. Residential access within this section must be maintained at all times. A marked detour is required as detailed in DTR-06.
6. Full Closure of Bonica Lane between Rosecrest Road and Rosaleen Lane is allowed for 14 days. Residential access within this section must be maintained at all times. A marked detour is required as detailed in DTR-07.
7. One of the Rosecrest Park accesses can be closed so long as the other is fully open.
8. Full Closure of Rosecrest Road between Callander Drive and Rocky Point Drive is allowed for 14 days. A marked detour is required as detailed in DTR-08.
9. One of the Rocky Point Drive and 13680 South accesses to Rosecrest Road can be closed so long as the other is fully open and all residential accesses are maintained.

C. At the 13400 South and Rosecrest Road intersection, a minimum of one lane in each direction shall be maintained at all times. Turn lanes may be closed but all turning movements shall be maintained with the following exception: westbound left-turn movements may be restricted and detoured. Bike lanes may be closed, and bicyclists may be diverted to sidewalks. A reduced capacity configuration at the 13400 South and Rosecrest Road intersection is allowed for 28 days.

D. Notify the fire department, police/sheriff department, highway patrol, ambulance service, local school district, waste management, postal service, and transit 14 days before closing roadway or portion thereof. Notify said departments or agencies when streets are again passable for vehicles. Coordinate all bus routes and schedules with the Jordan School District. Conduct operations with the least interference to fire equipment access, and at no time

prevent such access. Furnish CONTRACTOR's night emergency telephone numbers to the police or sheriff's department. Allow all emergency vehicles immediate passage.

E. Maintain at least one access to all church properties at all times. On Sundays, all church accesses must be open.

F. Maintain pedestrian access along at least one side of Rosecrest Road, 13400 South, and each cross street at all times. Open sidewalks shall be kept safe from construction activities. Whenever it is necessary to cross, close, or obstruct sidewalks, or other accesses, whether public or private, provide and maintain suitable and safe bridges, detours, or other temporary facilities for accommodation of public and private travel. All temporary facilities shall be ADA compliant.

G. Traffic control shall be conducted in accordance with the approved Traffic Control and Routing Plans and the MUTCD.

H. PCMS must be in place a minimum of 14 days prior to the beginning of construction and prior to any closure including the start date, time, and duration of closure as shown in the provided detour plans.

I. Work that interferes with public traffic, either one-lane or two-lane traffic, shall not cause any traffic delays to public traffic between 7 a.m. to 8:30 a.m., and between 4:30 p.m. and 6:00 p.m. Work that interferes with public access to Blackridge Elementary, shall not cause traffic delays from 8:30 a.m. to 9:00 a.m. and 12:50 p.m. to 1:30 p.m., and shall not impede pedestrian traffic. All work within the school zone shall be coordinated with the PROJECT REPRESENTATIVE, the Herriman City Crossing Guard Coordinator, and the assigned representative from Blackridge Elementary.

J. Minimum traveled way width shall be 11 feet, unless noted otherwise. Where 11 foot lanes are used, a 1 foot buffer with vertical panel channelizing devices shall be used between lanes traveling in opposing directions. Where cones are used to separate traffic lane from construction zone, do not use traffic lane for accessing construction zone, and do not store materials or equipment on or near shoulder of traffic lane side of roadway.

K. If work will interfere with mail delivery, move or provide temporary mailboxes to temporary locations accessible to postal service, and on completion of work in each area, replace them in their original location and in a condition equal to or better than original.

L. If work will interfere with garbage pickup, move property owner's (resident's) garbage cans to areas accessible for garbage pickup. Garbage cans shall be returned to owner's driveway after pickup.

M. Coordination: Coordinate traffic routing all adjacent or nearby road construction projects. Coordinate access for garbage pickup, mail delivery, and school buses.

N. Each evening prior to crew departure, all work areas shall be swept to ensure all construction debris (including, but not limited to, AC waste, gravel, and dirt) has been removed from the surface of the road. Debris shall be disposed of offsite and shall not be swept into ditches or otherwise outside of the work area.

O. Any traffic control plans that impact signalized intersections need to be coordinated with Salt Lake County, Herriman City, and Riverton City as applicable.

P. Barricades and Lights:
1. Provide as shown on all approved Traffic Control Plans and in sufficient quantity to safeguard public and work.
2. Provide as necessary to prevent unauthorized entry to construction areas and affected roads, streets, sidewalks, and alleyways, inside and outside of fenced area, and as required to ensure public safety and the safety of CONTRACTOR's employees, other employer's employees, and others who may be affected by the work.
3. Provide to protect existing facilities and adjacent properties from potential damage.
4. Locate to enable access by facility operators and property owners.
5. Protect streets, roads, highways, and other public thoroughfares that are closed to traffic by effective barricades with acceptable warning signs.
6. Locate barricades at the nearest intersecting public thoroughfare on each side of the blocked section as shown in the provided routing plans.

Q. Signs and Equipment:
1. Traffic control signs and equipment shall be as described herein, the MUTCD and the Standard Highway Signs, shown on Traffic Control Details, and as directed by PROJECT REPRESENTATIVE.
2. CONTRACTOR shall maintain existing traffic control signs during construction.
3. Message Boards: Provide four PCMS conforming to the provisions of Section 2.5 of these specifications for use as directed by PROJECT REPRESENTATIVE. CONTRACTOR shall be responsible for moving and programming message boards as required throughout the Project.
4. Portable TOW-AWAY-NO STOPPING Signs: Place where approved by police department of the agency having jurisdiction and the OWNER.
5. Traffic Cones: Provide to delineate traffic lanes to guide and separate traffic movements. Provide at obstructions, such as material piles and equipment, as directed by PROJECT REPRESENTATIVE.
6. Use to alert general public of construction hazards, which would include surface irregularities, unramped walkways, grade changes, and trenches or excavations in roadways and in other public access areas.
7. All portable and night use signs shall use “diamond” grade reflective lettering.
8. Detour signs shall be covered when not in use and uncovered just prior to use. Detour signs shall be covered with wood or metal. The use of easily displaced material such as plastic bags, burlap sacks, duct tape, etc. is not acceptable.

END OF SECTION

SECTION 01 57 19
TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

1.1 EXPLOSIVES AND BLASTING

A. The use of explosives on the Work will not be permitted.

1.2 DUST ABATEMENT

A. Furnish all labor, equipment, and methods required to prevent, control, and mitigate fugitive dust from the construction activities. In complying with this requirement, conform to all local requirements in all circumstances. Be responsible for damage resulting from dust generated by its activities. Dust abatement measures shall be continued until Engineer directs otherwise.

1. Unpaved Roads: Apply liquid dust palliative as appropriate for traffic areas as approved by Engineer.
2. All other Non-Paved Work Areas: Apply a liquid dust palliative (soil stabilizer type) derived from natural organic plant sources and containing no growth – or germination – inhibiting materials as approved by Engineer. Application shall be effective for dust suppression according to applicable County Health District Air Pollution Control Division dust regulations. Do not allow movement of vehicles or storage of materials on treated areas.

1.3 RUBBISH CONTROL

A. Prepare a trash abatement program and submit to Engineer for review. The program shall include placing all litter, trash, garbage, construction debris, and refuse in scavenger-proof, resealable containers. Trash includes, but is not limited to, cigarettes, cigars, gum wrappers, tissue, cans, paper, and bags. During the progress of the Work, keep the Project Site and other areas used by it in a neat and clean condition, and free from any accumulation of rubbish. Dispose of all rubbish and waste materials of any nature occurring at the Project Site, establish regular intervals of collection and disposal of such materials and waste. Keep haul roads free from dirt, rubbish, and unnecessary obstructions resulting from construction operations. Disposal of all rubbish and surplus materials shall be off the Site in accordance with local codes and ordinances governing locations and methods of disposal, and in conformance with all applicable safety laws, and to the requirements of Part 1926 of the OSHA Safety and Health Standards for Construction.

B. Clean up and properly dispose of any oil, fuel, and other equipment leaks at the time of occurrence. Service and maintenance vehicles shall carry a bucket and pads to absorb leaks and spills. Notify Engineer of any spills or leaks at the time of occurrence.

1.4 SANITATION

A. Toilet Facilities: Provide fixed or portable chemical toilets wherever needed for the use of employees. Toilets at construction job sites shall conform to the requirements of Part 1926 of the OSHA Standards for Construction.

B. Sanitary and Other Organic Wastes: Establish a regular collection of all sanitary and organic wastes. All wastes and refuse from sanitary facilities or organic material wastes from any other source related to the construction operations shall be disposed of away from the Site in a manner satisfactory to Engineer and in accordance with all laws and regulations pertaining thereto.

1.5 CHEMICALS

A. All chemicals used during project construction or furnished for project operation, whether soil sterilant, pesticide, disinfectant, polymer, reactant or of other classification, shall show approval of either the U.S. Environmental Protection Agency or the U.S. Department of Agriculture. Use of all such chemicals and disposal of residues shall be in strict accordance with the printed instructions of the manufacturer.

1.6 CULTURAL RESOURCES

A. Direct attention to the National Historic Preservation Act of 1966 (16 U.S.C. 470) and 36 CFR 800, which provide for the preservation of potential historical architectural, archaeological, or cultural resources (hereinafter called "cultural resources").

B. Conform to the applicable requirements of the National Historic Preservation Act of 1966 as it relates to the preservation of cultural resources.

C. In the event potential cultural resources are discovered during subsurface excavations at the Site of construction, institute the following procedures:
   1. Engineer will issue a Field Order directing the cessation all construction operations at the location of such potential cultural resources find. Mark the area in an appropriate manner to ensure that all construction equipment, activities, and personnel remain clear of the area until further notice.
   2. Field Order shall be effective until such time as a qualified archaeologist can be called to assess the value of these potential cultural resources and make recommendations to the State Historic Preservation Office.

D. If the archaeologist determines that the potential find is a bona fide cultural resource, at the direction of the State Historic Preservation Office, suspend work at the location of the find under the provisions for changes contained in Articles 10, 11, and 12 of the General Conditions.

1.7 AIR QUALITY

A. Maintain all vehicles and equipment in proper tune.

B. Use Best Available Control Technology on construction equipment, including a timing retardation.

C. Use natural-gas powered construction equipment where possible.

D. Encourage employee car-pooling.

1.8 NOISE

A. Comply with the hours of work as allowed by the local jurisdiction or land management agency.

B. Noise limits on construction equipment will comply with the noise limits of the local jurisdiction or land management agency. All construction equipment shall be equipped with manufacturer's standard noise control devices (i.e., mufflers, acoustical lagging, and/or engineer enclosures). Take special care not to throttle the engine excessively and keep engine speed as low as possible. Do not leave the equipment running or idling needlessly, especially when near noise-sensitive land uses. Noise-sensitive land uses include, but are not limited to, residences, schools, hospitals, libraries, retirement and elderly care centers, religious and worship facilities, courts of law, certain noise-sensitive professional offices, and quiet recreational areas such as campgrounds and hiking trails.

C. Use newer equipment whenever possible. Inspect all construction equipment at periodic intervals to ensure proper maintenance and the presence of noise control devices (i.e., mufflers and shrouding, etc.)

D. Keep heavy, noisier equipment a minimum of 100 feet away from the property line of any noise-sensitive land use for any length of time. Avoid coming closer than 200 feet if multiple pieces of equipment are operating simultaneously. If such cases are unavoidable, avoid throttling the engine excessively or leaving the equipment running needlessly. Heavy equipment shall be operated in a manner to comply with the jurisdiction's noise ordinance and vibration performance standard. To comply with these requirements, it may be necessary to operate heavy equipment only 30 minutes out of each one-hour period at distances closer than 200 feet from an occupied property. During the remaining 30 minutes, the equipment should move further away or be shut down but may resume 30 minutes later.

E. Locate stationary noisy equipment away from construction boundaries that are near noise-sensitive uses.

F. Concrete trucks shall perform initial mixing and other activities that require high revving of the truck engine a minimum of 600 feet from noise-sensitive land uses. Keep engine revolutions per minute as low as possible at closer distances.

G. Whenever possible, use electric hand tools rather than gas-powered tools.

H. If operation of dewatering pumps and generators is required between the hours of 6 p.m. and 7 a.m. and within 600 feet of a noise-sensitive land use, they shall be treated with acoustical noise control measures (e.g., mufflers, shrouding, and/or enclosures) so as not to exceed 56 dba at 50 feet or other appropriate requirements of the local jurisdiction.

I. If requested by the Engineer, install temporary noise barriers for construction activities, including staging areas that occur closer than 100 feet from noise-sensitive land uses. Noise barriers can be made of plywood, heavy vinyl curtain material, natural or temporary earth berms, or stockpiles of construction material.

1.9 CONTROL OF SURFACE WATER

A. Be advised that portions of the Work site are located on hills and at elevations higher than other structures, this may lead to or be subject to flooding from surface waters. Work located outside major drainage ways may still be subject to minor channelized flows and overland sheet flow during some rainfall events. Work is not to impact properties or structures

B. Be responsible for protecting the Work and temporary facilities from damage due to flooding, runoff, surface water flows, and related subsurface flows until final Project closeout. Provide protection for all aspects of the Work whether temporary or permanent. Provide all materials and equipment required to protect the Work. No additional payment will be made by Owner for providing protective measures or for any damage resulting from said flows. All damage from said flows shall be completely replaced in accordance with the Contract Documents at no additional cost to Owner.

C. Be responsible for protecting the existing facilities from damage due to flooding, runoff, surface water flows and related subsurface flows that may leave the Work site due to construction activities and that would normally not leave the site prior to construction.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 58 13
TEMPORARY PROJECT SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Provide four project identification signs, complete, in accordance with the Contract Documents.

B. Provide a publicly accessible bulletin board with required safety and labor law posters.

PART 2 - PRODUCTS

2.1 PROJECT IDENTIFICATION SIGNS

A. Construct each sign of 3/4-inch painted, exterior grade plywood with 4 inch by 4 inch supports and 2 inch by 4 inch cross bracing capable of withstanding 15 psf wind loads.

B. Each sign face shall be 4 feet vertical by 8 feet horizontal.

C. Design sign for professional appearance

D. Colors and text fonts
   1. Face
      a. White
   2. Lettering
      a. Black, block letter style

E. Sign Content: The content and appearance of the project sign shall be as direct by the Owner. Content shall include Project Title, Owner, Contractor, Engineer, schedule dates, company Logos, and contact information. An Approximate facsimile of a sign is included at the end of this Section, however additional information may be required on each sign. Submit a dimensioned drawing to illustrate proposed sign content to Engineer for approval prior to construction.

PART 3 - EXECUTION

3.1 PROJECT IDENTIFICATION SIGN LOCATIONS

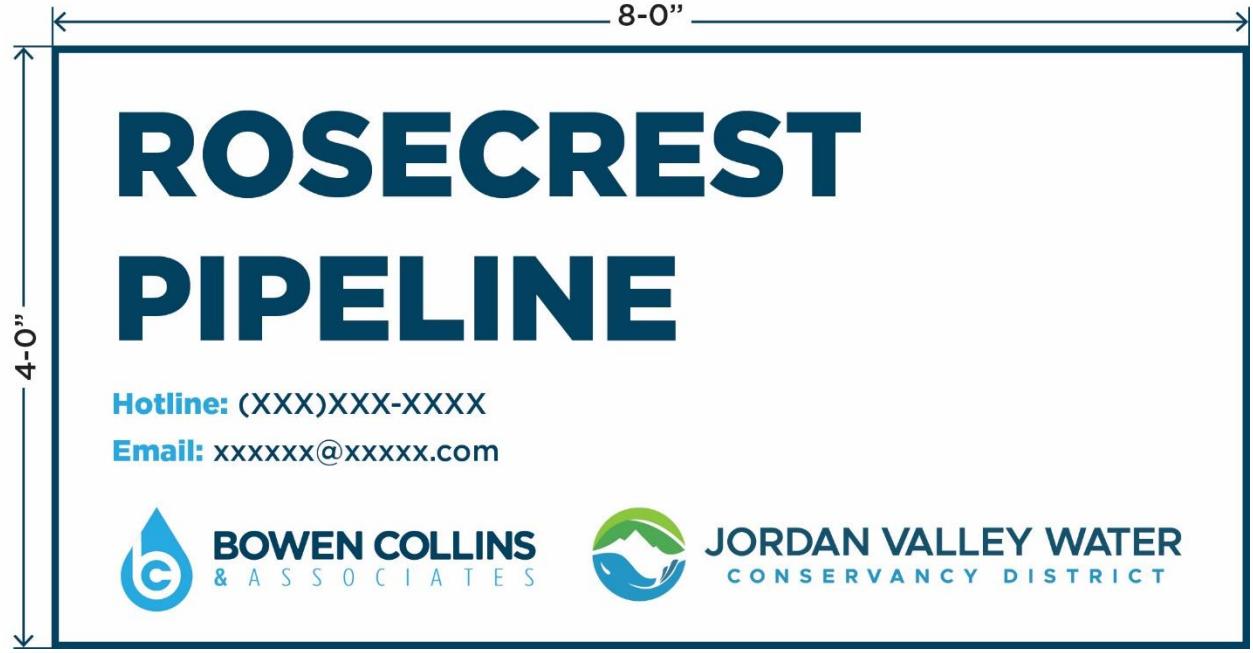
A. Locate signs on the Project Site as directed by Engineer, but shall generally be located at each major work site of the project.

B. Set the sign 4 feet above the ground, measured from grade to the lower edge of the plywood sheet.

C. If the sign is located outside of an Owner-acquired right-of-way or easement, secure written permission from the property owner where the sign will be located and submit to Engineer.

3.2 REMOVAL

A. Remove the project identification signs upon Substantial Completion of the Work.



END OF SECTION

SECTION 01 71 00
MOBILIZATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Organization and mobilization of the forces.

B. Transporting construction equipment to the jobsite and setting up.

C. Transporting various tools, materials, and equipment to the jobsite.

D. Erection of temporary buildings and facilities as required for field offices, staging, storage, and construction operations.

1.2 PAYMENT FOR MOBILIZATION

A. Payment for mobilization shall be as described in Section 01 20 00 – Measurement and Payment.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Mobilization shall include the following principal items:
1. Provide all required insurance certificates and bonds.
2. Move onto the site, or portion of site as available, of all equipment required for first month's operations including office and storage trailers.
3. Install temporary construction power, wiring, and lighting facilities.
4. Develop construction water supply.
5. Provide all on-site communication facilities, including telephones, cordless phone antenna, and radio pagers.
6. Provide on-site sanitary facilities and potable water facilities.
7. Arrange for and erection of work and storage yard.
8. Construct and implement security features and requirements complying with Section 01 31 30 – Safety.
9. Obtain all required permits.
10. Post all OSHA required notices and establish safety programs.
11. Provide Superintendent at the job site full time.

3.2 SUBMITTAL REQUIREMENTS

A. The following submittals are due by the day indicated and must be approved by Owner as a condition precedent to completion of mobilization.

No.	Submittal	Specification Section
1.	Quality Assurance / Control Plan	01 45 00
2.	Mobilization Plan	01 71 00
3.	Safety Program	01 31 30
4.	Concrete Mix Designs	03 30 00
5.	List of Permits and Licenses	01 41 26
6.	Schedule of Submittals	01 33 20

3.3 MOBILIZATION PLAN

A. Within 15 Days after receipt of the Notice to Proceed, submit a mobilization plan to Engineer for approval, which shall include a breakdown showing the estimated value of each component of mobilization as described in paragraphs 3.1 and 3.2 herein.

B. Include a bar chart schedule showing each item of mobilization listed in paragraphs 3.1 and 3.2 herein and include scheduled start date, finish dates, and total duration. The plan shall also list each activity to be initiated in the first 90 Days following Notice to Proceed, complete, with scheduled start date, finish date, and total duration.

END OF SECTION

SECTION 01 71 30
SITE CONDITIONS SURVEYS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes requirements to document conditions of the Project Site and adjacent properties before construction begins and after completion of the Work. Methods include still photographs, digital video recordings, and topographic surveys.

1.2 SUBMITTALS

A. Submit all photographs, digital videos, and topographic survey data of the preconstruction conditions to Engineer for record purposes prior to, but not more than three weeks before, commencement of any construction activities.

1.3 CLOSEOUT SUBMITTALS

A. Complete and submit all digital videos, still photographs, mapping, and survey data of the postconstruction conditions to Engineer prior to final inspection by Owner and Engineer.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Conduct thorough preconstruction and postconstruction Site conditions surveys of the entire Project. Site conditions surveys shall consist of photographs, digital video recordings, and topographic mapping. Provide and submit sufficient photographs, supplemented by digital video, to Engineer to resolve any damage claims, which may arise due to the construction of this Project. Develop topographic mapping using the Project coordinates and referenced to the Project base lines and benchmarks. Mapping shall be adequate to ascertain preconstruction and postconstruction conditions (including elevations) of all public and private property within and adjacent to the construction limits.

B. Digital video or photographic surveys shall include, but not be limited to, all access roads used to transport material or equipment to and from the Site and elevation of roadways, drives, walks, and buildings. Use spot elevation surveys to document the elevation on abutting roadways, drives, and walks, taken at approximately 20-foot intervals and at the point of juncture with any structure to which they are attached or otherwise influenced by the Work.

C. Digital video recordings required as part of this Section and by Section 31 10 00 – Site Preparation and Section 31 23 00 – Earthwork may be combined into a single set of media provided all the requirements for videos specified in all Sections are met.

D. As a minimum, note preconstruction and postconstruction conditions and perform digital video surveys of the following:

1. Areas used to access the Site or haul materials and equipment to the Site.
2. The access road, both original and relocated locations and ultimately to the Site.
3. All Work areas, including, but not limited to, access corridors, disposal areas, and staging areas.
4. Temporary Construction Easement areas
5. Any work completed by other contractors at the Site that will be impacted or otherwise affected by Work of this Project.

E. Supplement digital video surveys with still photographs and spot elevation surveys as required to document the original condition and location of existing features and facilities.

F. Provide digital video records.

G. Conduct mapping to document the post-construction topography of the following Sites.
1. Rosecrest Reservoir site – area for restoration and/or disturbed during Project
2. Goldenwest Credit Union property – area used for construction or disturbed during Project.

END OF SECTION

SECTION 01 71 40
PUBLIC INFORMATION PROGRAM

PART 1 - GENERAL

1.1 SUMMARY

A. This Section outlines requirements for the Contractor in keeping the public informed and educated about all aspects of the Project related to public involvement, community relations, information dissemination, reporting construction progress, answering questions from the public and being sensitive to the public's concerns during construction.

1.2 DEFINITIONS

A. Public Information Manager (PIM). PIM is a full time professional provided by the Contractor, responsible for managing public information activities for the Project as outlined herein.

B. Owner's Public Relations Personnel. Professional responsible for public information and involvement for the Jordan Valley Water Conservancy District (JVWCD).

C. Publics. Publics are defined as individuals, groups, organizations, and businesses that will either be affected by the Project or have an interest in the Project. The Publics identified for the Project are:
   1. Adjacent property owners and tenants,
   2. Nearby businesses, shopping centers and churches,
   3. The traveling public,
   4. Partners: Herriman City, Riverton City, Salt Lake County and Jordan Valley Water Conservancy District (JVWCD),
   5. Elected officials from non-partner entities such as the Council of Governments for Salt Lake County and smaller communities where JVWCD provides water services.
   6. Utilities and services (i.e. mail, garbage, etc.),
   7. Schools: Blackridge Elementary School,
   8. Emergency Services (EMS),
   9. Parks: Rosecrest Park, Rosecrest Splash Park, Emmeline Park,
   10. Special interest groups.

1.3 ADMINISTRATIVE REQUIREMENTS

A. The primary objectives of the public information program are to maintain a high level of communication with publics prior to and throughout the construction process. This project will be disruptive to many, and it is important that the Project gain and maintain public support throughout construction. Public support will best be achieved if the public is informed in a timely manner; if they have the opportunity to be heard and they receive responses to questions and concerns; if they know where to look or whom to call for information; and if they receive frequent information updates.
   1. Work for the public information program is to begin when Notice to Proceed is given, this will allow information to be distributed to the public prior to the actual active construction work begins.

B. The construction period is anticipated to last approximately 12 to 15 months. During this time, vault construction and the pipeline will be installed simultaneously in several locations. Traffic will be impacted with closures, detours, single lane use, flagging and/or other methods of traffic control will occur. In some areas, specific restrictions will limit when and how long construction can occur, see section 01 14 00 - Construction and Schedule Restraints, such as summer months near a school location or a three-month window of time along a busy intersection. Paving will occur only during certain times of the year. Keeping these guidelines in mind, there must be a coordinated communication effort between team members and the public.

1.4 PUBLIC INFORMATION EFFORTS TO DATE

A. Preliminary communication and coordination has taken place between JVWCD and Herriman City.

1.5 PUBLIC INFORMATION GOALS

A. Focus on achieving the following public information goals throughout the Project:
   1. Communicate with affected publics in a way that helps them cope with construction and that leads to positive associations for JVWCD and its partners.
   2. Help build positive reputations for JVWCD, Herriman City and Riverton City by being responsive to the public's needs during construction.

1.6 COMMUNICATIONS STRATEGIES

A. Communications strategies that will be implemented on the Project include:
   1. Coordination with Partners: Routine coordination with the communications staff from Herriman City and Riverton City will be established to keep them informed with current information prior to other publics receiving the information.
   2. Direct Communications: Communications with those most affected will be proactive. Active listening to issues and concerns and problem solving will be employed with the publics throughout the project.

1.7 PUBLIC INFORMATION ROLES

A. Owner provides oversight and management of all communication activities. Owner's communication manager also manages all media relations associated with Jordan Valley Water Conservancy District Projects and serves as the media spokesperson.

B. Contractor provides a full-time public information professional with experience in infrastructure projects or experience with other similar projects of this size. This person will be in close coordination with the Partner public involvement personnel and provide one-on-one contact with the public. This person provides day-to-day communication activities specific to the project and can be on-site within an 2 hour notice.

1.8 STAFF REQUIREMENTS

A. Public Information Manager (PIM). Provide a full time PIM responsible for managing all public information activities for the duration of the project. This person is required to have a minimum of either (a) a bachelor's degree in communications, public relations, or marketing plus two (2) years of related experience OR b) ten (10) years of related experience

including acting as the PIM for two(2) construction projects with greater than 10 months of active construction, with communications between Owner, City Public Relations Managers, residents, commercial and businesses. The PIM acts as a facilitator to resolve problems and is an advocate for the community. The PIM is to be one of the Contractor's key personnel and is to be available at all times during construction activities. The PIM shall have the responsibility to affect direction of the Work if the Work is in conflict with public information. The PIM is to have access to all project details, which may be relevant to the public, public agencies, emergency services providers, businesses, and other affected publics. The PIM's responsibilities include:

1. Be available by telephone, call or text, with a maximum of a 30-minute response time on every working day and available upon Owner's request at other than normal working hours.
2. Maintain daily communications with the Owner Project Representative and attend meetings as required.
3. Attend meetings with Herriman and Riverton Cities' public involvement teams to provide project updates and Q&A.
4. Organize an Open House style "Meet the Contractor" meeting to occur 3 to 4 weeks ahead of the start of construction. Coordinate with Herriman City and Riverton City for this meeting.
5. Participate in onsite walk throughs or impromptu in-person meetings with key stakeholders and Owner representatives to address concerns or issues and work to provide a solution that best aligns with the project goals.
6. Respond to questions concerning project activities and schedules, assist in organizing meetings, and provide documents for meetings held with affected individuals.
7. Implement and manage contact tracking system for issues and resolutions during construction, provide weekly summary to Owner's public relations personnel.
8. Maintain ongoing communications with businesses directly impacted by construction in coordination with Owner and Project Representative.
9. Provide information about project activities and schedules to affected property owners and residents, local neighborhoods associations, local city offices, local transit authorities, all affected utility companies, all affected public safety agencies, local schools, churches, trucking and carrier associations, the Utah Transit Authority, mail, garbage and delivery services.
10. Provide updates to the Project Representative and Owner's public relations personnel on project activities that affect public outreach, including the description of the work to be done, work locations, traffic restrictions, traffic detours, work times and days of the week.
11. Provide updates of all traffic and construction related activities to Herriman and Riverton Cities' public information staff.
12. Provide weekly construction schedule updates to Owner's public relations representative.
13. Monitor the placement of construction signage to comply with guidelines established.
14. Provide information and routine updates to schools along the corridor about bus and walking routes and pedestrian safety. Provide construction safety information to all schools along the project corridor.
15. Do not correspond to or speak with the news media regarding the Project or Project activities but forward such inquiries to Owner.

1.9 PUBLIC NOTIFICATION PROCESS

A. General construction notification must be made by the Contractor to property owners, residents, and other impacted publics about construction work in the timeframe identified in Table 1. The notification process will be further defined by Owner as follows:
   1. Notifications will be required for road closures and detours, access issues for homeowners, utility disruptions, tree removals, paving and excessive noise during construction as well as other items as defined in the Pre-Construction Conference.
   2. Advanced notification is required for extended construction hours.
   3. Herriman and Riverton Cities' public information officers will be included in all notifications.

Table 1.
Advance Notification Minimum Requirements

Type	Advance Notice	Signage	City Public Information	Residents	Schools, Fire & Police	Businesses	Transportation Related
Construction Schedule	Weekly	N/A	Weekly	Weekly	Weekly	Weekly	Weekly
Street Closure	2 weeks	VMS* 2 weeks	4 weeks	2 weeks	2 weeks	2 weeks	2 weeks
Utility Disruption	48 hrs.	N/A	72 hrs.	48 hrs.	not in session	48 hrs.	48 hrs
Excessive Noise	72 hrs.	N/A	72 hrs.	72 hrs.	72 hrs.	72 hrs.	72 hrs.
Extended Work Schedule	48 hrs.	VMS* 48 hrs.	72 hrs.	48 hrs.	48 hrs.	48 hrs.	48 hrs.
Work Affecting Private Property	1 week	N/A	2 weeks	1 week	1 week	1 week	1 week
Access Denied to Private Property	1 week	N/A	2 weeks	1 week	1 week	1 week	1 week
Access Denied to Private Road	1 week	1 week	2 weeks	1 week	1 week	1 week	1 week

* VMS is a variable message sign.

B. Advance notification by the Contractor's PIM shall utilize the following methods:
   1. City Public Information: Phone, email, and meetings
   2. Residents: In person and/or flyers and meetings
   3. Schools: In person and/or flyer, fax, emails, and meetings
   4. Businesses: In person and/or flyer, fax, emails, and meetings
   5. Transportation Related Agencies: Phone and fax UTA, Emergency Services (VECC), mail, garbage and delivery services.

1.10 PUBLIC INFORMATION MATERIALS

A. The Contractor will develop and distribute public information materials that have been approved by Owner's public relations representative.

B. Preconstruction project information materials that will include a project map, construction information, contact information for the PIM.

C. All notification flyers and door hangers.

1.11 PROJECT HOTLINE

A. The Contractor is to establish a project Hotline phone number or other equivalent type of communication with the publics.

B. The Contractor will include this Public Hotline number on all Project signage, and with all printed materials distributed for the Project.

C. The PIM shall be available to answer this Public Hotline at all times that construction activities are taking place on-site, and during all working hours Monday through Friday.

1.12 EVALUATION PROCESS

A. Owner's public relations representative will monitor all activities associated with the role of the Contractor's PIM. This will involve a quarterly evaluation of public information activities performed.

B. The Contractor's performance will be evaluated based upon following tasks:
   1. Conducting an open house for the public prior to construction.
   2. Establishing regular contact with the Owner's public relations personnel.
   3. Timely coordination for addressing stakeholder issues.
   4. Easily accessible for coordination both in person and virtually.
   5. Providing advance notification as indicated in Table 1.
   6. Monitoring the placement of construction signage to comply with project requirements and guidelines.
   7. Attend and actively participate in meetings as requested by the Owner, Herriman and Riverton Cities.
   8. Maintaining database for incoming key stakeholder concerns.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 71 50
PROTECTION AND RESTORATION OF EXISTING FACILITIES

PART 1 - GENERAL

A. Protect all existing utilities and improvements not designated for removal and restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than they were prior to such damage or temporary relocation, in accordance with the Contract Documents.

B. Call Blue Stakes before commencing any digging for location of underground utility lines and cable locations. The number is 811 or (801) 208-2100.Provide temporary 6-foot chain link fencing panels for protection of all open excavations and trenches within public streets, residential areas, and all other locations except for unimproved open areas where excavations and/or pipeline trenches that can be safely sloped in accordance with current OSHA standards to provide safe access without the use of shoring devices. Temporary fencing panels shall fully enclose open excavations and trenches and shall remain in place during all non-working hours. Provide temporary caps over pipe ends during non-working hours to prevent unauthorized access.

1.2 RIGHTS-OF-WAY

A. Do not perform any work that would affect any oil, gas, sewer, or water pipeline; any telephone, telegraph, or electric transmission line; any fence; or any other structure. Do not enter upon the rights-of-way involved until notified by Engineer that Owner has secured authority therefore from the proper party.

B. After authority has been obtained, give said party due notice of intention to begin work, if required by said party, and remove, shore, support or otherwise protect such pipeline, transmission line, ditch, fence, or structure or replace same.

C. When two or more contracts are being executed at one time on the same or adjacent land in such manner that work on one contract may interfere with that on another, Owner will determine the sequence and order of the Work. When the territory of one contract is the necessary or convenient means of access for the execution of another contract, such privilege of access or any other reasonable privilege may be granted by Owner to Contractor so desiring, to the extent, amount, in the manner, and at the times permitted and in full conformance with the conditions of the Contract Documents.

D. No such decision as to the method or time of conducting the Work or the use of territory shall be made the basis of any claim for delay or damage, except as provided for temporary suspension of the Work in the General Conditions of the Contract.

1.3 PROTECTION OF STREET OR ROADWAY MARKERS

A. Do not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization from governing agency. Do not begin pavement breaking or excavation until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced.

Accurately replace survey markers or points disturbed after all street or roadway resurfacing has been completed.

B. Obtain all monument permits required, see section 01 41 26 – Permits.

1.4 RESTORATION OF PAVEMENT

A. General: Replace all paved areas cut or damaged during construction with similar materials of equal thickness to match the existing adjacent undisturbed areas, except where specific resurfacing requirements have been called for in the Contract Documents or in the requirements of the agency issuing a permit. The pavement restoration requirement to match existing sections applies to all components of existing sections, including sub-base, base and pavement. Conform temporary and permanent pavement to the requirements of the affected jurisdictional agency. Neatly saw cut pavements, which are subject to partial removal, in straight lines.

B. Temporary Resurfacing: Wherever required by the public authorities having jurisdiction, place temporary surfacing promptly after backfilling and maintain such surfacing for the period of time fixed by said authorities before proceeding with the final restoration of improvements.

C. Permanent Resurfacing: In order to obtain a satisfactory junction with adjacent surfaces, saw cut back and trim the edge to provide a clean, sound, vertical joint before permanent replacement of an excavated or damaged portion of pavement. Damaged edges of pavement along excavations and elsewhere shall be trimmed back by saw cutting in straight lines. All pavement restoration and other facilities restoration shall be constructed to finish grades compatible with adjacent undisturbed pavement. Refer to plans for minimum dimension of T-patch replacement width over disturbed pipeline trenches in paved areas.

D. Pavement Crown: In areas where pipeline trenching impacts an existing crown of asphalt, survey, and submit to Engineer documentation showing the pre-construction location of the crown prior to trenching. Replace the crown of asphalt to its pre-construction location to the satisfaction of the governing agency and Engineer.

E. Restoration of Sidewalks or Private Driveways: Wherever sidewalks or private roads have been removed for purposes of construction, place suitable temporary sidewalks or roadways promptly after backfilling and maintain them in satisfactory condition for the period fixed by the authorities having jurisdiction over the affected portions before proceeding with the final restoration. If no such period of time is so fixed, maintain said temporary sidewalks or roadways until the final restoration thereof has been made.

F. Restoration of Curb and Gutter: Wherever curb and gutter, including driveway and sidewalk approaches, have been removed for purposes of construction, replace these improvements following construction to the specific dimension and requirements of the authority having jurisdiction. Replace improvements, including required ADA access details to the latest version of the authoritative standard regardless of their preconstruction condition.

1.5 EXISTING UTILITIES AND IMPROVEMENTS

A. General. Protect underground utilities and other improvements, which may be impaired during construction operations, regardless of whether the utilities are indicated on the

Drawings. Take all possible precautions for the protection of unforeseen utility lines to provide for uninterrupted service and to provide such special protection as may be necessary.

B. Except for utilities specifically located on the Drawings, be responsible for exploratory excavations (potholing) as deemed necessary to determine the exact locations and depths of utilities, which may interfere with the Work. Perform all such exploratory excavations as soon as practicable after Notice to Proceed and, in any event, a sufficient time in advance of construction to avoid possible delays to the Work's progress. When such exploratory excavations show the utility locations as shown on the Drawings to be in error, so notify Engineer. Refer to plans for minimum advance distance that potholing must be performed prior to pipeline trenching work.

C. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and grade of the utility.

D. Utilities to be Moved: In case it becomes necessary to move the property of any public utility or franchise holder, such utility company or franchise holder will, upon request of Contractor, be notified by Owner to move such property within a specified reasonable time. When utility lines that are to be removed are encountered within the area of operations, notify Engineer a sufficient time in advance for the necessary measures to be taken to prevent interruption of service.

E. Utilities to be Removed: Where the proper completion of the Work requires temporary or permanent removal and/or relocation of an existing utility or other improvement which is indicated, remove and, without unnecessary delay, temporarily replace or relocate such utility or improvement in a manner satisfactory to Engineer and the owner of the facility. In all cases of such temporary removal or relocation, restoration to the former location shall be accomplished in a manner that will restore or replace the utility or improvement as nearly as possible to its former locations and to as good or better condition as found prior to removal.

F. Owner's Right of Access: Owner and owners of public utilities and franchises reserve right to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the Work of this Contract.

G. Underground Utilities Indicated: Existing utility lines that are indicated or the locations of which are made known prior to excavation and that are to be retained, and all utility lines that are constructed during excavation operations shall be protected from damage during excavation and backfilling and, if damaged, shall be immediately repaired or replaced unless otherwise repaired by the owner of the damaged utility. If the owner of the damaged facility performs its own repairs, reimburse said owner for the costs of repair.

H. Underground Utilities Not Indicated: In the event of damage to existing utility lines that are not indicated or the locations of which are not made known prior to excavation, make a verbal report of such damage immediately to Engineer and a written report thereof promptly thereafter. Notify the utility owner of the damage. If directed by Engineer, repairs shall be made under the provisions for changes and extra work contained in the General Conditions.

I. Damages. Costs of locating and/or repairing damage not due to failure to exercise reasonable care, and removing or relocating such utility facilities not indicated in the Contract Documents with reasonable accuracy, and for equipment on the project which was actually working on that portion of the Work which was interrupted or idled by removal or relocation

of such utility facilities, and which was necessarily idled during such Work will be paid for as extra Work in accordance with the provisions of the General Conditions.

J. Approval of Repairs: All repairs to a damaged utility or improvement are subject to inspection and approval by an authorized representative of the utility or improvement owner before being concealed by backfill or other work.

K. Fire Hydrants: Keep all fire hydrants and water control valves free from obstruction and available for use at all times.

L. Maintaining in Service: Unless indicated otherwise, all oil and gasoline pipelines, power, and telephone or the communication cable ducts, gas and water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the Work shall remain continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the Engineer are made with the owner of said pipelines, duct, main, irrigation line, sewer, storm drain, pole, or wire or cable. Be responsible for and repair all damage due to construction operations. The provisions of this Section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of the backfilling.

M. Utility Service Laterals: Not all utility service laterals are shown on the plans. Anticipate that there are no less service laterals than there are homes where project trenches are located in the vicinity of a street between a home and the utility main. Protect in place or remove and replace to the satisfaction of the utility owner, all utility service laterals encountered during construction. Duration of utility service outages and public notification procedures shall conform to the standards of the controlling agency and these Contract documents.

1.6 TREES OR SHRUBS WITHIN STREET RIGHTS-OF-WAY AND PROJECT LIMITS

A. General: Except where trees or shrubs are indicated to be removed, exercise all necessary precautions so as not to damage or destroy any trees or shrubs, including those lying within street rights-of-way and project limits. Do not trim or remove any trees unless such trees have been approved for trimming or removal by the jurisdictional agency or Owner. Trim or replace existing trees and shrubs which are damaged during construction using the services of a certified tree company under permit from the jurisdictional agency and/or Owner.

B. Trimming; symmetry of the tree shall be preserved; no stubs or splits or torn branches left; clean cuts shall be made close to the trunk or large branch. Do not use spikes for climbing live trees. Cuts over 1-1/2 inches in diameter shall be coated with a tree paint product that is waterproof, adhesive, and elastic, and free from kerosene, coal tar, creosote, or other material injurious to the life of the tree.

C. Replacement: Immediately notify the jurisdictional agency and/or Owner if any tree or shrub is damaged by construction operations. If, in the opinion of said agency or Owner, the damage is such that replacement is necessary, replace the tree or shrub at no additional expense to Owner. The tree or shrub shall be of a like size and variety as the one damaged, or, if of a small size, the pay to the owner of said tree a compensatory payment acceptable to the tree or shrub owner, subject to the approval of the jurisdictional agency or Owner. The size of the tree or shrub shall not be less than 1-inch diameter nor less than 6 feet in height. Planting of replacement trees and shrubs shall be in accordance with the recommendations of the

nursery furnishing the plants. Unless otherwise indicated, water and maintain the replacement trees and shrubs for 6 months after planting.

1.7 LAWN AREAS

A. Repair lawn or landscaped areas damaged during construction to match the pre-construction condition to the satisfaction of the landowner and Owner. Use high quality sod to restore all lawn areas. Location and quality of irrigation system equipment shall be confirmed prior to construction. Where lawn irrigation systems have been removed or damaged during construction, be responsible for replacement of systems in kind to the satisfaction of the landowner. Anticipate that pressurized irrigation systems are present in all maintained lawn areas that will be impacted by construction. Verify proper operation of the irrigation system with landowner as required for maintenance of newly installed sod prior to transferring of watering responsibilities.

1.8 UNIMPROVED AREAS

A. Remove and stockpile topsoil prior to construction in accordance with Division 01 specifications. Replace topsoil prior to restoration of unimproved areas.

B. Unimproved areas, including unclassified open spaces, fields, and unimproved rights-of-way, damaged during construction shall be repaired to match pre-construction conditions to the satisfaction of the landowner and Owner. At a minimum, unimproved areas shall be smoothed and finished graded with topsoil to match preconstruction topography, and reseeded using a native seed mix acceptable to the landowner and Owner.

C. All slopes greater than 2H : 1V shall be protected with erosion control matting prior to reseeding.

1.9 OTHER SURFACE IMPROVEMENTS

A. Conduct a pre-construction survey of all properties that will be impacted by construction operations. All improvements that have the potential to be impacted by construction, including but not limited to fencing, landscaping, boulders, retaining walls, irrigation systems, concrete improvements, and other public and/or private improvements, shall be protected in place, or if necessary, removed and replaced with like kind or better quality following construction.

B. Work that will impact residential and commercial properties shall be subject to the notification and coordination requirements of Section 01 71 40 – Public Information Program.

1.10 NOTIFICATION BY CONTRACTOR

A. Prior to any excavation in the vicinity of any existing underground facilities, including all water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, communications, or television cables; all traffic signal and street lighting facilities; and all roadway and state highway rights-of-way, notify the owners or agencies responsible for such facilities not less than three days nor more than seven days prior to excavation so that a representative of said owner or agencies can be present during such Work if they so desire.

B. When it is necessary to temporarily deny access to property, or when any utility service connection must be interrupted, give notices sufficiently in advance to enable the affected persons to provide for their needs. Notices shall conform to any applicable local ordinance and, whether delivered orally or in writing, shall include appropriate information concerning the interruption and instructions on how to limit inconvenience caused thereby.

C. Contact, cooperate with, and provide written notice (including Contractor's phone number) at least seven days prior to beginning Work on each street. The written notice shall include the approximate schedule and explanation of Work and shall be given to each homeowner, business, all emergency agencies, schools, and residents, which will be affected by the project; particularly in reference to temporary interruptions to vehicular access. At least twenty-four hours prior to initiation of Work, provide a second notice to confirm the scope of scheduled Work. Submit a copy of the notifications to Engineer, for approval, prior to the start of construction. Make verbal door-to-door communication prior to construction to remind all affected parties of the construction to take place. In addition, be responsible to answer and resolve any conflicts that may arise between a homeowner or business owner and the construction personnel.

D. Refer to Section 01 71 40 – Public Information Program for detailed notification requirements and general responsibilities regarding public information.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 74 19
DISPOSAL OF WATER

PART 1 - GENERAL

1.1 SUMMARY

A. Prepare a detailed listing of all discharges and overflows that will occur during the disinfection procedure.

1.2 REFERENCES

A. American Water Works Association (AWWA) standards, latest edition.

AWWA C651	Disinfection Water Mains
AWWA C652	Disinfection of Water Storage Facilities

1.3 SUBMITTALS

A. Submit a listing of every significant discharge from a drain valve, pump well, overflow, drain piping, and from all related appurtenances. "Significant discharge" is defined as a volume that is greater than that required to exercise or fill piping with chlorinated water and briefly flush. The listing shall be utilized as input for the Construction Progress Schedule to identify the volume and duration for every discharge that must be accounted for. Very minor discharges for air-release piping or drains that are exercised briefly to ensure disinfection do not need to be identified on the Construction Progress Schedule for dechlorination or discharge.

B. Include the proposed method and equipment for dechlorination, including type of agent, temporary feed pumps, and appurtenant feed equipment.

C. Final Report: Submit to Engineer a final report of each significant discharge, its locations, dates sampled for effectiveness of dechlorination, and the test results.

PART 2 - PRODUCTS

2.1 MATERIALS FOR DECHLORINATION

A. Where dechlorination of water released back to the environment is required, use a sodium bisulfate or equivalent dechlorinator. Sodium bisulfite, if used, shall be applied at a ratio of at least 1.47 parts per every part of chlorine to be removed. This is to remove all the free active chlorine. Since the reaction produces a byproduct of hydrochloric acid, it will also tend to lower the pH of the water and remove calcium carbonate from the water. If the pH drops below 6.0, add calcium carbonate back into the water during the dechlorination process to restore the pH to an acceptable level of at least 6.0.

PART 3 - EXECUTION

3.1 MAJOR DISCHARGES, PUMP WELLS, OVERFLOWS

A. General: List each drain valve, pump well, and overflow, along with proposed volume and duration of discharge during the disinfection procedure. Locations requiring dechlorination shall be indicated. Refer to Drawings to obtain detailed information on size, location, and layout of facilities and access conditions. Review the site of each proposed discharge for the conditions at the proposed discharge.

END OF SECTION

SECTION 01 77 00
PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Contract closeout, including final cleaning, preparation, and submittal of closeout documents, warranties and bonds, and final completion certification.

B. Closeout submittals and submittal forms in both hard copy and electronic format.

1.2 SUBMITTALS

A. Closeout Documents: Submit the following closeout documents prior to making a written request for Final Completion.
   1. Project record drawings and documents per Section 01 78 39 – Project Record Documents.
   2. Shop drawings.
   3. Keys and keying schedule.
   4. Post construction survey record documents, where required.
   5. Quality Control reports per Section 01 45 00 – Quality Control.
   6. Final Operation and Maintenance Manuals.
   7. Maintenance stock items; spare parts and special tools.
   8. Written warranties and bonds where required.
   9. Bonds for roofing or maintenance, if indicated.
   10. Access Badges and Parking Permits.
   11. Release of liens or release of claims forms submitted by all subcontractors and suppliers, if requested by Owner

B. Evidence of Compliance With Inspections and Other Requirements of Governing Authorities: Submit the following:
   1. Special Inspection Reports.
   2. Release from each affected property owner or agency indicating final acceptance.

C. Operation and Maintenance Manuals
   1. One percent of the contract price will be withheld from any monies due as progress payments, if at the 75 percent construction completion point, the approved *Operations and Maintenance Manual* complying with Section 01 33 20 - Submittal Procedures has not been submitted. The aforementioned amount will be withheld by Owner as the agreed, estimated value of the approved *Operations and Maintenance Manuals.* Any such retention of money for failure to submit the approved *Operations and Maintenance Manuals* on or before the 75 percent construction completion point shall be in addition to the retention of any payments due under General Conditions of the Contract.

D. Final Change Order: A final Change Order shall be submitted and processed if required. Final payment and close-out procedures shall comply with requirements of the Contract Documents.

1.3 CLOSEOUT TIMETABLE

A. Establish dates for equipment testing, acceptance periods, and on-site instructional periods as required under the Contract Documents. Such dates shall be established not less than one week prior to beginning any of the required activities, to allow Owner, Engineer, and their authorized representatives sufficient time to schedule attendance at such activities.

1.4 COMPLETION PROCEDURES

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Prior to making such request, the following must be complete:
   1. Work necessary for the safe, proper, and complete use or operation of the facility as intended.
   2. Punch list of items remaining to be completed, for submission with the request for issuance of a Certificate of Substantial Completion.
   3. Submit and receive acceptance of accurate record drawings for all work completed to date.
   4. Submit and receive acceptance of all specified warranties, bonds, guarantees and operation and *Operations and Maintenance Manuals*.
   5. Complete all required vendor training, testing, and where required, start-up.
   6. Deliver all required spare parts, maintenance stock items, and special tools.
   7. Complete equipment and communications system testing successfully.

B. Upon receipt of the request, Engineer and designated representatives will review the request, the Work, and the above requirements to determine whether Substantial Completion has been achieved. If this review fails to support Substantial Completion, Engineer will notify Contractor in writing citing the reasons for rejection. If Engineer determines that Substantial Completion has been achieved, the following procedures will be followed:
   1. Engineer, his/her representative, and user representatives will review the Work and the punch list to assure all deficiencies are noted on a final punch list.
   2. Engineer will schedule and conduct a pre-final walk-through of the facility with representatives of Owner, Engineer, Contractor, and others, for the purpose of formally reviewing the Work, the final punch list, and the readiness of the Work for use. A copy of the final punch list will be furnished to all participants and any additional items noted during the walk-through will be added to the list.
   3. Upon completion of the pre-final walk-through, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which will fix the date of Substantial Completion as the date of the walk-through, provided the walk-through has verified that the Work is in fact ready for use and occupancy by Owner for its intended purpose. Engineer will attach to the certificate a punch list of items to be completed or corrected before final payment. In accordance with the General Conditions of the Contract, upon approval of this request by Owner, the facility will be considered Substantially Complete.

C. When Contractor deems that the entire Work or an agreed portion thereof is complete, Contractor shall notify Engineer and Owner in writing that the entire Work is complete. Final Completion will be deemed to have occurred when Work is completed including the following:

1. All final punch list items have been corrected, signed off by Contractor and Engineer, and demonstrated to Owner during a final walk-through.
2. All updates to record drawings, and *Operations and Maintenance Manuals* have been made.
3. Demobilization and site cleanup are complete.
4. Facilities and/or equipment have been properly demonstrated to be functioning as required.
5. Owner has received releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.
6. New permanent cylinders and key blanks for all locks have been provided to Owner.

D. Final Inspection and Payment
1. When all items have been completed or corrected, Engineer, Contractor, and Owner will promptly make a final inspection to verify completion. Final payment and Engineer's *Notice of Acceptability* will then be processed in accordance with the General Conditions of the Contract.

E. Partial Utilization may be desired at Owner's option, as described in the General Conditions. If Partial Utilization is requested, the same procedure for completion of that portion of the Work as indicated in paragraphs A and B above, will be used.

1.5 CLOSE-OUT PROCEDURE

A. Engineer and Contractor shall meet and resolve all outstanding issues including, but not limited to:
1. Claims and adjustments for time or costs
2. Outstanding, unused allowances
3. Procedures for handling warranty issues.

B. A Final Change Order shall be processed if required. Final payment and close out procedures shall comply with all requirements of the Contract Documents.

1.6 MAINTENANCE AND GUARANTEE

A. Comply with the maintenance and guarantee requirements contained in General Conditions of the Contract.

B. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as a part of such required repair work, and any repair or resurfacing which becomes necessary by reason of such settlement shall likewise be considered as a part of such required repair work unless Contractor has obtained a statement in writing from the affected private authority or public agency releasing Owner from further responsibility in connection with such repair or resurfacing. Submit such release(s) to Engineer.

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

1.7 BOND

A. Furnish a Performance Bond as required by General Conditions of the Contract.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. Certificate of Final Completion of the Work by Owner will be withheld until requirements for final cleanup of the Project Site are complete as follows:
   1. Perform final cleaning prior to inspections for final acceptance.
   2. Employ skilled workers who are experienced in cleaning operations.
   3. Use cleaning materials that are recommended by manufacturers of surfaces to be cleaned.
   4. Avoid scratching, discoloring, and otherwise damaging surfaces being cleaned.
   5. Broom clean and power wash exterior paved surfaces and rake clean other surfaces of sitework. Police yards and grounds to keep clean.
   6. Remove dust, cobwebs, and traces of insects and dirt.
   7. Clean grease, mastic, adhesives, dust, dirt, stains, fingerprints, paint, blemishes, sealants, plaster, concrete, and other foreign materials from sight-exposed surfaces, fixtures, and Equipment.
   8. Remove nonpermanent protection and labels.
   9. Polish finish hardware.
   10. Polish glossy surfaces to clear shine.
   11. Clean light fixtures and replace burned-out or dim lamps.

3.2 WASTE DISPOSAL

A. Remove temporary structures and facilities and arrange for and dispose of surplus materials, waste products, and debris as follows:
   1. Prior to making disposal on private property, obtain written permission from owner of such private property.
   2. Do not fill ditches, washes, or drainage ways which may create drainage problems.
   3. Do not create unsightly or unsanitary nuisances during disposal operations.
   4. Maintain disposal site in safe condition and good appearance.
   5. Complete leveling and clean-up prior to final acceptance of the Work.

3.3 TOUCH-UP AND REPAIR

A. Touch up or repair finished surfaces on structures, equipment, fixtures, and installations that have been damaged prior to inspection for final acceptance.

B. Refinish or replace entire surfaces that cannot be touched-up or repaired satisfactorily.

3.4 DEMOBILIZATION

A. Demobilization shall include moving equipment, field trailers, construction materials, debris, and so forth from the Site as well as performing final cleanup.
   1. Disturbed areas shall be restored to their original state or better.
   2. Permanent improvements damaged during construction operations shall be repaired or replaced at no additional cost to Owner.

3. Remove all equipment, materials, waste, and debris from the site and restore site to original condition upon completion of construction.
4. The work area shall be restored to its original or better condition and shall be inspected and approved by Engineer.

END OF SECTION

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SECTION 01 78 39
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Maintain at the Site for Owner, one record copy of the Drawings, Specifications, Operation and Maintenance manuals, coordination drawings, and Shop Drawings that are clearly marked with a red pen to indicate all changes and or revisions resulting from, but not limited to, the following:
   1. Actual Project as constructed.
   2. Addenda.
   3. Change Orders and other modifications.
   4. Engineer's instructions.
   5. Field revisions.
   6. Requests for Information (RFI).
   7. All other changes.

B. Give special attention to recording the horizontal and vertical location of all buried utilities that differ from the locations indicated, or which were not indicated on the Contract Drawings.

C. Record drawings shall be supplemented by any detailed sketches as necessary or directed to fully indicate the Work, as actually constructed.

D. Section Includes:
   1. Maintenance of Documents and Samples
   2. Marking Devices.
   3. Recording.
   4. Close-out Submittal Delivery.

1.2 MAINTENANCE OF DOCUMENTS AND SAMPLES

B. Store documents and samples in field office apart from documents used for construction.

C. Maintain documents in clean, dry, legible condition and in good order. Keep record documents separate from those used for construction.

D. Always make documents and samples available for reference by Engineer and Owner.

E. In the case of those drawings which depict the detail requirement for equipment to be assembled and wired in the factory, such as motor control centers and the like, the record drawings shall be updated by indicating those portions which are superseded by change order drawings or final shop drawings, and by including appropriate reference information describing the change orders by number and the shop drawings by manufacturer, drawing, and revision numbers.

F. During progress meetings, record documents may be reviewed to ascertain that changes have been recorded.

G. Updated Drawings, when provided by Engineer, will be substituted for the hand markups provided Contractor prints the applicable Drawings and inserts them into the record set each month.

H. Copies of the record drawings will be audited regularly by Engineer after the month in which the Notice to Proceed is given as well as on completion of the Work. Failure to properly maintain record drawings in an up-to-date condition may result in the withholding of payments due at the sole discretion of Owner.

1.3 MARKING DEVICES

A. Use a red color pen for recording all information to all documents defined herein.

1.4 RECORDING

A. Label each document "CONFORMING TO CONSTRUCTION RECORD" in neat large red printed letters.

B. Record information concurrently with construction progress, at the time the material or equipment is installed. Do not conceal any work until required information is recorded.

C. Drawings shall be legibly marked to record actual construction per the following:
   1. Record actual depths of various elements of foundations in relation to finish first floor datum.
   2. Record actual as-built depths, horizontal and vertical location, (at every direction change and a maximum of 100 feet intervals on straight runs), of underground pipes, duct banks, and other buried utilities. Reference horizontal location to Project coordinate system and vertical elevations to Project datum.
   3. Identify and record specific details of pipe connections, location of existing buried features and utilities located during excavation, and the final locations of piping, equipment electrical conduits, manholes, and pull boxes (horizontal coordinates and vertical elevation).
   4. Identify and record location of spare conduits including beginning, ending, and routing through pull boxes, and manholes. Record spare conductors, including number and size, within spare conduits, and filled conduits.
   5. Record actual schedules, lists, layout drawings, and wiring diagrams.
   6. Record field changes of dimension and detail.
   7. Record changes made by instruction from Engineer or by Change Order.
   8. Record details not on original Contract Drawings.

D. Specifications and Addenda shall be legibly marked to record:
   1. Manufacturer, trade name, catalog number, and supplier for each product and item of equipment installed.
   2. Changes made by instruction from Engineer or by Change Order.

E. Record potholing data and installation of marker balls.

F. All surveying for record documents shall be performed by a licensed surveyor.

1.5 CLOSEOUT SUBMITTALS

A. At Contract closeout, deliver complete record documents to Engineer as required in Section 01 77 00 - Project Closeout. Final payment will not be acted upon until the record drawings have been prepared and delivered to Engineer.

B. The information submitted will be incorporated by Engineer into final drawings to be provided to Owner. Be responsible for the accuracy of submitted construction information. Engineer will assume that the information provided by Contractor is correct and faithfully represents actual construction.

C. This submittal shall include the record paper set along with the electronic version. Electronic version shall include .pdf files and .dwg files of each drawing.

D. Prepare submittal with transmittal letter containing:
   1. Date.
   2. Project title and number.
   3. Contractor's name and address.
   4. Title and number of each record as-built document.
   5. Signature of Contractor's authorized representative and a statement that certifies that the record documents are accurate and reflect what was installed during construction.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 81 10
SEISMIC DESIGN CRITERIA

PART 1 - GENERAL

1.1 SUMMARY

A. This section Includes seismic design criteria for the following:
   1. Anchorage of mechanical and electrical equipment and piping.
   2. Seismic design of tanks and anchorage of tanks.
   3. Other structures or items as specified or indicated on the Drawings.

1.2 REFERENCES

A. International Code Council (ICC) documents as follows:

IBC	International Building Code, 2021 Edition with Utah state amendments

B. American Society of Civil Engineers (ASCE) documents as follows:

ASCE 7	Minimum Design Loads for Buildings and Other Structures, 2016 Edition

1.3 SUBMITTALS

A. Shop Drawings and Calculations: Submit shop drawings and structural calculations in accordance with Section 01 33 20 - Submittal Procedures. All drawings and calculations shall be signed and sealed by a licensed Civil or Structural engineer as required below under "Qualifications".

B. ICC-ES reports for concrete anchors.

1.4 QUALITY ASSURANCE

A. Qualifications
   1. Licensed Professionals: Design of items required by this Section and other items not specifically shown in the Contract Documents shall be performed by a Civil or Structural Engineer licensed to practice in the state of Utah.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Design Criteria: Design in accordance with the requirements of the International Building Code and ASCE 7.
   1. Seismic acceleration variables to be used in design are as follows:
      a. The design 5 percent damped spectral response acceleration at short periods, S_{DS} = 0.83g.

b. The mapped maximum considered earthquake, 5 percent damped, spectral response acceleration at short periods, S_S = 1.04g.
c. The mapped maximum considered earthquake, 5 percent damped, spectral response acceleration at a period of 1 second, S_1 = 0.37g.
d. Risk Category: IV
e. Soil Site Class = D.
f. Seismic Design Category = D.

2. Seismic Importance Factor for Anchorage of Mechanical and Electrical Equipment: 1.50.
3. Seismic Importance Factor for the Design of Tanks and the Anchorage of Tanks: 1.50.
4. Do not use friction to resist sliding due to seismic forces.
5. Use only headed anchor bolts, adhesive anchors, or welded studs for anchors resisting seismic forces. Embedded anchor bolts used to resist seismic forces shall have a standard hex bolt head.
   a. Adhesive anchors must have current ICC-ES reports showing that the anchors meet IBC requirements when installed in cracked substrates.
   b. Do not use other types of anchors unless indicated on the Drawings or approved in writing by Engineer.
   c. Seismic forces must be resisted by direct bearing on the fasteners used to resist seismic forces. Do not use connections which use friction to resist seismic forces.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 82 11
WIND DESIGN CRITERIA

PART 1 - GENERAL

1.1 SUMMARY

A. This section Includes design criteria for the following when exposed to wind forces:
   1. Anchorage of mechanical and electrical equipment and piping.
   2. Design of tanks and anchorage of tanks.
   3. Other structures or items as specified or indicated on the Drawings.

1.2 REFERENCES

A. International Code Council (ICC) documents as follows:

IBC	International Building Code, 2021 Edition with Utah state amendments

B. American Society of Civil Engineers (ASCE) documents as follows:

ASCE 7	Minimum Design Loads for Buildings and Other Structures, 2016 Edition

1.3 SUBMITTALS

A. Shop Drawings and Calculations: Submit shop drawings and structural calculations in accordance with Section 01 33 20 - Submittal Procedures. All drawings and calculations shall be signed and sealed by a licensed Civil or Structural engineer as required below under "Qualifications".

B. ICC-ES reports for concrete anchors.

1.4 QUALITY ASSURANCE

A. Qualifications
   1. Licensed Professionals: Design of items not specifically shown in the Contract Documents shall be performed by a professional Civil or Structural Engineer licensed to practice in the state of Utah.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Design Criteria: Design in accordance with the requirements of the International Building Code and ASCE 7.
   1. Basic Wind Speed: 115 miles per hour
   2. Risk Category: IV
   3. Exposure: B
   4. Topographic Factor: 1.0

5. Use only headed anchor bolts, adhesive anchors, or welded studs for anchors resisting wind forces. Embedded anchor bolts used to resist seismic forces shall have a standard hex bolt head.
   a. Adhesive anchors must have current ICC-ES reports showing that the anchors meet IBC requirements.
   b. Do not use other types of anchors unless indicated on the Drawings or approved in writing by the Engineer.
   c. Wind forces must be resisted by direct bearing on the fasteners used to resist wind forces.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

DIVISION 02
EXISTING CONDITIONS

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SECTION 02 41 00
DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes demolition, salvage, and reconstruction of existing civil, landscaping, structural, architectural, mechanical, HVAC, electrical, and instrumentation facilities as indicated in accordance with the Contract Documents.

1.2 RELATED SECTIONS

A. Section 09 90 00 – Painting and Coating

B. Section 31 23 00 – Earthwork

1.3 REFERENCES

A. Air-Conditioning, Heating, and Refrigeration Institute (AHRI) standards, most recent editions:

Guideline K	Containers for Recovered Non-flammable Fluorocarbon Refrigerants.

B. American National Standards Institute (ANSI) standards, most recent editions:

A10.6	Safety and Health Program Requirements For Demolition Operations.

C. Environmental Protection Agency (EPA), standards and laws, most recent editions:

40 CFR 61	National Emission Standards for Hazardous Air Pollutants.
40 CFR 82	Protection of Stratospheric Ozone.
40 CFR 273	Standards for Universal Waste Management.

D. Occupational Safety and Health Administration (OSHA) standards and laws, most recent editions:

29 CFR 1926	Safety and Health Regulations for Construction.

1.4 DEFINITIONS

A. Demolition: Dismantling, razing, destroying, or wrecking of any fixed building or structure or any part thereof. Demolition also includes removal of pipes, manholes, tanks, conduit, and other underground facilities, whether as a separate activity or in conjunction with construction of new facilities.

B. Modify: Provide all necessary material and labor to modify an existing item to the condition indicated or specified in Contract Documents.

C. Relocate: Remove, protect, clean, and reinstall equipment, including electrical, instrumentation, and all ancillary components required to make the equipment fully functional, to the new location identified herein and on Contract Drawings.

D. Renovation: Altering a facility or one or more facility components in any way.

E. Salvage/Salvageable: Remove and deliver to the specified location(s), the equipment, building materials, or other items so identified to be saved from destruction, damage, or waste; such property to remain that of Owner. Unless otherwise specified, title to items identified for demolition reverts to Contractor.

F. Universal Waste Lamp: In accordance with 40 CFR 273, the bulb or tube portion of an electric lighting device, examples of which include, but are not limited to, fluorescent, high-intensity discharge, neon, mercury vapor, high-pressure sodium, and metal halide lamps.

G. Universal Waste Thermostat: A temperature control device that contains metallic mercury in an ampule attached to a bimetal sensing element, and mercury-containing ampules that have been removed from these temperature control devices in compliance with the requirements of 40 CFR 273.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Coordinate the Work in areas where existing facilities are interconnected with new facilities and where existing facilities remain operational. The Work as indicated is not all inclusive. Be responsible for performing the reconstruction indicated plus that which can be reasonably inferred from the Contract Documents as necessary to complete the Project. The Specifications and Drawings identify the major facilities to be demolished and reconstructed, but auxiliary utilities such as water, air, chemicals, drainage, lubrication, fluid power, electrical wiring, controls, and instrumentation are not necessarily shown.
2. Drawings used to indicate demolition and reconstruction are based on drawings conforming to construction records for the existing facilities. These drawings have been reproduced to show existing conditions and to clarify the scope of Work as much as possible. Prior to bidding, conduct a comprehensive survey at the Site to verify the correctness and exactness of the Drawings, the scope of Work, and the extent of auxiliary utilities. A complete set of available drawings conforming to construction records may be provided upon request.
3. While demolition and reconstruction are being performed, provide adequate access for the continued operation and maintenance of equipment and treatment processes. Erect and maintain fences, warning signs, barricades, and other devices around the reconstruction as required for the protection of the Contractor employees and the Owner's personnel at the Site. Remove such protection when reconstruction activities are complete, or as work progresses, or when directed by Engineer.

1.6 SUBMITTALS

A. Submit in accordance with Section 01 33 20 – Submittal Procedures.

B. Informational Submittals
   1. Submit proposed Demolition/Renovation Plan, in accordance with requirements specified herein, for approval before such Work is started.
   2. Submit copies of any notifications, authorizations and permits required to perform the Work.
   3. Submit a shipping receipt or bill of lading for all universal waste shipped.

1.7 REGULATORY AND SAFETY REQUIREMENTS

A. When applicable, accomplish demolition Work in strict accordance with 29 CFR 1926 Subpart T.

B. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the General Conditions, conform to ANSI A10.6.

C. Furnish timely notification of this demolition/renovation project to applicable federal, state, regional, and local authorities in accordance with 40 CFR 61 Subpart M.

1.8 DEMOLITION/RENOVATION PLAN

A. Prepare Demolition/Renovation Plan to provide for safe conduct of the Work, including the following:
   1. Detailed description of methods and equipment to be used for each operation.
   2. Planned sequence of operations, including coordination with other work in progress.
   3. Procedures for removal and disposition of materials specified to be salvaged.
   4. Disconnection schedule of utility services.

B. Include statements affirming Contractor inspection of the existing roof deck, floors, walls, and framing members, and their suitability to perform as a safe working platform or, if inspection reveals a safety hazard to workers, state provisions for securing the safety of the workers throughout the performance of the Work if applicable for Project Work.

1.9 SEQUENCING AND SCHEDULING

A. Do not commence demolition work until the Demolition/Renovation Plan has been accepted by Engineer.

B. Include the Work of this Section in the progress schedule, as specified in Section 01 32 16 – Construction Progress Schedule.

C. Comply with sequencing requirements in Section 01 14 40 - Construction and Schedule Constraints.

1.10 USE OF EXPLOSIVES

A. Use of explosives is not permitted.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Coordinate demolition and reconstruction Work with Engineer. Unless otherwise indicated, be responsible for the sequence of activities and perform Work in accordance with applicable safety rules and regulations.

B. Verify that any utilities connected to structures, equipment, and facilities to be removed, relocated, salvaged, replaced, or abandoned are rendered inoperable, replaced with new utilities, or adequately bypassed with temporary utilities before proceeding with demolition and reconstruction.

C. Avoid damage to adjacent facilities and limit Work activities to the extent indicated. If reconstruction beyond the scope indicated is required, obtain approval from Engineer prior to commencing.

3.2 PROTECTION OF EXISTING FACILITIES

A. Before beginning any reconstruction, survey the existing facilities and examine the Contract Documents to determine the extent of demolition and/or reconstruction and coordination with the Work. Protect existing facilities not subject to the Work of this Section and maintain in accordance with Section 01 71 50 – Protection and Restoration of Existing Facilities. Repair or replace damaged existing facilities to the previous condition.

B. Provide safe passage for pedestrians and drivers around areas of demolition. Where pedestrian and driver safety is endangered in the area of Work, use traffic barricades with flashing lights.

C. Do not overload structural elements. Be responsible for shoring, bracing, or adding new supports as may be required for adequate structural support as a result of Work performed under this Section. Remove temporary protection when the Work is complete or when so authorized by Engineer.

D. Dust and Debris Control
   1. Prevent the spread of dust and debris to occupied portions of existing facilities and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution.
   2. Vacuum and sweep the Work area daily.
   3. Sweep pavements as often as necessary to control the spread of debris that may result in foreign object damage potential to vehicular traffic.

E. Weather Protection:
   1. For portions of the facility scheduled to remain, protect interior materials and equipment from weather at all times. Where removal of existing roofing is necessary to accomplish the Work, have materials and workers ready to provide adequate and temporary covering of exposed areas to ensure effectiveness and to prevent loss.

F. Facilities:

1. Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities.
2. Floors, roofs, walls, columns, pilasters, and other structural elements that are designed and constructed to stand without lateral support or shoring and are determined by Contractor to be in stable condition, may remain standing without additional bracing, shoring, or lateral support until demolished, unless directed otherwise by Engineer.
3. Protect all facility elements not scheduled for demolition.
4. Provide interior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities.

G. Protection of Personnel:

1. During demolition, continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site.
2. Provide temporary barricades and other forms of protection to protect Owner's personnel and the general public from injury due to demolition Work.
3. Provide protective measures as required to provide free and safe passage of Owner's personnel and the general public to occupied portions of the structure.

3.3 EXISTING FACILITIES TO BE DEMOLISHED AND ABANDONED

A. Facilities:

1. Buildings, vaults and adjacent designated areas scheduled for complete demolition are as shown on the Contract Drawings.
2. Portions of buildings and other areas scheduled for selective demolition, partial demolition, and renovation Work are as shown on the Contract Drawings.

B. Structures:

1. Remove existing above grade structures indicated to 3 feet minimum below grade unless otherwise indicated.
2. Remove interior walls, other than retaining walls and partitions, as shown on Contract Drawings.
3. Remove partition walls as shown on Contract Drawings.
4. Core drill concrete slabs and other concrete improvements scheduled to remain in place below ground, or break holes at the structure's lowest point to allow water to freely migrate through.
5. Remove sidewalks, curbs, gutters, and street light bases as indicated on Contract Drawings.
6. Where existing railing is removed, remove post embedments and anchors and fill post holes with non-shrink grout flush to the floor surface. At the point of continuation of existing handrailing, install a new post with rail connections matching the existing railing system. Install new posts in existing concrete floors in core-drilled socket holes and the annular space between the post and hole filled with non-shrink grout

C. Substructure: Where applicable, extract conflicting existing pilings prior to driving new piles.

D. Utilities and Related Equipment:

1. Notify Owner or appropriate utilities to turn off affected services at least 48 hours before starting demolition or renovation activities.
2. Remove existing utilities as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by Engineer.
3. When utility lines are encountered that are not indicated on Contract Drawings, notify Owner prior to further work in that area.
4. Remove meters and related equipment and deliver to a location as determined by Owner.
5. Excavate and remove utility lines serving buildings to be demolished to 5 feet beyond the outside perimeter of the demolition.
6. Provide a permanent leak-proof closure for water and gas lines.
7. Plug other utility lines with concrete to a minimum plug length of 2 feet to prevent groundwater infiltration.
8. When existing pipe is removed, plug the resulting open ends whether or not so indicated. When removed piping is exposed, blind flange the remaining piping or fit with a removable cap or plug.
9. When existing piping is removed from existing structures, fill resulting openings in the structures and repair any damage such that the finished rehabilitated structure appears as a new homogeneous unit with little or no indication of where the new and old materials join. Fill openings in water-bearing structures with non-shrink grout to be watertight and reinforced as required or indicated. In locations where the surface of the grout will be exposed to view, recess the grout approximately 1/2-inch and fill the recessed area with cement mortar grout.

E. Paving and Slabs:
1. Remove concrete and asphaltic concrete paving and slabs including aggregate base as indicated.
2. Provide neat sawcuts at limits of pavement removal as indicated.

F. Concrete:
1. Core drill corners of new opening to avoid overcutting adjacent reinforcing in existing concrete to remain. Saw concrete along straight lines to a depth of not less than 2 inches. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished Work, and the remaining concrete is sound.
2. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete.
3. Where new concrete adjoins existing concrete, thoroughly clean and mechanically roughen existing concrete surfaces to roughness profile of 1/4 inch. Rebar and small embeds at existing concrete may be required to be left to engage new concrete. Saturate surface with water for 24 hours prior to placing new concrete. Tie new Work into the existing construction as shown on Contract Drawings.
4. At locations not to receive new concrete, paint exposed rebar or metal embed ends.

G. Patching:
1. Where removals leave holes and damaged surfaces exposed in the finished Work, patch and repair to match adjacent finished surfaces as to texture and finish.
2. Where new Work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new Work.
3. Patching as specified and indicated, includes:

a. Fill holes and depressions caused by previous physical damage or left because of removals in existing exposed elements like walls with an approved patching material, applied in accordance with the manufacturer's printed instructions.

H. Cylinders and Canisters: Remove all fire suppression system cylinders and canisters and dispose as specified in 40 CFR 82.

I. Door Locksets: Remove all locksets from doors indicated to be removed and disposed of. Turn locksets over to Owner immediately after removal.

J. Electrical:
1. Cut off concealed or embedded conduit, boxes, or other materials a minimum of 3/4 inch below final finished surface.
2. When removing designated equipment, conduit and wiring may require rework to maintain service to other equipment.
3. Rework existing circuits or provide temporary circuits as necessary during renovation to maintain service to existing lighting and equipment not scheduled to be renovated. Existing equipment and circuiting shown are based on limited field surveys and drawings conforming to construction records. Verify existing conditions and make necessary adjustments. Record the Work on the Project's construction record drawings. This includes, but is not limited to, swapping and other adjustments to branch circuits and relocation of branch circuit breakers within panelboards as required to accomplish the finished work.
4. Reuse of existing luminaires, devices, conduits, boxes, or equipment will be permitted only where specifically indicated.
5. Remove raceways and cabling not scheduled for reuse.
6. For inaccessibly concealed items, cut off and abandon in place.
7. Remove items exposed or concealed above accessible ceilings.
8. Cap/seal or tab raceways and cabling scheduled for future use.
9. When relocating existing equipment, extend existing wiring or run new wiring from the source.
10. Where the existing raceway is concealed, clean the outlet box and install a blank cover plate.
11. Where the concealed raceway is uncovered, remove raceway (or extend to new location if appropriate).
12. Provide new typewritten panelboard circuit directory cards.

K. Universal Waste Lamps and Thermostats: Manage, contain, package, and label in strict accordance with 40 CFR 273.

3.4 EXISTING ITEMS TO BE SALVAGED

A. Remove items of existing equipment, piping, valves, electrical gear, instrumentation, utilities, and appurtenances indicated to be salvaged without any degradation in condition from that prior to removal. Stockpile salvaged items and protect on Site at a location directed by Engineer. Be responsible to properly safeguard the salvaged items against damage and loss during removal and handling.

B. Items to be salvaged include:

Item	Description
Flowmeter and valves	Rosecrest Reservoir Vault
Flowmeters	Herriman City Flowmeters in existing Vault at 13400 South
RTU Cabinet	13400 South north side of intersection

3.5 BURNING

A. The use of burning as the Site for disposal of refuse and debris will not be permitted.

3.6 BACKFILL

A. Do not use demolition debris as backfill material.

B. Fill excavation, open basements, and other hazardous openings to existing ground level or foundation level of new construction in accordance with Section 31 23 00 – Earthwork.

3.7 TITLE TO MATERIALS

A. Except for items listed herein to be salvaged, all items designated to be removed become the property of Contractor.

3.8 DISPOSITION OF MATERIAL

A. Do not remove equipment and materials until acceptance of Contractor's Demolition/Renovation Plan by Engineer.

B. Salvage equipment and material to the maximum extent possible.

C. Remove salvaged items designated as the property of Owner in a manner to prevent damage and pack or crate to protect the items from damage while in storage or during shipment. Properly identify containers as to contents.

D. Repair or replace, at the discretion of Engineer, items designated as the property of the Owner damaged during removal or storage.

E. Deliver salvaged items that are designated as the property of Owner to a storage site as directed by Owner.

F. Owner will not be responsible for the condition or loss of, or damage to, property scheduled to become Contractor's property after Engineer's authorization to begin demolition or renovation. Materials and equipment may not be viewed by prospective purchasers or sold on the Site.

G. Store Contractor owned salvaged items where approved by Owner and remove them from Owner's property before completion of the Contract.

3.9 REUSE OF MATERIALS AND EQUIPMENT

A. Store equipment and material designated to be reused in a location designated by Engineer.

B. Equipment and material designated to be reused must be cleaned, serviced, and checked for proper operability before being put back into service.

C. Engineer will determine condition of equipment and materials prior to removal. Properly store and maintain equipment and materials in same condition as when removed.

3.10 UNSALVAGEABLE MATERIAL

A. Dispose of concrete, masonry, and other noncombustible material, except concrete permitted to remain in place, off Site unless indicated otherwise.

B. Dispose of combustible material in a sanitary fill.

C. Dispose of universal waste lamps and thermostats in strict accordance with 40 CFR 273.

3.11 CLEANUP

A. Remove and transport debris and rubbish in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal apply.

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DIVISION 03
CONCRETE

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SECTION 03 11 00
CONCRETE FORMING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish, fabricate, and install concrete formwork, bracing, shoring, supports, and falsework in accordance with Contract Documents.

B. Work includes installation of form ties, clips, supports and other appurtenances necessary to meet Specifications and produce finished concrete structures.

1.2 RELATED SECTIONS

A. Section 03 30 00 – Cast-In-Place Concrete

1.3 REFERENCES

A. American Concrete Institute (ACI) standards, most recent editions:

ACI 117	Specification for Tolerances for Concrete Construction and Materials
ACI 317	Standard Tolerances for Concrete Construction and Materials
ACI 318	Building Code Requirements for Reinforced Concrete
ACI 347	Formwork for Concrete

B. National Sanitation Foundation (NSF), most recent edition:

NSF 61	Drinking Water System Components, Health Effects

C. U.S. Department of Commerce, National Institute of Standards and Technology, (NIST) standards, latest editions:

PS 1	Structural Plywood
PS 20	American Softwood Lumber Standard (ASLS)

1.4 SYSTEM DESCRIPTION

A. Be responsible for the design, engineering, construction, maintenance, and safety of all falsework, including staging, walkways, forms, ladders, and similar appurtenances, which shall equal or exceed the applicable requirements of the provisions of the OSHA Safety and Health Standards for Construction, and the requirements specified herein.

B. Design and construct falsework to provide the necessary rigidity and to support the loads imposed. Design falsework for the support of a superstructure to support the loads that would be imposed if the entire superstructure were placed at one time.

C. Falsework Calculations and Drawings: All falsework or vertical shoring installations where the height of the falsework or vertical shoring, as measured from the top of the sills to the soffit of the superstructure, exceeds 14 feet, or where individual horizontal span lengths exceed 16 feet, or provision for vehicular or railroad traffic through falsework or vertical shoring is made, shall be approved and signed by a civil or structural engineer, registered in the State of Utah. Always maintain a current copy of the falsework plan or shoring layout on the job site.

1.5 SUBMITTALS

A. Submit in accordance with Section 01 33 20 – Submittal Procedures.

B. Shop Drawings: Submit detailed drawings of the falsework proposed to be used. Include drawings with sufficient detail to indicate the general layout, sizes of members, anticipated stresses, grade of materials to be used in the falsework, means of protecting existing construction which supports falsework, and typical soil conditions. Submittals shall include the following:
   1. Form ties and all related accessories, including taper tie plugs, if taper ties are used.
   2. Form gaskets.
   3. Form releasing agent, including NSF certification when applicable.
   4. List of form materials and locations for use.

PART 2 - PRODUCTS

2.1 GENERAL

A. Except as otherwise expressly accepted by Engineer, utilize new material for all lumber brought on the job site for use as forms, shoring, or bracing. Unless otherwise indicated, form surfaces are to be smooth and fabricated from the following materials:
   1. Walls: Steel or plywood panel.
   2. Columns: Steel, plywood or fiberglass.
   3. Roof and Floor: Plywood.
   4. All Other Work: Steel panels, plywood or tongue and groove lumber

2.2 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
   1. Form ties (general):
      1) Burke Penta-Tie, Burke Company.
      2) Richmond Snap-Tys, Richmond Screw Anchor Company.
      3) Gates Ties, Gates and Sons, Inc.
      4) Engineer approved equal.

2.3 FORM AND FALSEWORK MATERIALS

A. Provide materials for concrete forms, formwork, and falsework that conform to the following requirements:
   1. Lumber: Douglas Fir or Southern Yellow Pine, construction grade or better, in conformance with U.S. Product Standard PS 20.

2. Plywood: New, waterproof, synthetic resin-bonded, exterior type Douglas Fir or Southern Yellow Pine plywood manufactured especially for concrete formwork, conforming to the requirements of PS 1 for Concrete Forms, Class I, edge sealed.
3. Form materials: Metal, wood, plywood, or other approved material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade shown. Metal forms shall be an approved type that will accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.

B. Unless otherwise indicated, provide exterior corners in concrete members with 3/4-inch chamfers. Re-entrant corners in concrete members do not require fillets unless otherwise indicated.

C. Design forms and falsework to support the roof and floor slabs for the total dead load, plus a live load of 50 psf (minimum). The minimum design load for combined dead and live loads is 100 psf.

2.4 FORM TIES

A. Provide form ties with integral waterstops with a plastic cone on both sides of walls, or other suitable means for forming a conical hole to ensure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, may not exceed 1-1/2 inches; and all such fasteners must leave holes of regular shape for reaming.

2.5 FABRICATION

A. Form tolerances: Provide forms in accordance with ACI 347, ACI 318, or 350 and the following tolerances.
1. Wall tolerances:
a. Straight wall surface:
1) Exposed wall surface: Flat planes within tolerance specified.
2) Plumb within 1/4 inch in 10 feet or within 1 inch from top to bottom for walls over 40 feet tall.
3) Depressions in wall surface: Maximum 5/16 inch when 10-foot straightedge is placed on high points in all directions.
4) Thickness: Maximum +1/4 inch or -1/2 inch from dimensions shown.
2. Slab tolerances:
a. Exposed slab surfaces: Comprise of flat planes as required within tolerances specified.
b. Slab finish tolerances and slope tolerances: Crowns on floor surface not too high as to prevent 10-foot straightedge from resting on end blocks, no low spots that allow a block of twice the tolerance in thickness to pass under the supported 10-ft straightedge:
1) Steel gage block: 5/16 inch thick.
c. Finish slab elevation: Slope slabs to floor sumps, drains, and gutter, to drain regardless of tolerances.
d. Thickness: -1/4 inch or +1/2 inch from thickness shown, except when thickness tolerance will affect slope, drainage, or slab elevation.
3. For all other tolerances, refer to ACI 117.
4. Make transitions from plus to minus tolerances gradual, even, and smooth.

PART 3 - EXECUTION

3.1 GENERAL

A. Use forms to confine the concrete and shape it to the required lines wherever necessary. Assume full responsibility for the adequate design of all forms. Promptly remove any forms which are unsafe or inadequate in any respect from the Work and replaced at no increased cost to Owner. Provide worker protection from protruding reinforcement bars in accordance with applicable safety codes. Provide a sufficient number of forms of each kind to permit the required rate of progress to be maintained. The design and inspection of concrete forms, falsework, and shoring shall comply with applicable local, state, and federal regulations.

B. Install plumb and string lines before concrete placement and maintain during placement. These lines will be used by both Contractor and Engineer for control and verification of the form lines. Provide sufficient number, properly installed for that purpose. During concrete placement, continually monitor plumb and string line form positions and immediately correct deficiencies.

C. Conform to the shape, lines, and dimensions of members as called for on the Drawings, substantial and free from surface defects, and sufficiently tight to prevent leakage. Brace forms or tie them together to maintain their position and shape under a load of freshly placed concrete. If adequate foundation for shores cannot be secured, provide trussed supports.

3.2 FORM CONSTRUCTION

A. Construct forms in conformance with ACI 347.

B. Set forms true to the required shape and size and conform to the established alignment and grade. Provide sufficient strength and rigidity to maintain form position and shape under the loads and operations incident to placing and vibrating the concrete. Provide suitable and effective means on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Plywood, 5/8-inch and greater in thickness, may be fastened directly to studding if the studs are spaced close enough to prevent visible deflection marks in the concrete. Assemble the forms tight to prevent the loss of water, cement, and fines during placing and vibrating of the concrete. Specifically, provide the bottom of wall forms that rest on concrete footings or slabs with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1 to 1-1/2-inch diameter polyethylene rod held in position to the underside of the wall form. Provide adequate clean-out holes at the bottom of each lift of forms. The size, number, and location of such clean-outs must be as acceptable to Engineer. Whenever concrete cannot be placed from the top of a wall form in a manner that meets the requirements of the Contract Documents, provide pour windows of the size and spacing needed to allow placement of concrete to the requirements of Section 03 30 00 - Cast-in-Place Concrete. Provide size, number, and location of such form windows acceptable to Engineer.

C. Vertical surfaces: Form all vertical surfaces of concrete members except where placement of the concrete against the ground is shown. Add no less than 1 inch of concrete to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the

required lines and will stand securely without caving or sloughing until the concrete has been placed and has set.

D. Construction joints: Concrete construction joints will not be permitted at locations other than those shown or specified, except as may be acceptable to Engineer. When a second lift is placed on hardened concrete, take special precautions to include the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory affect on the concrete. Set pipe stubs and anchor bolts in the forms where required.

E. Form ties

1. Embedded Ties: Ream holes left by the removal of form tie cones with suitable toothed reamers to leave the surface of the holes clean and rough before being filled with mortar as specified for finish of concrete surfaces in Section 03 30 00 - Cast-in-Place Concrete. Wire ties for holding forms will not be permitted. Leave no form-tying device or part thereof, other than metal, embedded in the concrete. Do not remove ties in such manner to leave a hole extending through the interior of the concrete members. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, provide rubber grommets where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods must remain embedded and must terminate not less than 2 inches back from the formed face or faces of the concrete.
2. Removable Ties: Where taper ties are approved for use, place the larger end of the taper tie on the wet side of walls in water retaining structures. After the taper tie is removed, thoroughly clean the remaining hole and roughen for bond. Place a precast neoprene or polyurethane tapered plug at the wall centerline. Fill the hole completely with nonshrink grout for water bearing and below-grade walls. For above-grade walls which are dry on both sides, fill the remaining hole with nonshrink or regular cement grout. On exposed faces of walls fill the outer 2 inches of the exposed face a cement grout matching the color and texture of the surrounding wall surface.

3.3 REMOVAL OF FORMS

A. Employ careful procedures for the removal of forms to avoid injury to the concrete. No heavy loading on green concrete will be permitted. In the case of roof slabs and above-ground floor slabs, maintain forms in place until test cylinders for the roof concrete attain a minimum compressive strength of 75 percent of the 28-day strength specified in Section 03 30 00 - Cast-in-Place Concrete; provided, that no forms shall be disturbed or removed under an individual panel or unit before the concrete in the adjacent panel or unit has attained 75 percent of the specified 28-day strength and has been in place for a minimum of 7 days. The time required to establish said strength will be determined by Engineer who will make several test cylinders for this purpose from concrete used in the first group of roof panels placed. If the time so determined is more than the 7-day minimum, then that time will be used as the minimum length of time. Forms for all vertical walls must remain in place at least 2 days after the concrete has been placed. Forms for all parts of the Work not specifically mentioned herein must remain in place for periods of time as determined by Engineer and ACI 347.

3.4 REUSE OF FORMS

A. Forms may be reused only if in good condition and only if acceptable to Engineer. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces which are permanently exposed to view. In the case of forms for the inside wall surfaces of hydraulic/water retaining structures, unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to Engineer.

3.5 MAINTENANCE OF FORMS

A. Maintain forms at all times in good condition, particularly as to size, shape, strength, rigidity, tightness, and smoothness of surface. Forms, when in place, must conform to the established alignment and grades. Before concrete is placed, thoroughly clean the forms to remove dirt and debris. Treat form surfaces with a non-staining mineral oil or other lubricant acceptable to Engineer. Remove excess lubricant before placing the concrete. Where field oiling of forms is required, perform the oiling at least 2 weeks in advance of their use. Take care to keep oil off the surfaces of steel reinforcement and other metal items embedded in concrete.

3.6 FALSEWORK

A. Place falsework on a solid footing, safe against undermining, and protected from softening. When the falsework is supported on timber piles, limit the maximum calculated pile loading to 20 tons. When falsework is supported on any portion of the structure which is already constructed, the load imposed by the falsework shall be spread, distributed, and braced to avoid any possibility of damage to the structure.

END OF SECTION

SECTION 03 20 00
CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish, fabricate, and install reinforcing steel as shown on Contract Documents.

B. Work includes installation of tie wires, clips, supports, and other appurtenances necessary to meet Specifications and produce finished concrete structures.

1.2 RELATED SECTIONS

A. Section 03 30 00 – Cast-In-Place Concrete

B. Section 03 60 00 - Grout

1.3 REFERENCES

A. American Concrete Institute (ACI) standards, most recent editions:

ACI 315	Details of Concrete Reinforcement
ACI 318	Building Code Requirements for Structural Concrete
ACI 350	Code Requirements for Environmental Engineering Concrete Structures

B. American Welding Society (AWS):

D1.4	Structural Welding Code – Reinforcing Steel

C. ASTM International (ASTM) standards, most recent editions:

ASTM A615	Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A706	Standard Specification for Low Alloy Steel Deformed Bars for Concrete Reinforcement
ASTM A775	Standard Specification for Epoxy-Coated Reinforcing Steel Bars
ASTM A1064	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

D. Concrete Reinforcing Steel Institute (CRSI) standards, most recent editions:

Placing Reinforcing Bars

Manual of Standard Practice

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 20 – Submittal Procedures.

B. Submit details of the concrete reinforcement steel and concrete inserts at the earliest possible date after receipt of the Notice to Proceed.

C. Include, but not limit to, the following:
   1. Complete bar schedule, bar details and erection drawings to conform to ACI 315.
   2. Each type of bar marked with identification corresponding to identification tag on bar.
   3. Length, type, and location of all splices.
   4. Erection drawings shall be clear, easily legible and to a minimum scale of:
      a. 1/4 inch = 1 foot.
      b. 1/8 inch = 1 foot if bars in each face are shown in separate views.
   5. Size and location of openings.

D. Furnish a certified Affidavit of Compliance issued by steel manufacturer that reinforcing steel furnished for project meets requirements of ASTM standards referenced herein, as applicable.

E. Do not use Contract Documents as erection drawings.

1.5 QUALITY ASSURANCE

A. Qualifications
   1. Welding operators, processes, and procedures to be qualified in accordance with AWS D1.4.
   2. Welding operators to have been qualified during the previous 12 months prior to commencement of welding.

B. Certifications
   1. Submit manufacturer's certification that products submitted meet requirements of standards referenced.

1.6 DELIVERY, STORAGE AND HANDLING

A. Comply with Section 01 25 10 - Products, Materials, Equipment and Substitutions.

B. Store reinforcing steel on wood supports in a manner that prevents it from coming in contact with the ground.

C. Store only bars with same identifying label in same stack.

D. Cover epoxy coated reinforcement for protection against both moisture and ultraviolet light and so that condensation does not form on the bars.

E. When handling coated bars, use systems with padded contact areas.

F. Thoroughly inspect coated steel after delivery to the job site and again after installation to ensure that it is not damaged.
   1. Repair damage with patching material meeting manufacturer's requirements.
   2. Promptly patch sheared ends and other cuts or exposed areas before detrimental oxidation occurs.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
   1. Mechanical Couplers:
      a. Lenton Form Saver by Erico Products.
      b. Dowel Bar Splicer System by Richmond Screw Anchor Company.
      c. Engineer-approved equal.

2.2 REINFORCEMENT STEEL

A. Materials:
   1. Reinforcing bars: ASTM A615, Grade 60.
   2. Reinforcing bars to be welded: ASTM A706.
   3. Smooth dowels: ASTM A615, Grade 60 plain billet steel bars epoxy coated in accordance with ASTM A775. Provide slip dowel sleeves to allow longitudinal movement equal to joint width plus 1/4 inch.
   4. Slip Dowel Sleeve: One or two component Speed Dowel System as manufactured by Greenstreak, Inc., to accept #5 rebar x 12-inch-long slip dowels, including epoxy coating when specified herein or shown on Drawings.
   5. Welded wire fabric: ASTM A1064 and the details indicated; provided, that welded wire fabric with longitudinal wire of W4 size wire and smaller shall be either provided in flat sheets or in rolls with a core diameter of not less than 10 inches; and provided further, that welded wire fabric with longitudinal wires larger than W4 size shall be provided in flat sheets only.
   6. Spiral reinforcement: Cold drawn steel wire conforming to the requirements of ASTM A1064.
   7. Welding Electrodes: E90 meeting requirements of AWS D1.4.

B. Fabrication of Bars:
   1. Fabricate with cold bends conforming to recommended dimensions shown in ACI 318.
   2. Field fabrication will be allowed only if Contractor has equipment to properly fabricate steel to same tolerances as for shop fabrications.
   3. Attach identification tags with identifying mark.
   4. Contractor may at his option continue steel reinforcement through openings in walls and slabs, then field cut opening.

2.3 BOLSTERS, CHAIRS AND ACCESSORIES

A. Conform to ACI 315 and CRSI Manual of Standard Practice.

B. Provide spacers, bolsters, chairs, ties and other devices necessary to properly space, place, support, and fasten steel reinforcement in place during concrete placement.

C. Metal accessories shall be stainless steel with plastic coated tips where legs will be exposed in finished concrete surfaces. Color of plastic shall be grey to match concrete color.

D. Do not use rocks, broken bricks, wood blocks, or concrete fragments for support of steel reinforcement.

E. Support between Reinforcing Steel and Formed Exposed Surfaces: Metal bar chairs.

2.4 PRECAST CONCRETE BLOCK BAR SUPPORTS (DOBIES)

A. Supports between Reinforcing Steel for Roof Slabs: Concrete block prohibited.

B. Minimum Compressive Strength of Blocks: 5,000 psi in seven days.

C. Minimum Bearing Area: 9 square inches. Place as required to maintain specified clearances.

D. Wire ties shall be embedded in concrete block bar supports.

2.5 MECHANICAL COUPLERS

A. Provide mechanical couplers where shown and where approved by Engineer and in accordance with ACI building code standards. The couplers shall develop the full tensile strength of the bars being spliced at each splice (Type 2).

B. Where the type of coupler used is composed of more than one component, supply all components required for a complete splice. This shall apply to all mechanical splices, including those splices intended for future connections.

2.6 EPOXY GROUT

A. Epoxy for grouting reinforcing bars shall be specifically formulated for such application, for the moisture condition, application temperature, and orientation of the hole to be filled. Epoxy grout shall meet the requirements found in Section 03 60 00 - Grouting.

2.7 FABRICATION

A. Tolerances:
   1. Sheared lengths: plus or minus 1 inch.
   2. Overall dimensions of stirrups, ties, and spirals: plus or minus ½ inch.
   3. All other bends: +0 inch, -½ inch.

B. Minimum diameter of bends measured on the inside of the rebar to be as indicated in ACI 318.

C. Ship all reinforcement to job site with attached plastic or metal tags.
   1. Place on each tag the mark number of the reinforcement corresponding to the mark number indicated on the shop drawings.
   2. Mark numbers on tags to be so placed that the numbers cannot be removed.

2.8 TESTING

A. Perform at mill for each heat.

B. If requested by Engineer, furnish samples of each type of welded splice used in the Work in a quantity and of dimensions adequate for testing.

C. At the discretion of Engineer, radiographic testing of direct butt-welded splices will be performed. Provide assistance necessary to facilitate testing. Repair any weld which fails to meet the requirements of AWS D1.4. The costs of testing will be paid by Owner; except, the costs of all tests which fail to meet specified requirements shall be paid by Contractor at no increase in cost to Owner.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Tolerances:
   1. Rebar Placement:
      a. Clear distance to formed surfaces: plus or minus ¼ inch.
      b. Minimum spacing between bars: ¼ inch.
      c. Top bars in slabs and beams:
         1) Members 8 inches deep or less: plus or minus ¼ inch.
         2) Members between 8 inches and 2 feet deep: plus or minus ¼ inch.
         3) Members more than 2 feet deep: plus or minus ¾ inch.
      d. Crosswise of members: Spaced evenly within plus or minus 1 inch.
      e. Lengthwise of members: plus or minus 2 inches.
   2. Minimum clear distance between rebars:
      a. Beams, walls, and slabs: Distance equal to rebar diameter or 1 inch, whichever is greater.

B. Minimum concrete protective covering for reinforcement, unless indicated otherwise on Contract Documents:
   1. Concrete deposited against earth: 3 inches.
   2. Formed surfaces exposed to weather or in contact with earth:
      a. 2 inches for reinforcing bars #6 or larger.
      b. 1½ inch for reinforcing bars less than #6.
   3. Formed surfaces exposed to any liquid: 2 inches for all rebar sizes.
   4. Interior surfaces:
      a. 1½ inch for beams, and girders..
      b. ¾ inch for slabs, walls, and joists.

C. Splice steel to conform to Chapter 12 of ACI 318 or ACI 350 as applicable. Unless indicated otherwise on Contract Documents, provide splices for reinforcing as follows:
   1. Rebar:
      a. Lapped splices shall be not less than a Class B splice for reinforcement unless otherwise indicated.
      b. Mechanical splices shall be used whenever shown on the Contract Documents and may be used at other locations at Contractor's option. Such locations shall be shown specifically on the rebar shop drawings.

c. Welding:
   1) Perform welding of rebars in accordance with requirements of AWS D1.4.
   2) Have each welder place an approved identifying mark near each completed weld.

2. Welded wire fabric: Splice lap length measured between outermost cross wires of each fabric sheet shall not be less than 1 spacing of cross wires plus 2 inches, or less than 1.5 times the development length, nor less than 6 inches. Development length shall be as required for the basic development length for the specified fabric yield strength in accordance with Section 12 of ACI 318 or ACI 350.
3. Provide splices of reinforcing not specifically indicated or specified subject to approval of Engineer.

D. Placing Rebars
1. Assure that reinforcement at time concrete is placed is free of mud, oil, or other materials that may affect or reduce bond.
2. Reinforcement with rust, mill scale, or a combination of both will be accepted as being satisfactory without cleaning or brushing provided dimensions and weights including heights of deformations on a cleaned sample are not less than required by applicable ASTM specifications that govern the rebar supplied.
3. Rebar support:
   a. Support rebars and fasten together to prevent displacement by construction loads or placing of concrete.
   b. On ground, provide supporting concrete blocks.
   c. Over formwork, provide plastic-coated metal chairs, runners, boosters, spacers, hangers, and other rebar support. Only tips in contact with the forms need to be plastic coated.
   d. Bars additional to those shown on the Contract Documents, which may be found necessary or desirable by Contractor for the purpose of securing reinforcement in position, shall be provided by Contractor at his own expense.
   e. Tie securely at minimum of 33% of intersections with 16-gage or larger annealed iron wire.
   f. Accommodate placement of formed openings.
   g. Where parallel horizontal reinforcement in beams is indicated to be placed in two or more layers, rebars in the upper layers shall be placed directly above rebars in the bottom layer with clear distance between layers to be 1 inch. Place spacer rebars at 3 feet maximum centers to maintain the required 1-inch clear distance between layers.
   h. Extend reinforcement to within 2 inches of concrete perimeter edges. If perimeter edge is earth formed, extend reinforcement to within 3 inches of the edge.
   i. To insure proper placement, furnish templates for all column vertical bars and dowels.
   j. Provide splices of reinforcement not specifically indicated or specified subject to Engineer's approval.
   k. Do not bend reinforcement after embedding in hardened concrete unless approved by Engineer. Do not bend reinforcing by means of heat.
   l. Tie wires shall be bent away from form surfaces.
   m. Do not tack-weld reinforcement.

E. Ensure that steel reinforcement and embedments do not exceed 160 Degrees F at time of concrete placement.

3.2 FIELD QUALITY CONTROL

A. Reinforcement Congestion and Interfaces:
   1. Notify Engineer whenever the specified clearances between rebars cannot be met.
   2. Do not place any concrete until Engineer submits a solution to rebar congestion problem.
   3. Rebars may be moved slightly to avoid interference with other reinforcement steel, conduits, or embedded items.
   4. If rebars are moved more than 1 bar diameter, or enough to exceed above tolerances, obtain Engineer's approval of resulting arrangement of rebars.
   5. No cutting of rebars shall be done without written approval of Engineer.

B. Employ a testing laboratory to perform and report following:
   1. Review and approve Contractor proposed welding procedures and processes for conformance with AWS D1.4.
   2. Qualify welders in accord with AWS D1.4.
   3. Test three samples of each bar size and each type of weld in accord with AWS D1.4. The tensile strength of each test shall be not less than 125 percent of the required yield strength of the rebar tested.
   4. Conduct nondestructive field tests (radiographic or magnetic particle) on not less than one random sample for each 10 welds. In addition, if any welds are found defective, test five previous welds performed by the same welder.
   5. Visually inspect each weld for presence of cracks, undercuts, inadequate size, and other visible defects.

3.3 COORDINATION

A. Coordination with placement of formwork, formed openings, embedded items, and other Work.

END OF SECTION

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SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Provide cast-in-place concrete work as shown on Contract Drawings and as specified herein.

B. Section includes:
1. Concrete Materials.
2. Proportioning and Mixing.
3. Ready Mixed Concrete.
4. Curing Materials.
5. Expansion Joint Filler.
6. Elastomeric Bearings.
7. Waterstops.
8. Liquid Floor Hardener.
9. Preparing for Concreting.
10. Placing of Concrete.
11. Finishing.
12. Curing.
13. Field Quality Control.

1.2 RELATED SECTIONS

A. Section 03 11 00 – Concrete Forming.

B. Section 03 20 00 – Concrete Reinforcing.

C. Section 03 60 00 – Grouting.

D. Section 07 14 00 – Fluid-Applied Waterproofing.

1.3 REFERENCES

A. American Concrete Institute (ACI) standards, most recent editions:

ACI 117	Standard Tolerances for Concrete Construction and Materials
ACI 211	Standard Practice for Selecting Proportions for Concrete
ACI 212	Chemical Admixtures
ACI 301	Specifications for Structural Concrete for Buildings
ACI 305R	Guide to Hot Weather Concreting
ACI 306R	Guide to Cold Weather Concreting
ACI 318	Building Code Requirements for Structural Concrete

ACI 350	Code Requirements for Environmental Engineering Concrete Structures

B. ASTM International (ASTM) standards, most recent editions:

ASTM C31	Standard Specification Making and Curing Concrete Test Specimens in the Field
ASTM C33	Standard Specifications for Concrete Aggregates
ASTM C39	Test for Compressive Strength of Cylindrical Concrete Specimens
ASTM C42	Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C94	Standard Specifications for Ready-Mixed Concrete
ASTM C138	Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C143	Standard Test Method for Slump of Hydraulic Cement Concrete
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C260	Specification for Air-Entraining Admixtures for Concrete
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C586	Standard Test Method for Potential Alkali Reactivity of Carbonate Rocks as Concrete Aggregates (Rock-Cylinder Method)
ASTM C595	Standard Specification for Blended Hydraulic Cements
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C827	Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
ASTM C1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)

ASTM C1293	Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction
ASTM C1567	Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM D412	Test Methods for Rubber Properties in Tension
ASTM D624	Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D746	Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D747	Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam
ASTM D1751	Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D2240	Test Method for Rubber Property - Durometer Hardness
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate

C. International Concrete Repair Institute (ICRI) standards, latest editions:

Guideline No 310.1R	Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion
Guideline No 320.2R	Guide for selecting and specifying Materials for repair of Concrete Surfaces

D. NSF International (NSF), most recent edition:

NSF 61	Drinking Water System Components, Health Effects

E. U. S. Army Corps of Engineers standards, most recent editions:

CRD-C 572	PVC Waterstops

1.4 DEFINITIONS

A. Construction Joints: Fresh concrete placed against a hardened concrete surface; joint between two pours is called a construction joint. Unless otherwise indicated, provide construction joints with a waterstop and sealant groove of the shape indicated.

B. Expansion Joints: To allow concrete to expand freely, space provided between two pours, formed as indicated. Space is made by placing filler joint material against the first pour; acts as a form for the second pour.

C. Control Joints: Provide weakened plane in concrete, where shrinkage cracks will likely occur. A groove, shape and dimensions indicated in Drawings, formed or saw-cut in concrete. Groove is filled with joint sealant material.

D. Laitance: In placement of concrete, accumulation of small inert particles of cement and aggregate on surface, caused by excess of water that, when it evaporates, leaves a thin layer, causing weakened plane for subsequent pour.

E. Alkalis: Term "alkalis" referred to herein is defined as sum of percentage of sodium oxide and 0.658 times percentage of potassium oxide ($Na_20+0.658K_20$). These oxides shall be oxide content determined in accordance with ASTM C114.

1.5 SUBMITTALS

A. Submit in accordance with Section 01 33 20 – Submittal Procedures.

B. Product data:
   1. Concrete mix design(s) proposed for use. Proposed concrete mix design submittal to include the following information:
      a. Sieve analysis and source identification of fine and coarse aggregates. Include sand equivalency.
      b. Source test results for aggregate organic impurities.
      c. Source test results for deleterious aggregate per ASTM standards.
      d. Proportioning of all materials.
      e. Type of cement with mill certificate for cement.
      f. Slump.
      g. Air Content.
      h. Brand, type, ASTM designation, and quantity of each admixture proposed for use.
      i. 28-day cylinder compressive test results of trial mixes per ACI 350 and as indicated herein.
      j. Shrinkage test results.
      k. Standard deviation value for concrete production facility.
   2. Manufacturer and type of joint filler, joint sealant, curing agent, finishing aid, and chemical floor hardener.
   3. Waterstops:
      a. Provide manufacturer’s current test reports with written material certification.
      b. Provide samples of extruded or molded sections of each size or shape to be used in the Work. Samples shall represent in all aspects, the material to be furnished under this Contract.
      c. Provide sample of fabricated cross-construction of each size or shape of waterstop to be used. Fabricate samples so that material and workmanship represent the materials to be furnished in the Work.
      d. Provide manufacturer's written certification as an integral part of the shipping form, to show that the material shipped to Work meets or exceeds the physical property requirements specified.

4. Manufacturer and type of bonding and patching mortar and bonding adhesive used at construction joints.
5. Pour plan for concrete pour sequence.

1.6 CONCRETE CONFERENCE

A. A meeting to review the detailed requirements of the Contractor's proposed concrete design mixes and to determine the procedures for producing proper concrete construction shall be held no later than 30 days after the notice to proceed.

B. All parties involved in the concrete work shall attend the conference, including the following:
1. Contractor's representative.
2. Testing laboratory representative.
3. Concrete subcontractor.
4. Reinforcing steel subcontractor and detailer.
5. Concrete supplier.
6. Admixture manufacturer's representative.

C. The conference will be held at a mutually agreed upon time and place. Notify Engineer no less than 5 days prior to the date of the conference.

1.7 QUALITY ASSURANCE

A. Preconstruction Testing: Perform all preliminary and trial batch laboratory tests on cement, aggregates, and concrete.

B. Testing Agencies: The testing laboratory shall meet or exceed the requirements of ASTM C1077.

1.8 DELIVERY, STORAGE AND HANDLING

A. Comply with Section 01 25 10 - Products, Materials, Equipment and Substitutions.

B. Mixing, transporting, handling, placing, curing, and testing concrete in accordance with applicable ACI and ASTM specifications and as specified.

C. Storage of material:
1. Cement:
a. Protect cement from exposure to moisture until used.
b. Do not use if caked or lumpy.
c. Store sacked cement to permit access for inspection and sampling.
2. Aggregate:
a. Store to prevent segregation and contamination with other sizes or foreign materials.
b. Obtain samples for testing from aggregates at point of batching.
c. Do not use frozen or partially frozen aggregates.
d. Do not use the bottom 6 inches of stockpiles in contact with ground.
e. Allow sand to drain until moisture content is uniform prior to use.
3. Admixtures:
a. Protect from contamination, evaporation, freezing, or damage.
b. Maintain within temperature range recommended by manufacturer.

c. Completely mix solutions and suspensions prior to use.

D. Delivery:

1. Prepare a delivery ticket for each load of ready-mix concrete delivered to the project. Truck operator shall hand ticket to Engineer at time of delivery, which shows the following information for each load:
   a. Mix identification mark.
   b. Quantity delivered (by volume).
   c. Amount of each material in batch.
   d. Outdoor temperature in the shade.
   e. Time at which cement was added.
   f. Amount of water added at jobsite by Contractor.
   g. Amount of superplastisizer added where applicable.

1.9 SITE ENVIRONMENTAL REQUIREMENTS

A. When temperature is below 40°F or is likely to fall below 40°F during 24-hour period after placing concrete, heat materials, (not in excess of 140°F) including both water and aggregates and protect concrete so that temperature of the concrete is between 50°F and 90°F for 24-hour period after placing concrete.

B. During hot weather, shade materials from sun and use cool water so temperature of concrete does not exceed 90°F at time of placing concrete.

C. Placing of concrete is not permitted where, in opinion of Engineer, wind, rain or inadequate facilities furnished by Contractor prevents proper finishing or curing of concrete.

1.10 COORDINATION

A. Coordination with placement of reinforcing steel, embedded items, and other Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. Expansion joint fillers:
   a. WR Meadows, Inc.
   b. NMW, Incorporated
   c. Rubberite Cypress Sponge Corporation
   d. Engineer approved equal.
2. Membrane Curing Compound.
   a. 1100-Clear, WR Meadows, Inc.
   b. Clear Resin Cure (J11w), Dayton Superior.
   c. L&M Cure R, L&M Construction Chemicals, Inc
   d. Engineer approved equal.
3. Evaporation Retardant:
   a. AquaFilm (J74), Dayton Superior.
   b. Eucobar, Euclid Chemical Company.

c. MasterKure ER 50, Master Builders.
d. Engineer approved equal.

4. Waterstops, Plastic Serrated Type:
   a. BoMetals, Inc.
   b. Durajoint, DCA Construction Products
   c. Greenstreak, Sika, Inc.
   d. Vinylex, Sika, Inc
   e. Engineer approved equal.
5. Waterstops, Plastic Adhesive Type:
   a. Lockstop, Sika, Inc.
   b. Synko-Flex, Henry Company
   c. Engineer approved equal.
6. Waterstops, Hydrophilic Type
   a. Ultraseal, Adeka, Inc.
   b. Adcor ES, WR Grace,
   c. Hydro-Flex, Henry Company.
   d. Hydrotite, Sika, Inc.
   e. Engineer approved equal.
7. Bonding agent:
   a. Armatek 110 EpoCem, Sika, Inc.
   b. Engineer approved equal.
8. Set Controlling Admixtures
   a. For air temperature at the time of placement over 80°F; set-retarding and hydration control:
      1) MasterSet Delvo, Master Builders.
      2) Recover, GCP Applied Technologies.
      3) SikaTard 440, Sika Corporation.
      4) Engineer approved equal.
   b. For air temperature at the time of placement under 40°F: Non-corrosive set accelerating:
      1) Daraset 400, GCP Applied Technologies.
      2) MasterSet FP 20, Master Builders.
      3) Plastocrete 161FL by Sika Corporation.
      4) Engineer approved equal.
9. Air-entraining Agent:
   a. MasterAir AE 200, Master Builders.
   b. Daravair 1000, GCP Applied Technologies.
   c. Sika AEA-15, Sika Corporation.
   d. Engineer approved equal.
10. Finishing Aids:
   a. Day1 Finishing Aid, Solomon Colors.
   b. Slab Assist, TK Products.
   c. Engineer approved equal.
11. Crystalline Waterproofing Repair Grout:
   a. Mortar IC, AquaFin, Inc.
   b. Penecrete Mortar, Penetron International, LTD.
   c. Concentrate Dry Pac, Xypex Chemical Corporation.
   d. Engineer approved equal.
12. Pigments for Underground Conduit Banks:
   a. Arizona Oxides, #1835.

b. Bayer, Bayferrox #130.
c. Davis, #117.
d. As currently approved by Rocky Mountain Power Company.

13. Liquid Chemical Floor Hardener:
a. Surfhard, Euclid Chemical Company, Cleveland, Ohio.
b. Burke-O-Lith, EDOCO.
c. Solidus Hardener, Lambert Corporation.
d. Engineer-approved equal.

2.2 MATERIALS

A. Blended Hydraulic Cement: Comply with ASTM C595, Type IL (10) (MS), grey color.
1. Cement shall not contain more than 0.60 percent equivalent alkalis.
2. Limestone content is limited to 10 percent.
3. Single brand of cement used throughout Work; brand approved by Engineer.

B. Fly Ash: ASTM C618, Class F including supplementary optional requirements relating to reactive aggregates and alkalis, and loss on ignition (LOI) not to exceed 5 percent.
1. Maximum of 25 percent replacement at 1.0 pounds of fly ash per pound of cement replaced.

C. Coarse Aggregate: Conforming to ASTM C33 and as noted below.
1. Clean, hard, durable gravel, crushed gravel, crushed rock or combination thereof.
2. Reactivity: Non-reactive or below innocuous behavior level.
3. Prepare and handle coarse aggregates in two or more size groups for combined aggregates with maximum size greater than 3/4 inch.
4. When aggregates are proportioned for each batch of concrete, combine the size groups.
5. Obtain coarse aggregates from sources approved by Engineer.

D. Combined Aggregates: Well graded from course to fine sizes; uniformly graded between screen sizes to produce a concrete that has optimum workability and consolidation characteristics. Where a trial batch is required for a mix design, the final combined aggregate gradation will be established during the trial batch process.

E. Fine Aggregates: Natural or combination of natural and manufactured sand that is hard and durable.
1. Lightweight Sand for Fine Aggregate: Not permitted.
2. Sand Equivalency: Tested in accordance with ASTM D2419; not less than 80 percent for an average of 3 samples; not less than 80 percent for an individual test.
3. Gradation: In accordance with ASTM C33; 15 to 30 percent passing number 50 screen; 5 to 10 percent passing number 100 screen.
4. Fineness Modulus: Not over 3.00.
5. Reactivity: Non-reactive or below innocuous behavior level.
6. Obtain fine aggregates from sources approved by Engineer.

F. Water: Clean and free from objectionable quantities of organic matter, alkali, salts, and other impurities, as determined by Engineer.

G. Admixtures:

1. Maximum total water-soluble chloride ion content contributed from all ingredients of concrete including water, aggregates, cementitious materials, and admixtures by weight percent of cement:
   a. 0.06 For prestressed concrete.
   b. 0.10 For all other concrete.
2. Do not use calcium chloride.
3. Provide admixtures of same type, manufacturer, and quantity as used in establishing required concrete proportions in the mix design.
4. Air entraining admixtures: ASTM C260.
5. Water reducing admixtures:
   a. Comply with ASTM C494, Type A.
   b. Conform to applicable provisions of ACI 212.3R.
   c. Follow manufacturer's instructions.
   d. Use chloride free admixtures only.
6. Set controlling admixtures with or without water-reducing properties.
   a. ASTM C494, Types B through E.
   b. Conform to applicable provisions of ACI 212.3R.
   c. Do not use retarding or accelerating admixtures unless specifically approved in writing by Engineer and at no additional cost to Owner.
   d. Follow manufacturer's instructions.
   e. Use chloride free admixtures only.
7. High Range Water Reducers:
   a. In accordance with ASTM C494, Type F.
   b. Conform to applicable provisions of ACI 212.3R.
   c. Locations for use of high range admixtures shall be as shown on the Contract Drawings. Do not use high range admixtures in other locations unless specifically approved by Engineer and at no additional cost to Owner.
   d. Added at the plant unless written permission is given by Engineer to add the product at the Site.
   e. Mixing: Minimum 70 revolutions or 5 minutes after addition of high-range water reducer.
   f. Slump before Addition: Maximum 2 inches.
   g. Slump after Addition: Minimum of 6 inches and maximum of 10 inches.
8. Pigments for Underground Conduit Banks: Add pigment to concrete encasing electrical duct banks as required by governing agency.

H. Curing Materials
1. Polyethylene sheet for use as concrete curing blanket shall be white and shall have a nominal thickness of 6 mils. The loss of moisture when determined in accordance with the requirements of ASTM C156 shall not exceed 0.055 grams per square centimeter of surface.
2. Polyethylene-coated waterproof paper sheeting for use as concrete curing blanket shall consist of white polyethylene sheeting free of visible defects, uniform in appearance, having a nominal thickness of 2 mils and permanently bonded to waterproof paper conforming to the requirements of Federal Specification UU B 790A (1) (2). The loss of moisture, when determined in accordance with the requirements of ASTM C156, shall not exceed 0.055 gram per square centimeter of surface.
3. Polyethylene-coated burlap for use as concrete curing blanket shall be 4 mils thick, white opaque polyethylene film impregnated or extruded into one side of the burlap. Burlap shall weigh not less than 9 ounces per square yard. The loss of moisture, when

determined in accordance with the requirements of ASTM C156, shall not exceed 0.055 gram per square centimeter of surface.

4. Membrane Curing Compound: ASTM C309, Type 1, Class B. Sodium silicate compounds will not be allowed.

I. Expansion Joint Filler

1. Provide expansion joints in concrete construction where shown on Contract Drawings.
2. Expansion Joint Filler: Preformed, non-extruding, resilient type, constructed of cellular sponge rubber, extending full thickness of slab, in accordance with ASTM D1752, Type I.

J. Grout: As specified in Section 03 60 00 – Grouting.

K. Waterstop, Plastic Serrated Type:

1. Extruded elastomeric polyvinyl chloride compound: containing plasticizers, resins, stabilizers, and other materials necessary to meet requirements of Specifications.
   a. Store waterstops to permit free circulation of air around waterstop material.
   b. Provide manufacturer's factory fabrications for intersections, transitions, and changes of direction.
   c. In accordance with Specification CRD-C572.

	VALUE	ASTM STD.
PHYSICAL PROPERTY, SHEET MATERIAL		
Tensile Strength-minimum (psi)	1750	D412, Die C
Ultimate Elongation-minimum (%)	350	D412, Die C
Low Temp. Brittle-maximum (°F)	-35	D746
Stiffness in Flexure-minimum (psi)	400	D747
ACCELERATED EXTRACTION (CRD-C572)		
Tensile Strength-minimum (psi)	1500	D412, Die C
Ultimate Elongation-minimum (%)	300	D412, Die C
EFFECT OF ALKALIES (CRD-C572)		
Change in Weight (%)	+.25/-.10	-----
Change in Durometer, Shore A	+5	D2240
FINISHED WATERSTOP		
Tensile Strength minimum (psi)	1400	D412, Die C
Ultimate Elongation minimum (%)	280	D412, Die C

   d. Style:
      1) Centerbulb, 7/8 inch OD, 6 inches long.
      2) Flat Strip, 6 inches long unless noted otherwise.
      3) Labyrinth, 4 3/8 inch long minimum

L. Waterstop, Plastic Adhesive Type: Non expansive plastic adhesive strip type conformable, manufactured solely for the purpose of preventing water from passing through construction joints.

1. Primer as recommended by waterstop manufacturer.

M. Waterstop, Hydrophilic Type: Expansive, conformable blended rubber-based material.

1. Primer as recommended by waterstop manufacturer.

N. Liquid Chemical Floor Hardener:
1. Colorless, aqueous solution containing magnesium fluosilicate combined with a wetting agent.
a. Premeasured, premixed, and packaged at the factory.
b. Not less than 2 pounds fluosilicate per gallon.
c. Provide material which does not react with, inhibit, or otherwise interfere with adhesives and bonding of future floor finishes.

O. Elastomeric Bearing Materials:
1. Rubber bearing pads shall be furnished with the dimensions, material properties, and elastomer grade as required by the Drawings and in accordance with ASTM D2240, Type A, Shore 30 or 40 Durometer.
2. Prepare concrete support surfaces and adhere pads to concrete per manufacturer's recommendations.

P. Finishing Aids:
1. Topically applied colloidal silica compound.
2. Do not use as a curing compound.
3. Only to be used to assist in finishing by working into the surface immediately after application.

Q. Waterproofing: Refer to Section 07 14 00 – Fluid-Applied Waterproofing.

2.3 EQUIPMENT

A. On-Site Batch Plants:
1. Direct weighing equipment approved by Engineer for measuring cement and aggregate. Scales certified by Bureau of Weights and Measures. Certification current within 6 months.
2. Equip mixer with suitable water meter or another measuring device approved by Engineer.
a. Meter capable of measuring water in variable amounts within a tolerance of 1 percent.
b. Water feed control mechanism capable of being locked in position to deliver constant supply of specified amount of water to each batch of concrete.
c. Meter equipped with setback register with a readily visible vertical face and double hands indicating in cubic feet and decimals.
d. Provide positive, quick-acting cut-off valve in the water line to the mixer. Operating mechanism must not leak when valves are closed.
3. Batch mixer of an approved type and size, designed to ensure uniform distribution of all component materials throughout the mass during the mixing operation. Install and use a batch timer and counter, including lock release and audible indicator on each concrete mixer.

B. Concrete Pumps:
1. Provide pumping equipment with two cylinders, designed to operate with only one cylinder in case one is not functioning. In lieu of this requirement, provide a standby pump on the site during pumping.
a. Minimum Diameter of Hose (conduit): 4 inches.
b. Aluminum conduits for conveying the concrete will not be permitted.

C. Vibrators:

1. Internally vibrated, high speed power vibrators of an approved immersion type. In sufficient numbers with standby units as required.

D. Truck Mixers:

1. At the Contractor's option, ready-mixed concrete may be used meeting the requirements as to materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C94, including the following supplementary requirements.
2. Ready-mixed concrete shall be delivered to the site of the Work, and discharge shall be completed within 90 minutes after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever is first.
3. Truck mixers shall be equipped with electrically actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.
4. Mix each batch of concrete in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.
5. Truck mixers and their operation shall be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix, and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than one inch when the specified slump is 3 inches or less, or if they differ by more than 2 inches when the specified slump is more than 3 inches, the mixer shall not be used on the Work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit, and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.
6. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the Engineer.

2.4 REINFORCEMENT STEEL

A. Provide in accordance with Section 03 20 00 – Concrete Reinforcing.

2.5 CONCRETE MIXES

A. General: Concrete shall be composed of cement, admixtures, aggregates, and water. These materials shall be of the qualities specified and in accordance with ACI 301 specifications. The exact proportions in which these materials are to be used for different parts of the Work will be determined during the trial batch. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage and, where deposited in forms, to have good consolidation properties and

maximum smoothness of surface. The aggregate gradations shall be formulated to provide fresh concrete that will not promote rock pockets around reinforcing steel or embedded items. The proportions shall be changed whenever necessary or desirable to meet the required results at no additional cost to the Owner. All changes shall be subject to review by the Engineer.

B. Fine Aggregate Composition:

1. In mix designs for structural concrete, the percentage of fine aggregate in total aggregate by weight shall be as indicated in the following table:

Fineness Modulus	Maximum Percent
2.7 or less	41
2.7 to 2.8	42
2.8 to 2.9	43
2.9 to 3.1	44

2. In all other concrete, the maximum percentage of fine aggregate of total aggregate, by weight, shall not exceed 50.

C. Concrete compressive strength, aggregate size, and slump in accordance with the following:

Type of Construction	Compressive Strength (psi)	Aggregate Gradation (ASTM C33)	Slump in Inches (Max.)	Max W/C Ratio (by Weight)
Structure walls and top slabs.	4,500	#57 (1")	4	0.45
Structure footings; foundations and bottom slabs.	4,500	#467 (1-1/2")	4	0.45
Reinforced concrete encasements; thrust blocks	4,000	#467 (1-1/2")	4	0.50
Site Slabs; Curb and gutter	4,000	#57 (1")	4	0.50
Lean Concrete	3,000	#467 (1-1/2")	5	0.60
Site underground conduit banks: Min. 3 lbs red pigment/sack cement	3,000	#8 (3/8")	5	0.60

1. Compressive Strength: minimum at 28 days of age.
2. Slump as shown above, plus or minus 1 inch.
   a. When plasticizing agents are added at the Site, measure slump before addition of any plasticizing agents.
   b. Measure at point of discharge of the concrete from delivery truck per ASTM C143.
   c. Concrete of lower than maximum slump may be used provided it can be properly placed and consolidated.
3. Minimum cement content:
   a. Reinforced Concrete: Six sacks (564 lbs) Portland Cement per cubic yard.
   b. Unreinforced Concrete: Five sacks (470 lbs) Portland Cement per cubic yard.

4. Air content: Provide air entrainment resulting in a total air content of 4 to 7 percent for all types of construction.
    a. Air content to be measured in accordance with ASTM C231, ASTM C173, or ASTM C138.
    b. Air may be omitted from interior slabs to be trowel finished.

D. Selection of Proportions:
1. General: Proportion ingredients to produce proper workability, durability, strength, and other required properties. Prevent segregation and collection of excessive free water on the surface.
2. Pan stair fill:
    a. Coarse aggregate: 100 percent passing a 1/2-inch sieve.
    b. Proportions:
        1) One sack (94 lbs) cement.
        2) 150 pounds coarse aggregate.
        3) 150 pounds fine aggregate (sand).
        4) Adjust mix to obtain satisfactory finishing.
3. Submit mix design data for approval as required by this specification Section.
4. Proportion mixture to provide desired characteristics using one of the methods described below:
    a. Method 1 (Trial Mix): Per ACI 350, Chapter 5, except as modified herein.
        1) Air content within range specified above.
        2) Record and report the temperature of trial mixes.
        3) Proportion trial mixes per ACI 211.1.
    b. Method 2 (Field Experience): Per ACI 350, Chapter 5, except as modified herein.
        1) Field test records must be acceptable to Engineer to use this method.
        2) Test records shall represent materials, proportions, and conditions similar to those specified herein.
    c. Required average strength to exceed the specified 28-day compressive strength by the amount determined or calculated in accordance with the requirements of ACI 350, using the standard deviation of the proposed concrete production facility.
5. Shrinkage Limitation
    a. Shrinkage limitations apply only to structural concrete.
    b. The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 21-day drying age or at 28-day drying age shall be 0.036 percent or 0.042 percent, respectively per ASTM C157, as modified herein.
    c. Use a mix design for construction that has first met the trial batch shrinkage requirements.

2.6 SOURCE QUALITY CONTROL

A. Trial Batch: Based on submitted concrete mixes for each class of concrete.

B. Aggregates:
1. Fine and coarse aggregates shall be tested in accordance with ASTM C1260 or ASTM C1293 to show compliance with ASTM C33 for alkali-silica reactivity and the aggregates shall be non-reactive.

2. The fine aggregate shall be tested in accordance with ASTM C40 to show compliance ASTM C33 for organic impurities.
3. The fine and coarse aggregate shall be tested in accordance with ASTM C88 to show compliance with ASTM C33.
4. The fine and coarse aggregate shall be tested in accordance with ASTM C142 to show compliance with ASTM C33.
5. The fine and coarse aggregate shall be tested in accordance with ASTM C123 to show compliance with ASTM C33.
6. The fine and coarse aggregate shall be tested in accordance with ASTM C117 to show compliance with ASTM C33.
7. The coarse aggregate shall be tested in accordance with ASTM C131 to show compliance with ASTM C33.
8. In addition to initial aggregate testing, each type of aggregate shall be tested at no increased cost to the Owner for conformance to ASTM C33 under any of the following conditions:
    a. Concrete placement extending longer than six months.
    b. There is a noticeable change in aggregate appearance, consistency, or ease of excavation.
    c. The aggregate supplier changes pits, or locations in the original pit.
9. If the test results fail to meet the requirements of ASTM C33 and this Section, the Engineer may stop the placement of concrete, and may require additional testing of aggregates or field and trial batch testing of concrete to verify conformance to ASTM C33 and the strength and shrinkage requirements of this Section.
10. The Engineer may conduct any additional testing of aggregates at any time during the concrete placement period. Depending on the test results, testing cost will be paid by Contractor or Owner, according to the General Conditions. If test data fails to conform to ASTM C33, the Engineer may stop the placement of concrete or take corrective actions as indicated above.

C. Concrete Testing:
1. Concrete testing to be performed by certified laboratory under direction of professional engineer licensed to practice in the State of Utah. Submit test results to Engineer and obtain approval prior to placement of concrete.
2. When concrete mix design is done per ACI 350, Method 1, (Trial Mix) incorporate shrinkage testing as specified herein into the mix design for all structural concrete mixes.
3. When concrete mix design is done per ACI 350, Method 2, (Field Experience), provide three drying shrinkage with seven compressive strength test specimens for approval of structural concrete mixes, using the actual materials and proportions proposed for the mixes. Provide additional trial batch testing when required by Engineer because of unsatisfactory test results.
4. Test four compression test cylinders at 7 days and three at 28 days:
    a. Determination of compressive strength in units of psi will be made in accordance with ASTM C31.
    b. Modulus of elasticity will be determined by following formula:
        1) $Ec = 33 * W * 1.5\sqrt{f'c}$
            a) Ec = Modulus of Elasticity
            b) W = Weight of Concrete, lb/ft3.
            c) f'c = Required 28 day strength, psi.
5. Drying Shrinkage Tests:

a. Perform drying shrinkage tests for the trial batch.
b. Provide one set of three specimens from each class of structural concrete.
c. Specimen Prisms: 4 inches by 4 inches by 11 inches with effective 10-inch gauge length, fabricated, cured, dried, and measured in accordance with ASTM C157, modified as follows:
    1) Remove specimens from molds at an age of 23 plus/minus 1/2 hour after trial batching; place immediately in water at 73 plus/minus 1 degree F for 30 minutes; and measure within 30 minutes thereafter to determine original length.
    2) Submerge in saturated lime water at 73 plus/minus 3 degrees F for 7 days.
    3) Remove specimens from lime water and measure length at 7 days of age. This is the base length for drying shrinkage calculations ("0" days drying age).
    4) After determining base length for drying shrinkage, store specimens immediately in a humidity control room maintained at 73 plus/minus 3 degrees F and 50 plus/minus 4 percent relative humidity for remainder of test.
    5) Make measurements to determine shrinkage expressed as percentage of base length: Report separately for 0, 7, 14, 21, and 28 days of drying age, after 7 days of moist curing.
d. Drying shrinkage deformation of each specimen shall be computed as the difference between the base length (at "0" days drying age) and the length after drying at each test age.
    1) If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004 inch, the results obtained from that specimen shall be disregarded.
    2) Compression test specimens shall be taken in each case from the same concrete used for preparing drying shrinkage specimens.

PART 3 - EXECUTION

3.1 PREPARING FOR CONCRETING

A. Earth surfaces shall be thoroughly wetted by sprinkling, prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. Surface shall be free from standing water, mud, and debris at the time of placing concrete.

B. Construct forms to the shape, lines and dimensions of members shown on Drawings and sufficiently tight to prevent leakage of mortar. Take special care when forming concrete containing high range water reducing agents. Brace and tie forms to maintain position and shape.
    1. Before placing concrete containing superplastisizing agents, Contractor shall submit a Pour Plan to Engineer for approval. Engineer may require additional manpower or equipment for these pours as required to limit defects in the concrete. The Pour Plan shall include the following:
        a. Number of crew members and assignment of each.
        b. Number of vibrators to be used.
        c. Number of vibrators in reserve.

d. Time of day and anticipated duration of pour.
e. Type and capacity of pumping equipment if used.

C. Provide slabs and beams of minimum indicated depth when sloping foundation base slabs or elevated floor slabs to drains.
1. For slabs on grade, slope top of subgrade to provide floor slabs of minimum uniform indicated depth.
2. Do not place floor drains through beams.

D. Unless otherwise indicated, provide exterior corners in concrete members with 3/4-inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise indicated.

E. Complete all formwork, installation of parts to be embedded, reinforcement and surface preparation prior to placing concrete.
1. Use setting diagrams, templates, and instructions for locating and setting embedments and attachments.
2. Prior to placing concrete, position and support pipe, conduit, dowels, and other ferrous items required to be embedded, to ensure clearance between items and any part of concrete reinforcement as specified below.
3. Securing such items in position by welding to reinforcement is prohibited.
4. Embedded electrical conduits and piping:
a. Install pipe, conduits and their sleeves passing through slabs or walls so as not to impair the strength of the concrete member.
b. Pipes and conduits larger than 3 inches in diameter may be embedded in structural concrete only after submittal and review of location and reinforcement details.
c. Pipes and conduits may be installed without the specific permission noted in paragraph b. above as follows:
1) They are 3 inches or less in diameter, are spaced not less than 3 diameters on center (horizontally and vertically) and conform to paragraph 2) and 3) below.
2) Pipes, conduits, and their sleeves embedded within a wall or slab are not larger (outside dimension) than 1/3 the overall thickness of the wall or slab in which they are embedded.
3) There is a minimum of 2 inches between the pipe or conduit and surface of the slab or wall.
d. In walls and slabs with 2 layers of reinforcement, install pipes and conduits between layers of reinforcement as close to the middle of the concrete as practical without disturbing the reinforcement. Outside diameter of the pipe or conduit shall not exceed 1/3 the slab or wall thickness. Do not space parallel and crossing runs of pipe or conduit closer than 3 diameters on center, except at cabinet and outlet box locations.
e. In slabs with a single layer of reinforcement, install under reinforcement steel with a minimum of 2 inches clear to the concrete surface.

F. Provide openings in formwork to accommodate other trades. Accurately place and securely support all items built into forms.

G. Waterstops:
1. Preparation

a. Uncoil waterstop minimum of 24 hours prior to installation for ease of handling and fabrication.
b. Position waterstop to ensure proper distance from steel reinforcing bars and to prevent rock pockets and honeycomb.
c. Clean concrete joint and waterstop after first pour to remove debris and dirt.

2. Installation
   a. Position waterstop across joints as specified herein and as indicated on Drawings.
   b. Center waterstops on joint unless shown otherwise.
   c. When centerbulb is present at moving joints, ensure that it is not embedded.
   d. All waterstops fully continuous for the extent of the joint.
   e. Secure plastic serrated waterstop in correct position before concrete placement with hog rings and wire to adjacent reinforcing steel at 12-inch maximum spacing. Center-to-center spacing may be increased upon written request and approval of Engineer.
   f. Take suitable precautions and means to support and protect waterstops during the progress of the work.
   g. Carefully place concrete without displacing waterstop from proper position.
   h. For waterstops in slabs, limit concrete placement to elevation of waterstop in first pass, vibrate concrete under waterstop, lift waterstop to confirm full consolidation without voids, then place remaining concrete to full height of slab.

3. Field Splices
   a. Only butt splices are permitted in the field. Butt splices shall be made by the method of continuous heat welding using a manufacturer-approved waterstop welding iron.
   b. Splice PVC waterstops neatly and in accordance with manufacturer's written instructions.
   c. Excessive PVC weld spatter is not acceptable.
   d. A maximum of one splice is permitted in any straight 20 feet of waterstop.

H. Construction, Expansion, and Contraction Joints:
1. Provide at locations indicated or as approved by Engineer.
2. Install construction joints in beams, slabs, and girders perpendicular to the planes of their surfaces.
3. At least 48 hours shall elapse between placing of adjoining concrete construction.
4. Before new concrete is placed against existing concrete, coat all construction joints with an approved bonding adhesive used and applied in accordance with manufacturer's instructions.

I. Thoroughly clean surfaces of metalwork to be in contact with concrete immediately before concrete is placed.

J. Remove ponded water from the excavation and moisten fill.

K. Remove laitance, tighten forms, roughen, clean, wet and slush hardened concrete with cement grout prior to placing fresh concrete at construction joints. Coat form surfaces with form release agents prior to placing reinforcing bars in forms.

L. Cylinder Storage Device

1. Provide and maintain a cylinder storage device at a protected location on the Site, acceptable to Engineer and as follows:
    a. Maintain concrete test cylinders at a temperature range of 60 degrees F to 80 degrees F for the initial 24-hour curing period.
    b. Once placed in the storage device, do not move the cylinders during this period.
    c. Equip the storage device with an automatic 24-hour temperature recorder that continuously records on a time/temperature chart with an accuracy of ±1 degree F.
    d. Have the storage device available at the point of use at least 24 hours before concrete placement.
    e. A 24-hour test run may be required before placement of concrete.
2. Engineer may stop placement of concrete if the storage device is not functional or cannot accommodate the required number of test cylinders.
3. Use water containing hydrated lime if water is to be in contact with cylinders.

3.2 PLACING CONCRETE

A. Notify Engineer not less than 24 hours in advance of the times and places at which Contractor intends to place concrete.

B. Place concrete in compliance with ACI Specifications and requirements of this Section.

C. Place concrete only in presence of duly authorized representative of Engineer.

D. Remove and replace concrete not placed as specified or of inferior quality, as determined by Engineer, and assume associated expense.

E. Ready Mix Equipment:
1. Do not exceed manufacturer's rated capacity of the mixer.
2. Ensure sufficient mixing time for uniform distribution of materials.
3. Discharge all concrete from mixer prior to mixing new batch.
4. In accordance with ASTM C94.

F. Transporting:
1. Transport concrete from mixer to place of deposit by methods, which prevent segregation or loss of material.
2. Provide runways when wheelbarrows are used to transport concrete.
3. Do not wheel conveying equipment over reinforcement or support runways on reinforcement.

G. Placing:
1. Deposit concrete in a continuous manner and as rapidly as possible within planned joints or sections.
2. Do not use concrete that has attained initial set or contained mixing water for more than 90 minutes.
3. Uniformly distribute concrete during process of depositing and in no case move deposited concrete in forms more than 6 feet in horizontal direction.
4. Do not drop freely more than 5 feet in unexposed work or more than 3 feet in exposed work; where greater drops are required, use duct or other approved method.
5. Do not place concrete against icy or frost covered earth surfaces.

H. Compacting:
   1. Compact by internal type vibrators supplemented by rodding and tamping as necessary, to maximum practicable density, free from pockets of coarse aggregate in such a manner that surfaces are smooth and free from voids.
   2. Avoid excessive vibration of concrete; avoid segregation of aggregates.
   3. Avoid disturbance of previous lifts where initial set has taken place.
   4. Use of form vibrators or tapping of forms is prohibited.

I. Finishing/Trowel Aid:
   1. Use finishing/trowel aid on horizontal surfaces where identified on Contract Drawings. The product may also be used on other horizontal surfaces at Contractor's option.
   2. Apply finishing/trowel aid directly in front of float or trowel operations and immediately finish into the concrete surface.

J. Temperature of Delivered Concrete:
   1. Maximum 90 degrees F.
   2. Minimum concrete temperature in accordance with following table:

Outdoor Temperature at Placement (In shade)	Concrete Temperature (At delivery to Site)
Below 30 Degrees F	65 Degrees F
Between 30 and 45 Degrees F	60 Degrees F
Above 45 Degrees F	50 Degrees F

   3. Heating concrete ingredients: Heat ingredients to temperature no higher than necessary to maintain specified placement temperature of concrete; maximum of 80 Degrees F.
   4. Methods of heating concrete ingredients subject to approval of Engineer.
   5. Pre-cooling of ingredients: Cool ingredients as required to maintain specified placement temperature of concrete.
   6. No additional compensation due to the foregoing requirements.

K. Concrete Protection:
   1. Protect all concrete against physical injury until final acceptance by Owner.
   2. Protect concrete from reduced strength due to weather extremes.
   3. Protect concrete that is still plastic and whenever precipitation is imminent or occurring, as determined by Engineer.
   4. When the temperature is below 40 Degrees F or is likely to fall below 40 Degrees F during the 24-hour period after placing the concrete, follow the recommendations of ACI 306R, except as modified herein.
      a. Do not place concrete on frozen ground or in contact with forms or reinforcing bars coated with frost, ice, or snow.
      b. After the mean daily temperature in the vicinity of the Project site falls below 40 degrees F for more than 1 day, maintain concrete at a temperature above 50 degrees F for at least 72 hours after it is placed, with additional requirements listed under Article 3.3 - Curing below.
      c. When removing protection, do not allow concrete to cool suddenly.
      d. Calcium chloride will not be permitted as a concrete accelerator or to thaw frozen subgrade prior to concrete placement.

5. When the temperature is 90 Degrees F or above, or is likely to rise above 90 Degrees F within the 24-hour period after concrete placement; or when there is any combination of high air temperature, low relative humidity, and wind velocity which would impair concrete strength or quality, follow the recommendations of ACI 305R and the following:
    a. Keep concrete as cool as possible during placement and curing.
    b. Do not allow concrete temperature to exceed 90 Degrees F at placement.
    c. Prevent plastic shrinkage cracking due to rapid evaporation of moisture.
    d. Dampen subgrade and forms with cool water immediately prior to placement of concrete.
    e. Apply an evaporation retardant per manufacturer's instructions between placement and finishing operations.
    f. Protect the concrete with temporary wet covering during any appreciable delay between placement and finishing.
    g. Take appropriate precautions per ACI 305R when the actual or anticipated evaporation rate equals or exceeds 0.2 LBS/SF/HR as determined from ACI 305R.

3.3 CURING

A. Cure concrete for not less than 14 days after placing as follows:
    1. Leave forms in place at least 14 days.
    2. Strictly follow careful procedures for the removal of forms and perform with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted.
    3. Keep encasement concrete, concrete cradles and anchor blocks moist until covered. The surface shall be covered with moist earth not less than 4 hours, or more than 24 hours, after the concrete is placed. Earthwork operations that may damage the concrete shall not begin until at least 7 days after placement of concrete.
    4. Concrete slabs may be cured by either of the following two methods:
        a. Method 1:
            1) After finishing slab, wet surface with a fine spray of water and cover with polyethylene-bonded waterproof paper sheeting.
            2) Lap sheets 4 inches at sides and ends and seal with adhesive tape to form a continuous watertight joint.
            3) Weigh sheeting down with wood planks to keep sheeting in contact with concrete.
            4) Repair or replace sheets immediately if damage occurs.
        b. Method 2:
            1) Cover concrete with water-saturated polyethylene-coated burlap curing mats and keep continuously wet for curing period.
            2) Lap sheets 4 inches at sides and ends and seal with adhesive tape to form a continuous watertight joint.
            3) Weigh sheeting down with wood planks to keep sheeting in contact with concrete.
            4) Repair or replace sheets immediately if damage occurs.

B. As an alternative to above referenced curing methods for formed and slab concrete, spray surface with liquid curing compound that does not affect bond of paint to concrete surface.
    1. Apply curing compound in accordance with manufacturer's instructions as soon as the concrete has hardened enough to prevent marring on unformed surfaces, and

within 2 hours after completion of finish or stripping of forms, if stripped in less than 14 days.

a. Maximum coverage rate of 200 square feet per gallon, applied in such a manner as to cover surface with a uniform film to seal thoroughly.

2. Curing vertical surfaces with a curing compound:
   a. Cover vertical surfaces with a minimum of two coats of the curing compound.
   b. Apply the first coat of curing compound immediately after form removal. Vertical surface at the time of receiving the first coat shall be damp with no free water on the surface.
   c. Allow the preceding coat to completely dry prior to applying the next coat.
   d. Vertical surface is defined as any surface steeper than 1 vertical to 4 horizontal.
3. Curing Compound: As specified herein.
4. Take care to avoid damage to seal during curing period.
5. Repair broken or damaged seals occurring before expiration of curing period by application of additional curing compound over damaged portion.
6. Do not use curing film method where construction joints are to be made

C. In hot weather, follow curing procedures outlined in ACI 305R and the following:
   1. Begin curing unformed surfaces immediately after finishing and continue for 24 hours. Curing shall consist of application and maintenance of water saturated material to all exposed surfaces; horizontal, vertical, and otherwise. After 24-hour interval, continue curing, using one of the following methods:
      a. Moist cure for six more days.
      b. Application of curing compound as specified above.
   2. Begin curing formed concrete immediately after placing. Curing shall consist of keeping forms continuously wet for 24 hours. Thereafter, continue curing, using one of the following methods:
      a. Loosen forms and position soaker hose so that water runs down along concrete surfaces. Continue for six more days.
      b. Strip forms and apply during compound as specified for vertical surfaces above. Do not allow concrete surfaces to dry prior to application of curing compound.

D. In Cold Weather, following curing procedures outlined in ACI 306R and the following:
   1. Water curing of concrete may be reduced to 6 days during periods when the mean daily temperature in the vicinity of the worksite is less than 40 degrees F; provided that, during the prescribed period of water curing, when temperatures are such that concrete surfaces may freeze, water curing shall be temporarily discontinued.
   2. Concrete cured by an application of curing compound will require no additional protection from freezing if the protection at 50 Degrees F for 72 hours is obtained by means of approved insulation in contact with the forms or concrete surfaces; otherwise, the concrete shall be protected against freezing temperatures for 72 hours immediately following 72 hours protection at 50 Degrees F. Concrete cured by water curing shall be protected against freezing temperatures for 72 hours immediately following the 72 hours of protection at 50 Degrees F.
   3. Discontinuance of protection against freezing temperatures shall be such that the drop in temperature of any portion of the concrete will be gradual and will not exceed 40 Degrees F in 24 hours. In the spring, when the mean daily temperature rises above 40 Degrees F for more than 3 successive days, the specified 72-hour protection at a temperature not lower than 50 degrees F may be discontinued for as long as the mean

daily temperature remains above 40 Degrees F; provided, that the concrete shall be protected against freezing temperatures for not less than 48 hours after placement.

4. Where artificial heat is employed, special care shall be taken to prevent the concrete from drying. Use of unvented heaters will be permitted only when unformed surfaces of concrete adjacent to the heaters are protected for the first 24 hours from an excessive carbon dioxide atmosphere by application of curing compound; provided, that the use of curing compound for such surfaces is otherwise permitted by these Specifications

3.4 TREATMENT OF SURFACE DEFECTS

A. As soon as forms are removed, all exposed surfaces shall be carefully examined, and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until after inspection by the Engineer. In no case will extensively patching honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall have them repaired as specified herein. Remove and replace concrete containing extensive voids, holes, honeycombing, or similar depression defects. Promptly execute all repairs and replacements herein specified at no additional expense to Owner.

B. Perform all repairs in accordance with the manufacturer's recommendations and with ICRI Guideline No 310.1R and Guideline No 320.2R. Follow these guidelines for removal geometry, exposing and undercutting reinforcing steel, cleaning and repair of reinforcing steel, and edge and surface condition of concrete, regardless of the amount of corrosion present or not present in the reinforcing steel.

1. Remove unsound deteriorated concrete from Work by high pressure water blasting machines capable of scoring concrete surfaces to minimum amplitude roughness of 3/16-inch. Remove to provide for minimum thickness specified for mortar. If reinforcing is exposed in this process, remove additional concrete until the surface is a minimum of 1-inch or 1 bar diameter behind the exposed reinforcing.
2. Clean exposed reinforcing bars of rust and other deleterious materials which may prevent bonding of the repair product.
3. Keep surface at saturated surface dry (SSD) condition for a minimum of 24-hours prior to placement of repair material.
4. Place and cure repair grout as specified in Section 03 60 00 – Grouting and in accordance with manufacturer's written recommendations.
5. For exposed walls, include a portion of white Portland cement as required to make the color of the patch match the color of the surrounding concrete.

C. Ream holes left by tie-rod cones with suitable toothed reamers to leave the surfaces of the holes clean and rough. Repair these holes in an approved manner with dry-packed cement grout specified in Section 03 60 00 - Grouting. Do not ream holes left by form-tying devices having a rectangular cross-section, and other imperfections having a depth greater than their least surface dimension but repair them in an approved manner with dry-packed cement grout specified in Section 03 60 00 - Grouting.

D. Build up and shape repairs in such a manner that the completed Work will conform to the requirements of this Section, as applicable, using approved methods which will not disturb the bond, cause sagging, or cause horizontal fractures. Cure surfaces of said repairs as required for the concrete in the repaired section.

E. Prior to filling any structure with water, repair all cracks that may have developed by grooving and filling as shown on the Contract Drawings. Perform this repair method on the water bearing face of members. Prior to backfilling, repair cracks on faces of members in contact with fill, which are not covered with a waterproofing membrane, as specified herein.

3.5 PATCHING HOLES IN CONCRETE

A. Patching Small Holes
   1. Fill holes which are less than 12 inches in their least dimension and extend completely through concrete members, as specified herein.
   2. Fill small holes in members which are water-bearing or in contact with soil or other fill material, with nonshrink grout specified in Section 03 60 00 - Grouting. Where a face of the member is exposed to view, hold the nonshrink grout back 2 inches from the finished surface. Patch the remaining 2 inches according to the paragraph in Part 3 entitled "Treatment of Surface Defects."
   3. Fill small holes through all other concrete members with nonshrink grout, with exposed faces treated as above.

B. Patching Large Holes
   1. For holes which are larger than 12 inches in their least dimension, provide a keyway chipped into the edge of the opening all around, unless a formed keyway exists. Fill holes with concrete as specified herein.
   2. For holes which are larger than 24 inches in their least dimension and which do not have reinforcing steel extending from the existing concrete, set reinforcing steel in drilled holes and epoxy grout as specified in Section 03 60 00 – Grouting. Match the reinforcing added to the reinforcing in the existing wall unless otherwise shown.
   3. For large holes in members which are water bearing or in contact with soil or other fill, place either a hydrophilic type or a plastic adhesive type waterstop material around the perimeter of the hole as specified herein, unless there is an existing waterstop in place.

3.6 CONCRETE FINISH

A. General: Provide surfaces free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, with finished, smooth, continuous hard surface. Allowable deviations from plumb or level and from the alignment, profiles, and dimensions shown are defined as tolerances and are specified herein. These tolerances are to be distinguished from irregularities in finish as described herein.

B. Do not use aluminum finishing tools.

C. Formed Surfaces:
   1. Exterior buried surfaces require no treatment after form removal except for curing, repair of defective concrete, and treatment of surface defects.
   2. Finish surfaces exposed to view as specified under "Architectural Concrete Finish" below.

D. Surface holes larger than 1/2 inch in diameter or deeper than 1/4-inch are defined as surface defects in basins and exposed walls.

E. Unformed Surfaces: After proper and adequate vibration and tamping, bring all unformed top surfaces of slabs, floors, walls, and curbs to a uniform surface with suitable tools. Immediately after the concrete has been screeded, treated with a liquid evaporation retardant. Use the retardant again after each operation as necessary to prevent drying shrinkage cracks. The classes of finish specified for unformed concrete surfaces are designated and defined as follows:

1. Finish U1 – Sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8 inch. No further special finish is required.
2. Finish U2 After sufficient stiffening of the screeded concrete, float finish surfaces with wood or metal floats or with a finishing machine using float blades. Excessive floating of surfaces while the concrete is plastic and dusting of dry cement and sand on the concrete surface to absorb excess moisture will not be permitted. Minimize floating as necessary to produce a surface that is free from screed marks and is uniform in texture. Surface irregularities are limited to 1/4-inch. Tool joints and edges where shown or as determined by the Engineer.
3. Finish U3 After the floated surface (as specified for Finish U2) has hardened sufficiently to prevent excess of fine material from being drawn to the surface, steel trowel with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes, ripples, and trowel marks. Provide finish that is smooth and free of all irregularities.
4. Finish U4 Steel trowel finish (as specified for Finish U3) without local depressions or high points. In addition, lightly broom the surface with broom lines perpendicular to drainage unless otherwise shown. The resulting surface shall be rough enough to provide a nonskid finish.

F. Floor Hardener:

1. Apply to all exposed concrete floor surfaces.
2. Apply after concrete has cured minimum 7 days.
3. Apply in accordance with manufacturer's recommendations.
4. Keep floors covered and free of traffic and loads for a minimum of 10 days after completion.

3.7 ARCHITECTURAL CONCRETE FINISH

A. General: Architectural finish is required for permanently exposed concrete surfaces and in other locations where specifically called out on the Contract Drawings.

1. Immediately after the forms have been stripped, inspect the concrete surface, and repair any poor joints, voids, rock pockets, or other defective areas. Fill all form-tie holes as indicated herein.
2. Do not apply architectural finishes until the concrete surface has been repaired as required and the concrete has cured at least 14 days.
3. Conform all architecturally treated concrete surfaces to the accepted sample required herein in texture, color, and quality. Maintain and protect the concrete finish.

B. Smooth Concrete Finish

1. Wet the concrete surface and apply grout with a brush. Use grout made by mixing one part Portland cement and one part fine sand that will pass a No. 16 sieve with sufficient water to give it the consistency of thick paint. Use 1/2 gray and 1/2 white Portland Cement as determined by Engineer. Vigorously rub the freshly applied grout into the concrete surface with a wood float filling all small air holes. After all the surface grout has been removed with a steel trowel, allow the surface to dry and,

when dry, vigorously rub with burlap to remove completely all surface grout so that there is no visible paint-like film of grout on the concrete. Complete the entire cleaning operation for any area the day it is started and leave no grout on the surface overnight.

2. Terminate cleaning operations for any given day at panel joints. It is essential that the various operations be carefully timed to secure the desired effect which is a light-colored concrete surface of uniform color and texture without any appearance of a paint or grout film.
3. If improper manipulation results in an inferior finish, rub such inferior areas with carborundum bricks.
4. Before beginning any of the final treatment on exposed surfaces, treat in a satisfactory manner, a trial area of at least 200 square feet in some inconspicuous place selected by the Engineer and preserve said trial area undisturbed until the completion of the job.

3.8 WATERPROOFING

A. Apply waterproofing to exterior surface of all buried roof slabs and walls of underground concrete structures.

B. Refer to Section 07 14 00 – Fluid-Applied Waterproofing.

3.9 TOLERANCES:

A. Construction Tolerances: Set and maintain concrete forms and perform finishing operations so as to ensure that the completed Work is within the tolerances specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the specified permissible variation from lines, grades, or dimensions shown. Where tolerances are not stated in the Specifications, permissible deviations will be in accordance with ACI 117.

1. The following non-cumulative construction tolerances are hereby established and apply to finished walls and slab unless otherwise shown:

Item	Tolerance
Variation of the constructed linear outline from the established position in plan.	In 10 feet: 1/4 inch In 20 feet or more: 1/2 inch
Variation from the level or from the grades shown.	In 10 feet: 1/4 inch In 20 feet or more: 1/2 inch
Variation from plumb.	In 10 feet: 1/4 inch In 20 feet or more: 1/2 inch
Variation in the thickness of slabs and walls.	Minus 1/4 inch Plus 1/2 inch
Variation in the locations and sizes of slabs and wall openings.	Plus or minus 1/4 inch

3.10 FIELD QUALITY CONTROL

A. General

1. Tests on component materials and for slump, temperature, air content, unit weight, compressive strength and shrinkage of concrete will be performed as specified herein.

2. The cost of all laboratory tests for qualification of mix designs on cement, aggregates, and concrete, including strength and shrinkage testing will be borne by Contractor. The cost of all field-testing during construction, including slump, temperature, air, strength, and shrinkage will also be borne by Owner. However, Contractor will be charged for the cost of any additional tests and investigation on work performed which does not meet the Specifications.
3. Provide access for Engineer to aggregate stockpiles for concurrent sampling during construction.
4. Provide access for Engineer to batch plant for monitoring batching procedures during construction.
5. Supply concrete for testing at no additional cost to Owner. Assist Engineer in obtaining samples, and disposal and cleanup of excess material.
6. Take composite samples of concrete placed in the Work in accordance with ASTM C172 from the first placement of each class of concrete and at the following minimum frequency for each class:
    a. Not less than one sample per day on which concrete is placed.
    b. Not less than one sample for each 50 cubic yards of concrete placed.
    c. Not less than one sample for each 5,000 square feet of surface area for slabs or walls.
    d. Not less than 5 samples from randomly selected batches for the Work.

B. Slump Tests
1. Perform in accordance with requirements of ASTM C143 at frequency indicated for sampling above.

C. Temperature Tests
1. Test concrete temperature per ASTM C1064 at frequency indicated for sampling above.

D. Air Content Tests
1. Test air content per ASTM C231 at frequency indicated for sampling above.

E. Unit Weight
1. Test unit weight per ASTM C138 at frequency indicated for sampling above.

F. Shrinkage Tests
1. Drying shrinkage tests will be made for the first placement of each class of structural concrete, and during construction every 3 months to ensure continued compliance with these Specifications. Make A minimum of 1 test per structure shall be made regardless of the timing.
2. Drying shrinkage specimens shall be 4-inch by 4-inch by 11-inch prisms with an effective gage length of 10 inches, fabricated, cured, dried, and measured in accordance with ASTM C157 as modified in this Section.
3. The maximum concrete shrinkage for specimens cast in the field may not exceed the trial batch maximum shrinkage test value by more than 25 percent.
    a. If the required shrinkage limitation is not met during construction, take any or all the following actions, at no additional cost to the Owner, for securing the specified shrinkage requirements. These actions may include changing the source or aggregates, cement and/or admixtures; reducing water content; washing of aggregate to reduce fines; increasing the number of construction

joints; modifying the curing requirements; or other actions designed to minimize shrinkage or the effects of shrinkage.

G. Field Compression Tests
1. Field compression test specimens will be made at the frequency indicated for sampling above.
2. Each set of test specimens will be a minimum of five cylinders.
3. Make compression test specimens for concrete in accordance with ASTM C31. Specimen size: Cylinders, 6-inch diameter by 12-inch high.
4. Perform compression tests in accordance with ASTM C 39. Test one cylinder at 7 days and two at 28 days. The remaining cylinders will be held to verify test results, if needed.

H. Evaluation and Acceptance of Concrete
1. Evaluation and acceptance of the compressive strength of concrete will be according to the requirements of ACI 350 and as specified herein.
2. A statistical analysis of compression test results will be performed according to the requirements of ACI 214. The standard deviation of the test results may not exceed 640 psi, when ordered at equivalent water content as estimated by slump.
3. If any concrete fails to meet these requirements, take immediate corrective action to increase the compressive strength for all subsequent batches of the type of concrete affected.
4. When the standard deviation of the test results exceeds 640 psi, the average strength for which the mix is designed shall be increased by an amount necessary to satisfy the statistical requirement that the probability of any test being more than 500 psi below or the average of any three consecutive tests being below the specified compressive strength is 1 in 100. Calculate the required average strength using Criterion No. 3 of ACI 214 with the actual standard of deviation.
5. All concrete which fails to meet the ACI requirements and these Specifications, is subject to removal and replacement at no increase in cost to the Owner.

3.11 APPLICATION OF LOADS

A. Do not allow traffic, construction equipment, or materials of any kind to be placed on elevated concrete slabs until the concrete has attained a minimum age of 7 days and 80% of the minimum specified 28-day strength as proven by concrete strength tests.

B. Do not place backfill against cantilevered walls until the concrete has attained a minimum age of 7 days and 100% of the minimum specified 28-day concrete strength as proven by concrete strength tests.

C. Do not place backfill against walls that are tied to elevated slabs or decks until both the slabs and walls have attained a minimum age of 7 days and 80% of the minimum specified 28-day strength as proven by concrete strength tests.

3.12 SCHEDULES

A. Grout: As specified in Section 03 60 00 – Grouting.

B. Unformed Concrete Surfaces: Apply finish as follows.

Area	Finish
Grade slabs and foundations to be covered with concrete or fill material	U1
Floors to be covered with grouted tile or topping grout	U2
Slabs not water bearing	U4
Slabs to be covered with built-up roofing	U2
Interior and exterior slabs where Drawings require only light broom finish	U4
Interior slabs and finished floors with architectural finishes	U3
Top surface of walls	U3

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SECTION 03 60 00
GROUTING

PART 1 - GENERAL

1.1 SUMMARY

A. Work includes various types of cementitious grout to be provided and installed per the Contract Documents

B. Section includes the following types of grout:
1. Cement grout.
2. Nonshrink grout.
3. Epoxy grout.
4. Grout for repair of concrete.
5. Pump and motor grout.
6. Concrete topping gout and concrete fill.

1.2 RELATED SECTIONS
1. Section 03 30 00 – Cast-in-Place Concrete

1.3 REFERENCES

A. American Concrete Institute (ACI) standards, most recent editions:

ACI 318	Building Code Requirements for Reinforced Concrete
ACI 308	Standard Practice for Curing Concrete

B. American Society for Testing and Materials (ASTM) standards, most recent editions:

ASTM C78	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C94	Standard Specifications for Ready-Mixed Concrete
ASTM C109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
ASTM C307	Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings
ASTM C348	Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars
ASTM C469	Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression
ASTM C531	Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.

ASTM C579	Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
ASTM C827	Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
ASTM C882	Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete By Slant Shear
ASTM C884	Standard Test Method for Thermal Compatibility Between Concrete and an Epoxy-Resin Overlay
ASTM C939	Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
ASTM C1090	Standard Test Method for Measuring Changes in Height of Cylindrical Specimens of Hydraulic-Cement Grout
ASTM C1107	Packaged Dry, Hydraulic Cement Grout (Nonshrink)
ASTM C1181	Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts
ASTM C1202	Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration
ASTM C1339	Standard Test Method for Flowability and Bearing Area of Chemical-Resistant Polymer Machinery Grouts
ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D696	Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C With a Vitreous Silica Dilatometer
ASTM E329	Standard Specification for Agencies Engaged in Construction Inspection and/or Testing

C. International Concrete Repair Institute (ICRI) standards, latest editions:

Guideline No 310.1R	Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion
Guideline No 320.2R	Guide for selecting and specifying Materials for repair of Concrete Surfaces

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 20 – Submittal Procedures.

B. Product Data:
   1. Submit certified test results verifying the compressive strength, shrinkage, and expansion requirements indicated herein.
   2. Submit manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of nonshrink and epoxy grout used in the Work.

C. Certification:
   1. Provide manufacturer's independent certification of compliance with ASTM C1107 without modification to the standard methods certifying that the Class B or C grout's post-hardening non-shrink properties are not based on gas expansion.
   2. Provide Manufacturer's certification that grouts have strengths of 3500 psi at 1 day, 6500 psi at 3 days and 7500 psi at 28 days when cured at 72 degrees F as well as meeting the 3, 7, and 28-day strengths when tested and cured at the 45 deg F and 95 degree F limits and all other requirements of ASTM C1107.
   3. The Contractor shall engage an independent testing laboratory to run a 24-hour grout evaluation in accordance with ASTM C1107 of each grout submitted for approval showing compliance with all aspects of the evaluation. Submit results to the Engineer for review.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with Section 01 25 10 - Products, Materials, Equipment and Substitutions.

B. Maintain all materials clean, dry and protected against dampness, freezing and foreign matter.
   1. Store non-shrink grout materials in temperature controlled environments above 40 degrees F and below 90 degrees F.
   2. Store epoxy grout components in temperature controlled environments above 60 degrees F and below 90 degrees F.

C. Deliver epoxy resin, hardener, and aggregate in sealed pre-measured containers, palletized, and shrink-wrapped to prevent shipping damage.

D. Immediately remove from the Project site any cement-based grout material which becomes damp or otherwise defective.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
   1. Nonshrink, nonmetallic grout:
      a. 5 Star Grout, Five Star Products, Inc.
      b. Masterflow 928, BASF Building Systems, Inc.
      c. NS Grout, Euclid Chemical Company.
      d. Sika Grout 212, Sika Corporation.
      e. Engineer approved equal.
   2. Epoxy grout:

a. HP Epoxy Grout, Five Star Products, Inc.
b. Masterflow 648 CP Plus, BASF Building Systems, Inc.
c. E3-Flowable, Euclid Chemical Company.
d. Sikadur 42 Grout-Pak, Sika Corporation.
e. Engineer approved equal.

3. Grout for pumps and motors:
a. Escoweld, ITW Polymer Technologies.
b. Chockfast Red, ITW Polymer Technologies.
c. DP Epoxy Grout, Five Star Products, Inc.
d. Engineer approved equal.

2.2 CEMENT GROUT

A. Cement grout shall be composed of one-part cement, three parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white Portland cement shall be blended with regular cement as needed. The minimum compressive strength at 28 days shall be 4,500 psi.

B. Cement grout materials shall be as specified in Section 03 30 00 – Cast-in-Place Concrete.

2.3 NONSHRINK GROUT

A. Non-shrink grout shall be a prepackaged, inorganic, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water.

B. Cement from kilns burning metal-rich hazardous waste fuel shall not be used.

C. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout herein shall be that recommended by the manufacturer for the particular application. All grouts (Grade B or C) shall be tested for height change of the hardened grout at 1, 3, 14, and 28 days in accordance with ASTM C1090 and shall be tested for compression at 1, 3, 7, and 28 days in accordance with the modified ASTM C109 testing procedure.

D. Class A non-shrink grouts: Not used.

E. Class B or C high precision, fluid, extended working time, non-shrink grouts:
1. Minimum 28-day compressive strength of 7500 PSI.
2. No shrinkage (0.0 percent) and a maximum of 4.0 percent expansion in the plastic state when tested in accordance with ASTM C827.
3. No shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state
4. When mixed to a fluid consistency of 20 to 30 seconds per ASTM C939 at temperature extremes of 45 to 90 degrees F shall have an extended working time of 30 minutes when tested in accordance with ASTM C1107.

F. Application:
1. Class B or C non-shrink grout shall be used for grouting under all base plates for structural steel members, grouting under all equipment base plates except for pumps and motors, and at all locations where grout is required by the Contract Documents except where epoxy grout or grout for pumps and motors is specifically required.

Class B or C non-shrink grout shall be used in place of Class A non-shrink grout for all applications. Class B or C non-shrink grout shall not be used for dry packing applications or repair of concrete.

2.4 EPOXY GROUT

A. Epoxy grout shall be a pourable, nonshrink, 100 percent solids system. The epoxy grout system shall have three components: resin, hardener, and specially blended aggregate, all premeasured and prepackaged. The resin component shall not contain any nonreactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged. The chemical formulation of the epoxy grout shall be as recommended by the manufacturer for the particular application.

B. The mixed epoxy grout system shall have a minimum working life of 45 minutes at 75 degrees F.

C. The epoxy grout shall develop a compressive strength of 5,000 psi in 24 hours and 10,000 psi in 7 days when tested in accordance with ASTM C579, Method B. There shall be no shrinkage (0.0 percent) and a maximum 4.0 percent expansion when tested in accordance with ASTM C827.

D. The epoxy grout shall exhibit a minimum effective bearing area of 95 percent. This shall be determined by testing in accordance with ASTM C1339, for bearing area and flow.

E. The peak exotherm of a 2-inch diameter by 4-inch high cylinder shall not exceed 95 degrees F when tested with 75 degree F material at laboratory temperature. The epoxy grout shall exhibit a maximum thermal coefficient of 30 x 10-6 inches/inch/degree F when tested according to ASTM C531 or ASTM D696.

F. Application:
   1. Epoxy grout shall be used to embed all anchor bolts and reinforcing steel required to be set in grout and for all other applications in the Contract Documents where grout type is not specifically indicated.

2.5 GROUT FOR REPAIR OF CONCRETE

A. Vertical, overhead, and shotcrete applications:
   1. Shall not produce a vapor barrier.
   2. One component, reoplastic, cement based, shrinkage compensated, non-expansive, gray concrete product.
   3. Sprayable, extremely low permeability, sulfate resistant, easy to use and requiring only the addition of water.
   4. Free of chlorides and other chemicals causing corrosion with the following properties:
      a. Minimum Slant Shear Bond Strength: 2500 PSI at 28 days when tested in accordance with ASTM C882.
      b. Minimum Compressive strength: 6,500 PSI at 28 days when tested in accordance with ASTM C109.
      c. Minimum Tensile Bond Strength: 200 PSI at 28 days per ASTM C307.

d. Minimum Flexural Strength: 1,200 PSI when tested in accordance with ASTM C348.
e. Modulus of Elasticity: 3.6E6 PSI when tested in accordance with ASTM C469.
f. Maximum Rapid Chloride Permeability: 772 coulombs when tested in accordance with ASTM C1202.

B. Horizontal and formed applications:
1. Shall not produce a vapor barrier.
2. One component, reoplastic, cement-based, shrinkage compensated, non-expansive, gray concrete product.
3. Flowable, extremely low permeability, sulfate resistant, easy to use and requiring only the addition of water.
4. Free of chlorides and other chemicals causing corrosion with the following properties:
a. Minimum Shear Bond Strength: 2150 PSI at 7 days.
b. Minimum Compressive Strength: 6000 PSI at 7 days when tested in accordance with ASTM C109.
c. Minimum Flexural Strength: 770 PSI at 28 days when tested in accordance with ASTM C78.
d. Maximum Chloride Permeability: 1,000 coulombs when tested in accordance with ASTM C1202.
e. Modulus of Elasticity: 4.8E6 PSI when tested in accordance with ASTM C469.

2.6 GROUT FOR PUMPS AND MOTORS

A. Grout for pumps and motors shall be epoxy grouts meeting the following minimum requirements:
1. Creep shall be less than 0.005 in/in when tested by ASTM C1181 method. The test shall be at 70 degrees F and 140 degrees F with a load of 400 PSI.
2. Linear shrinkage shall be less than 0.080 percent and thermal expansion less than 17E-6 in/in/degree F when tested by ASTM C531.
3. The compressive strength shall be a minimum of 12,000 PSI in 7 days when tested by ASTM C579 Method B, modified.
4. Bond strength of grout to Portland cement concrete shall be greater than 2,000 PSI when using ASTM C882 test method.
5. Grout shall pass the thermal compatibility test when overlaid on Portland cement concrete using test method ASTM C884.
6. Tensile strength and modulus of elasticity shall be determined by ASTM D638. The tensile strength shall not be less than 1,700 PSI and the modulus of elasticity shall not be less than 1.8E6 PSI.
7. Peak exothermic temperature shall not exceed 110 degrees F when a specimen 6 inches in diameter by 12 inches high is used. Gel time shall be at least 150 minutes.
8. The grout shall be suitable for supporting precision machinery subject to high impact and shock loading in industrial environments while exposed to elevated temperatures as high as 150 degrees F, with a load of 2,000 PSI.

B. Primer, if required, shall conform to the written recommendations of the grout manufacturer.

C. Surface preparations shall conform to the written recommendations of the grout manufacturer.

D. Placement and Curing

1. Placement and curing procedures shall be in accordance with the written recommendations of the grout manufacturer.
2. A grouting performance demonstration/training session shall be conducted by the grout manufacturer's representative prior to foundation and baseplate preparation and the first grouting on site. This training session shall demonstrate proper preparation and installation methods and that the grouting material meets the strength requirements.

2.7 CONCRETE TOPPING GROUT AND CONCRETE FILL

A. Grout for topping of slabs and concrete fill for built up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures as necessary, with strength as specified above.

B. Where concrete topping is deeper than 6 inches, it will be considered "Concrete Fill" and may be placed using either grout as specified herein or "lean concrete", as specified in Section 03 30 00 – Cast-In-Place Concrete, when approved by Engineer.

2.8 CURING MATERIALS

A. Curing materials shall be as specified in Section 03 30 00 – Cast-In-Place Concrete for cement grout and as recommended by the grout manufacturer for prepackaged grouts.

2.9 CONSISTENCY

A. Use grouts with the consistency necessary to completely fill space to be grouted for the particular application. Where "dry pack" is called for in the Contract Documents, use grout with a consistency such that the grout is plastic and moldable but will not flow.

B. Regardless of consistency called for on the Contract Documents, the type of grout to be used shall be as indicated herein for the particular application.

2.10 MEASUREMENT OF INGREDIENTS

A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement will not be allowed.

B. Prepackaged grouts shall have ingredients measured by means recommended by the grout manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. All surface preparation, curing, and protection of cement grout shall be as indicated in Section 03 30 00 – Cast-In-Place Concrete. The finish of the grout surface shall match that of the adjacent concrete.

B. Do not place grout on concrete or masonry substrates until those substrate materials have attained 28-day design strength unless authorized by Engineer.

3.2 MANUFACTURER'S SERVICES

A. The manufacturer of nonshrink grout and epoxy grout shall provide onsite technical assistance upon request.

B. Coordinate with the manufacturer all demonstrations, training sessions, and applicable site visits. The grout manufacturer shall conduct onsite, demonstration and training sessions for bleed tests, mixing, flow cone measurements, cube testing, application, and curing for each category and type of grout.

C. Training by the manufacturer is required for all types of grout installations. Grout manufacturer's representative shall train Contractor to perform the grout Work including mixing of grouts to required consistency, testing, placing, and curing on actual project base plates, tie holes, rock pockets, and other applications.

3.3 GROUTING PROCEDURES

A. Prepackage Grouts: All mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

B. Base Plate Grouting:
   1. For base plates, the original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a 1 inch thickness of grout or a thickness as indicated on the Contract Drawings.
   2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout. The mixture shall be of a trowelable consistency and tamped or rodded solidly into the space between the plate and the base concrete. A backing board or stop shall be provided at the back side of the space to be filled with grout. Where this method of placement is not practical or where required by Engineer, alternate grouting methods shall be submitted for acceptance by Engineer.

C. Concrete Topping Grout:
   1. All mechanical, electrical, and finish Work shall be completed prior to placement of concrete topping or concrete fill. The base slab shall be given a roughened textured surface by sandblasting or hydroblasting exposing the aggregates to ensure bonding to the base slab.
   2. The minimum thickness of grout topping and concrete fill shall be one inch. Where the finished surface of concrete fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 6-inches wide by 1-1/2 inches deep.
   3. The base slab shall be thoroughly cleaned and wetted prior to placing topping and fill. No topping concrete shall be placed until the slab is complete free from standing pools or ponds of water. A thin coat of neat Type II cement grout shall be broomed into the surface of the slab just before topping of fill placement. The topping and fill shall be compacted by rolling or tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in

accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade.

4. Concrete topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.
5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping and fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement or mixture of dry cement and sand shall be applied to the surface.

D. Grout for Repair of Concrete

1. All repairs shall be performed in accordance with the manufacturer's recommendations and with ICRI Guideline No 310.1R and Guideline No 320.2R. These guidelines shall be followed for removal geometry, exposing and undercutting of reinforcing steel, cleaning and repair of reinforcing steel, and edge and surface condition of concrete and shall be followed regardless of the amount of corrosion present or not present in the reinforcing steel.
2. Remove unsound deteriorated concrete from Work by high pressure water blasting machines capable of scoring concrete surfaces to minimum amplitude roughness of 3/16-inch. Remove to provide for minimum thickness specified for mortar. If reinforcing is exposed in this process, then additional concrete shall be removed until the surface is a minimum of 1-inch or 1 bar diameter behind the exposed reinforcing.
3. Clean exposed reinforcing bars of rust and other deleterious materials which may prevent bonding of the repair product.
4. Keep surface at saturated surface dry (SSD) condition for a minimum of 24-hours prior to placement of repair material.
5. Place material in accordance with Manufacturer's written recommendations.
6. Cure material continuously for 7-days with water fog nozzles or other applications which provide a continuous wet curing of the repaired area in accordance with ACI 308.

E. CONSOLIDATION

1. Grout shall be placed in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

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DIVISION 05
METALS

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SECTION 05 50 00
METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish, fabricate, and install metal fabrications in accordance with Contract Documents.

1.2 RELATED SECTIONS

A. Section 05 52 13 – Pipe and Tube Railings

B. Section 09 90 00 – Painting and Coating

C. Section 09 90 10 – Pipeline Coatings and Linings

1.3 REFERENCES

A. ASTM International (ASTM) standards, most recent editions:

ASTM A6	Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A36	Specification for Structural Steel
ASTM A47	Standard Specification for Ferritic Malleable Iron Castings
ASTM A48	Gray Iron Castings
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A123	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
ASTM A197	Standard Specification for Cupola Malleable Iron
ASTM A276	Standard Specification for Stainless Steel Bars and Shapes
ASTM A307	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A325	Specification for Structural Bolts, Steel Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A563	Specification for Carbon and Alloy Steel Nuts

ASTM A653	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A666	Standard Specification for Annealed or Cold-Worked Austenitic Stainless-Steel Sheet, Strip, Plate, and Flat Bar
ASTMA668	Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A780	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A1085	Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)
ASTM B209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B211	Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire
ASTM B221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B308	Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles
ASTM B429	Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM F593	Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Standard Specification for Stainless Steel Nuts
ASTM F1554	Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

B. American National Standards Institute (ANSI) standards, most recent editions:

ANSI A14.3	Standard for Ladders - Fixed - Safety Requirements

C. American Welding Society (AWS) Standards, most recent editions:

AWS D1.1	Structural Welding Code – Steel
AWS D1.2	Structural Welding Code – Aluminum
AWS D1.6	Structural Welding Code – Stainless Steel
AWS QC1	Specification for AWS Certification of Welding Inspectors

AWS Welding Handbook

D. American Water Works Association (AWWA) standards, most recent editions:

AWWA C105	American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C217	Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines

E. National Sanitation Foundation (NSF), most recent edition:

NSF 61	Drinking Water System Components, Health Effects.

F. Federal Specifications:

MIL-A-907E	Anti-seize Thread Compound, High Temperature

G. Occupational Safety and Health Administration (OSHA), most recent editions:

OSHA 1910.27	Fixed Ladders

H. Society for Protective Coatings (SSPC):

SSPC-PA 1	Shop, Field, and Maintenance Painting of Steel

1.4 DEFINITIONS

A. Metal Fabrications: Defined as items to be fabricated from metal shapes, plates, or bars and their products.

1.5 SUBMITTALS

A. Submit in accordance with Section 01 33 20 – Submittal Procedures.

B. Shop Drawings: Submit shop drawings of all metal fabrications to the Engineer for review.
   1. Shop drawings detailing fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other Sections.
   2. Submit layout drawings for grating showing the direction of span, type and depth of grating, size and shape of grating panels, seat angle details, and details of grating hold down fasteners. Submit load and deflection tables for each style and depth of grating used.

C. Submit ICC-ES report listing the ultimate load capacity in tension and shear for each size and type of concrete anchor submitted. Submit manufacturer's recommended installation instructions and procedures for adhesive anchors. Upon review, by Engineer, these instructions shall be followed specifically.

D. No substitution for the indicated adhesive anchors will be considered unless accompanied by an ICC-ES report verifying strength and material equivalency, including temperature at which load capacity is reduced to 90 percent of that determined at 75 degrees F.

1.6 QUALITY ASSURANCE

A. All weld procedures and welder qualifications shall be available in the Contractor's field office for review.

B. Qualification of Welders: Use welders with current certifications (previous 12 months) for the material, type, and position of welding used. Certify in accordance with AWS Specifications according to the following:
   1. AWS D1.1, Structural Welding Code – Steel.
   2. AWS D1.2, Structural Welding Code – Aluminum.
   3. AWS D1.6, Structural Welding Code – Stainless Steel.

C. Furnish a welding inspector who is qualified in accordance with AWS requirements and approved by Engineer. Inspector to inspect all welding.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with Section 01 25 10 - Products, Materials, Equipment and Substitutions.

B. Metal fabrications shall be loaded for transport in such a manner that they may be transported and unloaded without being excessively stressed, deformed, or otherwise damaged.

C. Protect metal fabrications from corrosion and deterioration.

D. Store material in a dry area and do not place in direct contact with the ground.
   1. Do not place materials on the structure in a manner that might cause distortion or damage to the members or supporting structures.
   2. Repair or replace damaged materials or structures as directed.

1.8 PROJECT CONDITIONS

A. Check actual locations of walls and other construction to which metal fabrications must fit by accurate field measurements before fabrication. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabricating products without field measurements. Coordinate construction to ensure that actual dimensions correspond to guaranteed dimensions. Allow for trimming and fitting.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. Safety stair nosing:
    a. Style 231-A, American Abrasive Metals Company.
    b. 31-A American Mason Safety Tread Company.
    c. Supergrit Type 231, Wooster Products Company.
    d. Engineer approved equal.
2. Concrete and masonry anchors:
    a. Hilti, Inc.
    b. ITW Ramset/Redhead.
    c. Simpson Strong Tie Company, Inc.
    d. Engineer approved equal.
3. Castings, trench covers, and accessories:
    a. D&L Foundry and Supply
    b. Deeter Foundry company.
    c. Neenah Foundry Company.
    d. Engineer approved equal.
4. All-purpose metal framing
    a. Allied Tube and conduit.
    b. B-Line Systems.
    c. Unistrut Building Systems.
    d. Engineer approved equal.
5. Steel Ladder Rungs:
    a. Perforated “Traction Tread”; McNichols, Co.
    b. Engineer approved equal.
6. Floor hatches:
    a. Type “APS” or “APD”, Nystrom.
    b. Type “J” or “JD”, Bilco.
    c. Type “SLG” or “DLG”, Dur-Red Products.
    d. Engineer approved equal.
7. Anti-seize lubricant:
    a. AS-470 by Dixon Ticonderoga
    b. PURE WHITE by Anti-Seize Technology
    c. Engineer approved equal.
8. Drill-in anchors:
    a. Epoxy anchors (Concrete):
        1) HIT-HY 200.
        2) Set 3G, Simpson Strong-Tie.
        3) Pure110+, DeWalt
        4) Red Head C6+, ITW Ramset/Redhead.
        5) Engineer approved equal.
    b. Screw anchors:
        1) KH-EZ, Hilti.
        2) Titen HD, Simpson Strong-Tie.
        3) Tapcon LDT, ITW Ramset/Redhead.
        4) Engineer approved equal.

2.2 MATERIALS

A. Steel:
1. Structural steel pipe shall be ASTM A53, Type E or S, Grade B.
2. Structural tubing shall be ASTM A500, Grade C or ASTM A1085. Furnish members full length without splices unless otherwise noted or approved by Engineer.

3. Welded anchor studs shall be headed concrete anchor studs (HAS), or deformed bar anchors (DBA), or threaded studs (TAS), as indicated in the Contract Documents.

B. Steel Forgings: ASTM A668.

C. Stainless steel: ASTM A666 and ASTM A276, Type 316 or 316L

D. Aluminum: Alloy 6061 – T6 conforming to the following specifications:
1. Sheet and plate: ASTM B209.
2. Rolled Bars and Rods: ASTM B211.
3. Extruded bars, rods, shapes, and tubes: ASTM B221.
4. Rolled or extruded structural shapes: ASTM B308.
5. Extruded structural pipe and tube: ASTM B429.

E. Iron:
1. Ductile iron: ASTM A536.
2. Gray cast iron: ASTM A48.
3. Malleable iron: ASTM A47, A197.

F. Bolts and Anchors:
1. Standard Service (non-corrosive applications): Unless otherwise indicated, provide steel bolts, anchor bolts, washers, and nuts as indicated herein. Form threads on galvanized bolts and nuts with suitable taps and dies such that they retain their normal clearance after hot-dip galvanizing. Except as otherwise indicated, provide steel for bolt material, anchor bolts, and cap screws in accordance with the following:
   a. Anchor bolts: ASTM F1554, Grade 36, of dimensions indicated, with nuts conforming to ASTM A563 and flat washers where indicated.
   b. Install high-strength structural connections using ASTM A325 bolts and nuts per ASTM A563, coated to match material being connected.
2. Corrosive Service: Provide stainless steel for bolts, nuts, and washers in the locations listed below.
   a. All buried locations except as noted below for pipe flange, fitting, and coupling connections.
   b. All submerged locations.
   c. Inside hydraulic structures, below the top of the structure.
   d. Inside buried vaults, manholes, and structures that do not have a forced-air ventilation system and either a gravity drain or a sump with a sump pump.
   e. All chemical handling areas.
   f. Other locations indicated by the Contract Documents or designated by the Engineer to be provided with stainless steel bolts.
3. Stainless steel bolts, anchor bolts, nuts, and washers shall be Type 316 stainless steel, conforming to ASTM F593 for bolts and to ASTM F594 for nuts. Protect all threads on stainless steel bolts with an anti-seize lubricant suitable for submerged stainless steel bolts, to meet government specification MIL-A-907E and classified as acceptable for potable water use by NSF. Coat buried bolts in poorly drained soil the same as the buried pipe.
4. Pipe Flange, Fitting and Coupling Connection Applications: Unless otherwise noted, all pipe flange, fitting and coupling connection bolts for welded steel pipe shall be carbon steel per ASTM A193, Grade B7 hex bolts, with nuts per ASTM A194, Grade 2H and all pipe flange, fitting and coupling connection bolts for ductile iron pipe shall be carbon steel per ASTM A307, Grade A hex bolts and ASTM A563, Grade A hex nuts.

All bolts, nuts and washers shall be zinc plated. Protect all threads on bolts and nuts with anti-seize lubricant.

a. Exposed Connections: For exposed pipe connections in buried vaults, manholes, and structures with forced-air ventilation and which drain through a gravity sewer or to a sump with a pump, prepare and coat bolts and nuts after installation with the same system as the adjacent flanged piping, in accordance with Section 09 90 00 – Protective Coatings and Linings.

b. Buried Connections: Coat all buried connections in accordance with Section 09 90 10 – Pipeline Coatings and Linings. Provide wax tape coating per AWWA C217 for steel pipe connections, including sleeve couplings and restrained sleeve couplings. For other pipe materials, grease and wrap connections per AWWA C105.

c. Submerged Connections: Bolts for submerged flanges and pipe connections shall be Type 316 stainless steel, ASTM A193/A193M, Grade B8M hex head bolts, and ASTM A194/A194M Grade 8M hex head nuts. Fabricate in accordance with ASME B18.2.2.

d. Provide two washers for each bolt and nut with a washer installed on each side of the flange. Washers shall be of the same material as the nuts.

e. Provide bolts of the proper length to accommodate flange, washer, and gasket thickness to accommodate bolt minimum length per AWWA C207.

5. Bolt Requirements:

a. The bolt and nut material shall be free-cutting steel.

b. The nuts shall be capable of developing the full strength of the bolts.

c. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads.

d. Provide bolts with hexagon heads. Provide nuts conforming to Heavy Hexagon Series.

e. Install all bolts and nuts with washers fabricated of material matching the base material of bolts, except that hardened washers for high strength bolts shall conform to the requirements of the AISC Specification.

f. Install lock washers with washers where indicated and fabricated of material matching the bolts.

G. Provide bolts of length such that after joints are made up, each bolt extends through the entire nut, but in no case more than 1/2-inch beyond the nut.

H. Drill-in anchors:

1. Epoxy anchors: Unless otherwise indicated, all drilled concrete and masonry anchors shall be epoxy anchors. No substitutions will be considered unless accompanied by ICC-ES reports verifying strength and material equivalency.

a. Epoxy anchors are required for drilled anchors exposed to weather, in submerged, wet, splash, and corrosive conditions, and for anchoring handrails, pumps, mechanical equipment, and reinforcing bars. Provide threaded stainless steel rod, Type 316.

b. Unless otherwise indicated, epoxy anchors will also be permitted in locations not indicated above.

2. Expansion Anchors: Expansion anchors will only be permitted when specifically approved by the Engineer. Expansion anchors that are to be fully encased in grout may be carbon steel. For non-encased buried or submerged anchors, provide stainless steel anchors.

3. Screw Anchors: Screw anchors will only be permitted when specifically approved by the Engineer. Screw anchors that are to be fully encased in grout may be carbon steel. For non-encased buried or submerged anchors, provide stainless steel anchors.

I. Corrosion Protection:
   1. Hot dip galvanize all miscellaneous steel metalwork after fabrication.
      a. Galvanizing: ASTM A123 or A653 with minimum coating of 1.5 ounce per square foot.

2.3 MANUFACTURED UNITS

A. Handrails and Guardrails: Refer to Section 05 52 13 – Pipe and Tube Railings.

B. Bollards:
   1. Standard weight steel pipe, diameter as shown on Drawings.
   2. Minimum 48 inches projection above finish grade.
   3. Minimum 42 inches embedment in concrete.
   4. Fabricate sleeves for removable bollards from steel pipe with 1/4-inch thick steel plate welded to bottom of sleeve.

C. Abrasive Stair Nosings:
   1. Extruded aluminum shape with cast-in abrasive strips and integral extruded anchors.
   2. Material: Alloy 6063-T6 extruded aluminum, mill finish, heat treated.
   3. Color to be selected by Engineer from manufacturer's standard colors.
   4. Units: 3 inches wide by 4 inches less in length than stair tread width, centered on tread width.

D. Stairs, Grating:
   1. Treads: Grating treads as specified with exception that nosing shall have integral non-slip edge. Checkered plate nosings are not acceptable.
   2. Landings: Grating as shown on Contract Documents or specified herein.
   3. Fabricate and design stair tread, landing assembly, and connections not shown on Contract Documents to support a 500-lb concentrated, moving load or 100 psf uniform load, whichever requires the greater component.
   4. Design, fabricate and install in compliance with applicable codes.
   5. Maximum deflections as specified below under "Metal grating."
   6. Material:
      a. Aluminum: Alloy 6061-T6 or 6063-T6.
      b. Steel: ASTM A36, galvanized as specified.

E. Ladders:
   1. Ladders shall be of stainless steel or galvanized steel as shown on the Contract Documents. When material is not specifically noted, material shall be stainless steel.
   2. Design to support minimum 300-pound concentrated vertical load with 150-pound concentrated horizontal load.
      a. Maximum allowable stresses per AISC manual.
      b. Maximum lateral deflection: Side rail span/300.
      c. Design in accordance with OSHA standards.
   3. Fabricate ladders for the locations shown, with dimensions, spacings, details, and anchorages as indicated. Comply with requirements of ANSI A14.3.

4. Side rails, minimum sizes: Continuous, 1 1/2-inch nominal diameter pipe. Fabricate with eased edges, spaced 18 inches apart.
5. Rungs: 1-1/8 inch by 1-5/8 inch by 14 gage perforated "traction tread" rungs.
   a. Top rung level with top platform.
6. Fit rungs in centerline of side rails, plug weld and grind smooth on outer rail faces.
7. Support each ladder at top and bottom and at intermediate points spaced not more than 4 feet on center with welded or bolted steel brackets.
8. Size brackets to support design dead and live loads indicated and to hold centerline of ladder rungs clear of the wall surface by not less than 9 inches.
9. When required by Drawings, every ladder that does not have an exterior handhold shall be equipped with a pop-up extension. Pop-up extension device shall be manufactured of the same material and finish as the ladder with telescoping tubular section that locks automatically when fully extended. Upward and downward improvement shall be controlled by stainless steel spring balancing mechanisms. Units shall be completely assembled with fasteners for securing to the ladder rungs in accordance with the manufacturer's instructions.

F. Metal Grating:
1. Metal grating shall be of the design, sizes, and types indicated. Completely band at all edges and cutouts using material and cross section equivalent to the bearing bars. Such banding shall be welded to each cut bearing bar. Support grating at bearings by support members. Where grating is supported on concrete, embedded support angles matching grating material shall be used unless indicated otherwise. Such angles shall be mitered and welded at corners.
2. Bearing Bars:
   a. Type: Rectangular bar.
   b. Thickness: 3/16 inch minimum.
   c. Depth: 1-1/2 inch unless otherwise indicated on Contract Documents.
   d. Spacing: 1-3/16 inch maximum.
   e. Configuration of top surface: Plain unless otherwise indicated on Contract Documents.
3. Cross Bars:
   a. Cross bars shall be welded or mechanically locked tightly into position so that there is no movement allowed between bearing and cross bars.
   b. Spacing: 4 inches maximum.
4. All pieces of grating shall be fastened in at least two locations to each support.
5. Where grating forms the landing at the top of a stairway, the edge of the grating, which forms the top riser, shall have an integral non-slip nosing, width equal to that of the stairway.
6. Where grating depth is not given, grating shall be provided which will be within allowable stress levels, and which shall not exceed a deflection of ¼-inch or the span divided by 180, whichever is less. For standard duty plank, and safety grating, the loading to be used for determining stresses and deflections shall be the uniform live load of the adjacent floor or 100 psf, whichever is greater or a concentrated moving load of 1000 pounds.
7. Material:
   a. Galvanized Steel: Except where indicated otherwise, bar grating shall be fabricated entirely of hot-dip galvanized carbon steel.
   b. Aluminum: Bearing and banding bars, alloy 6063-T5.
   c. Grating which may be partially or wholly submerged shall be fabricated entirely of stainless steel.

8. No single piece of grating shall weigh more than 80 pounds or be wider than 3 feet, unless indicated otherwise on Contract Documents.

G. Metal Ships' Ladder:
1. Provide metal ships' ladders where indicated on Drawings. Fabricate open-type construction with channel or plate stringers and pipe or tube railings unless otherwise indicated. Provide brackets and fittings for installation.
   a. Fabricate ships' ladders, including railings from aluminum or steel as indicated on the Drawings.
   b. Fabricate treads and platforms from pressure locked metal grating as specified herein.

H. Floor Hatches:
1. Where floor access hatches are called for on the Contract Documents to be mounted on a floor slab (including top slabs which are not covered with a roofing membrane) or on a concrete curb, the hatch shall be a flush type as indicated herein.
2. Material: Aluminum alloy 6061-T6 unless otherwise indicated. Provide Type 316 stainless steel hardware.
3. Design Live Load: Minimum 300 psf.
4. Provide hatch opening sizes, number and directional swing of door leaves, and locations as indicated on the Drawings. Sizes given are for the clear opening. Where the number of leaves is not indicated, provide double-leaf doors for openings larger than 42 inches in either direction. Unless indicated otherwise, locate hinges on the longer dimension side. Unless indicated otherwise, ladder hatches shall be a minimum of 36 inches wide by 36 inches long, with the door hinge opposite the ladder.
5. Hatch shall have oversized recessed padlock clip that can accommodate a lock with a 2.5" shackle length.
6. Hatches without ladders shall be equipped with recesses safety grating for fall protection.
7. Door leaves shall be a minimum of 1/4-inch checkered pattern plate. Channel frames shall be a minimum of 1/4-inch material with an anchor flange around the perimeter. Hatches shall be provided with an automatic hold-open arm with release handle. Hatches shall be designed for easy opening from both inside and outside.
8. Aluminum surfaces in contact with other metals or concrete shall be painted for aluminum metal isolation. Caulk the mounting flange of access hatches for water tightness when mounted to concrete curbs.

I. Iron Castings:
1. Iron castings shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion, or other defects. They shall be smooth and well cleaned by shot blasting. Castings shall be prefabricated, conforming to ASTM A48 or A536.
2. Covers and grates shall fit together evenly, so that the cover fits flush with the surrounding finished surface and so that the cover does not rock or rattle when loading is applied. Round covers and frames shall have machined bearing surfaces.
3. Covers and grates with matching frames shall be designed to support the following loadings:
   a. Where located within a structure, the design loading shall match that required for the adjacent floor area, or, if no floor loading is given, a minimum of 300 pounds per square foot.

b. Exterior covers and grates shall be designed for AASHTO HS-20 loading unless indicated otherwise.

J. All Purpose Metal Framing:
1. Material: Carbon Steel.
2. Channels and inserts:
a. Minimum 12 gage.
b. Channels to have one side with a continuous slot and inturned lips.
3. Fittings: Hot-rolled steel strip and plate.
4. Nuts: Steel, ASTM A563, with toothed grooves in top of nuts to engage the inturned lips of channels.
5. Finish: Epoxy coated. Galvanize items which cannot be epoxy coated.

2.4 FABRICATION

A. Verify field conditions and dimensions prior to fabrication.

B. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.

C. Form exposed work true to line and level with accurate angles and surfaces straight and sharp edges.

D. Drill and punch holes with smooth edges.

E. Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in the design, fabrication, and installation of installed metal assemblies to prevent buckling, opening of joints, and overstressing of welds and fasteners. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.
1. Temperature Range: 0 degrees F minimum to 110 degrees F maximum ambient temperature.

F. Shear and punch metals cleanly and accurately. Remove burrs.

G. Ease exposed edges to a radius of approximately 1/32 inch unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

H. Remove sharp or rough areas on exposed traffic surfaces.

I. Welding
1. Welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards governing same.
2. In assembly and during welding, the component parts shall be adequately clamped, supported and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as indicated by the AWS Code. Upon completion of welding,

all weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. All sharp corners of material that are to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

3. Weld corners and seams continuously to comply with the following:
   a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   b. Obtain fusion without undercutting or overlap.
   c. Remove welding flux immediately.
   d. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing, and contour of welded surface matches those adjacent.

J. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners whenever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

K. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

L. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

M. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

N. Fabricate joints that will be exposed to weather in a manner to exclude water or provide weep holes where water may accumulate.

2.5 MISCELLANEOUS FRAMING AND SUPPORTS

A. Provide steel framing and supports for applications indicated that are not a part of structural steel framework as required to complete the Work.

B. Fabricate units to sizes, shapes, and profiles indicated and required to receive other adjacent construction retained by framing and supports.

C. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitered joints for field connection.

D. Cut, drill, and tap units to receive hardware, hangers, and similar items.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installing anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

B. Inspect and verify condition of substrate. Correct any surface defects or conditions which might interfere with or prevent a satisfactory installation.

C. Set sleeves in concrete with tops flush with finish surface elevations. Protect sleeves from water and concrete entry.

3.2 INSTALLATION

A. Set metal work level, true to line, plumb.

B. In fabrication and erection of structural steel, conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction."

C. Shim and grout as necessary.

D. To the maximum extent possible, use bolted field connections. Where practicable, conceal the fastenings. When field welding is warranted, comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercutting or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish/grind exposed welds and surfaces smooth and blended so that no roughness shows after finishing, and contour of welded surface matches those adjacent.

E. Unless notes or specified otherwise:
   1. Connect steel members to steel members with 3/4-inch diameter high strength bolts.
   2. Connect aluminum to aluminum with 3/4-inch diameter aluminum bolts.
   3. Connect aluminum to structural steel using 3/4-inch diameter stainless steel bolts.
   4. Connect aluminum and steel members to concrete and masonry using 3/4-inch stainless steel epoxy anchors. Provide a minimum of 5 1/2 inches of embedment into concrete or masonry.

F. Do not field splice fabricated items unless said items exceed standard shipping length or change of direction requires splicing. Provide fully welded splices where continuity is required.

G. Provide each fabricated item complete with attachment devices as indicated or required to install.

H. Anchor metal items so that items will not be distorted, nor fasteners overstressed from expansion and contraction.

I. Install bollards in concrete as detailed. Fill pipe with concrete and round off at top of pipe.

J. Center abrasive stair nosings in stair width.

K. Attach grating to end and intermediate supports with grating saddle clips and bolts.
   1. Maximum spacing: 2 feet on center with a minimum of two attachments per support.
   2. Attach individual units of grating together with clips or attachments at 2 feet on center maximum with a minimum of two clips per side.

L. Coat ferrous metals in accordance with Section 09 90 00 – Painting and Coating.

M. Coat surfaces of aluminum that will come in contact with grout, concrete, masonry, wood or dissimilar metals with the following:
   1. Cast Aluminum: Heavy coat of bituminous paint.
   2. Extruded Aluminum: Two coats of clear lacquer.

3.3 DRILLED ANCHORS

A. Drilled-in anchors and reinforcing bars shall be installed in strict accordance with the manufacturer's instructions. Holes shall be roughened with a brush on a power drill, cleaned and dried. Drilled anchors shall not be installed until the concrete has reached the specified 28-day compressive strength. Epoxy anchors shall not be loaded until the adhesive has reached its indicated strength in accordance with the manufacturer's instructions.

3.4 SETTING LOOSE PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.

B. Set loose level and bearing plates on wedges or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout.
   1. Use non-shrink grout in concealed locations where not exposed to moisture.
   2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.5 CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop painted surfaces.
   1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780

END OF SECTION

SECTION 05 52 13
PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes guardrails and handrails to be fabricated and installed complete, in accordance with the Contract Documents.
   1. Aluminum pipe railings.
   2. Steel pipe railings.
   3. Stainless steel pipe railings.

1.2 RELATED SECTIONS
   1. Section 03 60 00 – Grouting
   2. Section 05 50 00 – Metal Fabrications
   3. Section 09 90 00 – Painting and Coating

1.3 REFERENCES

A. Aluminum Association (AA) standards, most recent editions:

ADM 1	Aluminum Design Manual, Part 1-A Aluminum Structures, Allowable Stress Design
ASD 1	Aluminum Standards and Data
DAF 45	Designation System for Aluminum Finishes
SAA 46	Standards for Anodized Architectural Aluminum

B. American Institute of Steel Construction (AISC) standards, most recent editions:

AISC 360	Specification for Structural Steel Buildings

C. American Society of Civil Engineers (ASCE) standards, most recent editions:

ASCE 8	Specification for the Design of Cold-Formed Stainless Steel Structural Members

D. ASTM International (ASTM) standards, most recent editions:

ASTM A36	Standard Specification for Carbon Structural Steel
ASTM A47	Standard Specification for Ferritic Malleable Iron Castings
ASTM A48	Standard Specification for Gray Iron Castings

ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A312	Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A510	Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel
ASTM A653	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A666	Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
ASTM A743	Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
ASTM A780	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM B26	Standard Specification for Aluminum-Alloy Sand Castings
ASTM B108	Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B429	Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM B633	Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM F1267	Standard Specification for Metal, Expanded, Steel

ASTM F1941	Standard Specification for Electrodeposited Coatings on Threaded Fasteners (Unified Inch Screw Threads (UN/UNR))

E. American Welding Society (AWS) standards, most recent editions:

D1.1	Structural Welding Code – Steel
D1.2	Structural Welding Code – Aluminum
D1.6	Structural Welding Code – Stainless Steel

F. National Association of Architectural Metal Manufacturers (NAAMM) standards, most recent editions:

Metal Finishes Manual for Architectural and Metal Products

AMP 521	Pipe Railing Systems Manual

G. The Society for Protective Coatings standards, most recent editions:

SSPC-SP 6	Commercial Blast Cleaning

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 20 – Submittal Procedures.

B. Shop Drawings: Submit shop drawings of all railings to the Engineer for review, including the following information:
1. Manufacturer's installation details.
2. Layout drawings showing location of each railing, type of railing, and type of anchorage to be used.
3. Manufacturer's recommendations on fastening and cleaning after installation.

C. Mill Certificates: Signed by manufacturers of stainless steel products certifying that products furnished comply with requirements.

D. Product Test Reports: From a qualified testing agency indicating railings comply with ASTM E985, based on comprehensive testing of current products and current building code required by authority having jurisdiction, whichever is more stringent.

E. Certification: Submit a written certification, prepared by a Professional Engineer, licensed to practice in the state of Utah, verifying that the railing system design and related structural connections will meet the indicated loading requirements specified herein and included in the codes and standards referenced.

F. Engineer's seal and signature to be affixed to shop drawings, and certification.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing from single manufacturer.

B. Welding
   1. Maintain all weld procedures and welder qualifications available in the Contractor's field office for review.
   2. Qualification of Welders: Use welders with current certifications (previous 12 months) for the material, type, and position of welding used. Certify in accordance with AWS Specifications according to the following:
      a. AWS D1.1, Structural Welding Code – Steel.
      b. AWS D1.2, Structural Welding Code – Aluminum.
      c. AWS D1.6, Structural Welding Code – Stainless Steel.
   3. All welding shall be inspected by a Contractor-furnished inspector qualified in accordance with AWS requirements and approved by the Engineer.

C. Licensed Professional: Design railings, including comprehensive engineering analysis by a qualified Professional Engineer who is licensed to practice in the state of Utah, using performance requirements and design criteria indicated herein.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with Section 01 25 10 - Products, Materials, Equipment and Substitutions.

B. Deliver products to site in original, unbroken packages, containers, or bundles and bearing the label of the manufacturer.

C. Store all materials off the ground and protect from weather until ready for use.

1.7 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, which are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. General: Unless otherwise indicated, install all railings complete and ready for use with all anchors, attachments, balusters, brackets, caps, fasteners, gates, posts, sleeves, trim, and other items required or necessary for the complete installation. Attachment details shown on the Contract Drawings are for the purpose of indicating the type of attachment and may be substituted with the Manufacturer's standard products for the same type of attachment.

B. Structural Design Requirements:
   1. Unless otherwise specifically noted, all railings, guardrails and handrails shall conform to the code requirements for industrial-commercial, non-public use under the State-approved OSHA. Railings, guardrails, and handrails, when part of a means of egress as defined by the governing codes, shall conform to the requirements of the

most stringent of the codes or reference standards. The whole project shall conform to the code and State-approved OSHA for industrial-commercial, non-public use unless otherwise indicated. Limited public use shall mean that the facility is not designed for public use; however, occasionally the public is allowed controlled access when approved.

2. Loading Conditions: Provide railings and handrail brackets capable of withstanding the following loading conditions without exceeding the allowable working stress of the material and without permanent deformation:
   a. General: Distribute loads to the various parts of the railing system consistent with methodology described in ANSI/NAAMM AMP 521 – Pipe Railing Systems Manual.
   b. Top Rail of Guards: Concentrated load of 200 pounds applied at any point and in any direction, and a uniform load of 50 pounds per lineal foot applied in any direction. Concentrated and uniform loads need not be assumed to act concurrently.
   c. Handrails Not Serving As Top Rails: Concentrated load of 200 pounds applied at any point and in any direction, and a uniform load of 50 pounds per lineal foot applied in any direction. Concentrated and uniform loads need not be assumed to act concurrently.
   d. Intermediate Rails: Uniform load of 50 pounds per lineal foot applied horizontally. Reactions due to this loading are not required to be applied concurrently with loadings specified above.
   e. Posts: Concentrated load of 200 pounds applied at any point and in any direction.
3. In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
   a. Steel: AISC 360.
   b. Aluminum: Referenced Aluminum Association publications.
   c. Stainless Steel: ASCE 8.

C. Height Requirements: Set top of upper railing at 42 inches above the working surface or toe line of stairs. Install toe boards not more than 1/4 inch off the working surface and provide where indicated and required by codes or referenced standards. Provide a separate handrail at stair locations.

D. Guardrail Configuration: Three-rail system with equal open spaces between rails (and toe board when required) as required by OSHA.

E. Thermal Movements:
1. Exterior railing systems to provide for 1/4 inch expansion and contraction per 20 linear feet of railing.
2. Interior railing systems to provide for 1/8 inch expansion or contraction per 20 linear feet of railing.
3. Temperature change (range): 120 Degrees F, ambient; 180 Degrees F, material surfaces.

F. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

2.2 MATERIALS

A. Iron and Steel
   1. Pipe: ASTM A53, Type S, Grade B, 1-1/2 inch diameter, Standard Weight (Schedule 40), unless another grade and weight is required by structural loads.
      a. Provide galvanized finish for exterior installations and where indicated.
   2. Plates, Shapes, and Bars: ASTM A36.
   3. Cast Iron: Either gray iron, ASTM A48, or malleable iron, ASTM A47, unless otherwise indicated.
   4. Expanded Metal: ASTM F1267, Type II (expanded and flattened), Class 1 (uncoated).
      a. Style Designation: 1-1/2 number 10.
   5. Perforated Metal: Galvanized-steel sheet, ASTM A653, G90 coating, commercial steel Type B, 0.064 inch thick, with 1/4-inch holes 3/8 inch on center in staggered rows.
   6. Woven-Wire Mesh: Intermediate-crimp, square pattern, 2-inch woven-wire mesh, made from 0.135-inch nominal diameter wire complying with ASTM A510.

B. Stainless Steel
   1. Pipe: ASTM A312, Grade TP316L, 1-1/2 inch diameter, Standard Weight (Schedule 40) unless another grade and weight is required by structural loads.
   2. Castings: ASTM A743 Grade CF8M or CF3M.
   3. Plate and Sheet: ASTM A240 or ASTM A666, Type 316L.

C. Aluminum
   1. Pipe: Alloy 6061-T6 or 6063 – T6, ASTM B429, 1-1/2 inch diameter, Schedule 40 unless another grade and weight is required by structural loads.
   2. Sheet and plate: Alloy 6061 – T6 or 6063-T6, ASTM B209.
   3. Extruded bars, rods, shapes, and tubes: Alloy 6061-T6 or 6063-T6, ASTM B221.
   4. Cast fittings: Aluminum, ASTM B108 or ASTM B26.

D. Brackets: Handrail brackets shall be stainless steel or aluminum that matches the handrail or railing of which they are a part, including the finish.

E. Toe Boards: Toe board material and finish shall match railing system and be not less than 4 inches in height. Toe boards shall be formed in an angle or channel section for strength.

F. Connection splices: Internal mechanical connection splices for aluminum railings shall be of extruded aluminum.

G. Fasteners:
   1. Non-galvanized Steel Railings: Plated steel fasteners complying with ASTM B633 or ASTM F1941, Class Fe/Zn 5 for zinc coating.
   2. Hot-Dip Galvanized Railings: Type 316 stainless-steel.
   3. Aluminum Railings: Type 316 stainless-steel fasteners.
   4. Stainless-Steel Railings: Type 316 stainless-steel fasteners.
   5. Fasteners for anchoring railings to other construction shall be of stainless steel, per requirements of Section 05 50 00 – Metal Fabrications.
   6. Fasteners for Anchoring Railings to Other Construction: Select fasteners to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads. Unless otherwise indicated,

provide stainless steel fasteners per requirements of Section 05 50 00 – Metal Fabrications.

7. Fasteners for interconnecting railing components shall be of the same basic metal as the fastened metal. Do not use metals that are corrosive or incompatible with materials being joined.

H. Miscellaneous Materials:

1. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded. For both aluminum and stainless-steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
2. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
3. Galvanizing Repair Paint: High-zinc-dust-content paint compatible with coatings specified to be used over it.
4. Shop Primers: Refer to Section 09 90 00 – Painting and Coating.
5. Intermediate Coats and Topcoats: Refer to Section 09 90 00 – Painting and Coating.
6. Grout: Refer to Section 03 60 00 – Grouting.

2.3 FABRICATION

A. General

1. Fabricate handrails and railing systems with welded or non-welded (aluminum only), internal and mechanical connections to comply with manufacturer's printed requirements, Construction Documents, details, dimensions, finish and member sizes, including post spacing and anchorage, but not less than the structural requirements to support applied loadings.
    a. Clearly mark component units for site assembly and installation.
    b. Use only connections that maintain structural capacity of joined members.
2. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
3. Provide weep holes or other means to exit entrapped water from hollow section of railing members exposed to exterior, condensation, or moisture from other sources.
4. Fabricate smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names, and roughness.
5. Form exposed elements with smooth, long radius bends, accurate angles and straight sharp edges.
    a. Ease exposed edges to a radius of approximately 1/32 inch.
    b. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the work.
6. For aluminum railings with exposed connections with flush, smooth, hairline joints.
    a. Hand file to remove burrs and sharp edges before assembly.
    b. Use recessed screws or flush blind rivets.
    c. Top rail splices and expansion joints shall be located within 8 inches of post or other support.
7. Provide for anchorage to side face of support unless shown otherwise in Contract Drawings. Where this is impractical, provide for top face attachment.
8. Handrail Termination:
    a. Fit exposed ends of handrails with solid terminations.

b. Handrails to extend not less than 12 inches beyond the toe of the top and bottom risers in a run of stairs.

c. Ends of handrails to be returned to the wall or to be terminated in posts or safety terminals. Posts and safety terminals may be used only when approved by the Engineer. Close ends of returns unless clearance between end of railing and wall is 1/4 inch or less.

B. Welded Railing Fabrication:

1. All welding to be continuous.
2. Remove flux immediately.
3. All exposed welds to be ground and buffed smooth and flush to match and blend with adjoining surfaces.
4. No ragged edges, surface defects, or undercutting of adjoining surfaces will be accepted.

C. Non-welded Railing Fabrication:

1. All railings to be prefabricated or component formed, marked and sized for on-site installation.
2. Top railing to be single continuous length attached to a minimum of three posts where possible.
3. Posts and intermediate railings shall be single continuous lengths of pipe.

D. Form changes in direction by bending or by inserting prefabricated elbow fittings.

1. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of members throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

E. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

1. For railing posts set in concrete, provide steel as detailed on the Drawings.
2. For removable railing posts, fabricate slip-fit sockets from tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.
    a. Provide stainless steel chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated.
3. Expanded-Metal Infill Panels: Fabricate infill panels from expanded metal made from same metal as railings in which they are installed.
    a. Edge panels with U-shaped channels made from metal sheet, of same metal as expanded metal and not less than 0.043 inch thick.
    b. Orient expanded metal with long dimension of diamonds parallel to top rail.
4. Perforated-Metal Infill Panels: Fabricate infill panels from perforated metal made from same metal as railings in which they are installed.
    a. Edge panels with U-shaped channels made from metal sheet, of same metal as perforated metal and not less than 0.043 inch thick.
    b. Orient perforated metal with pattern parallel to top rail.
    c. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into 1-by-1/2-by-1/8-inch metal channel frames. Make wire mesh and frames from same metal as railings in which they are installed.

d. Orient wire mesh with wires perpendicular and parallel to top rail.

2.4 FINISH

A. General
1. Comply with NAAMM "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
2. Protect mechanical finishes on exposed surfaces from damage per manufacturer's recommendations.
3. Noticeable variations in appearance within the same piece or adjacent pieces are not acceptable.

B. Steel and Iron Finishes
1. Galvanized Railings:
a. Hot dip galvanize indicated steel and iron railings, including hardware, after fabrication.
b. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
c. Comply with ASTM A123 for hot-dip galvanized railings.
d. Comply with ASTM A153 for hot-dip galvanized hardware.
e. When galvanized railings are to be coated, do not quench or apply post galvanizing treatments that might interfere with paint adhesion. After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
2. Non-Galvanized Railings:
a. For non-galvanized steel railings, provide non-galvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanized anchors embedded in exterior concrete or masonry.
b. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6.
c. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Primer need not be applied to surfaces embedded in concrete or masonry.
1) Do not apply primer to galvanized surfaces.
3. Shop-Painted Finish: Refer to Section 09 90 00 Painting and Coating.
a. Color: As selected by Engineer from manufacturer’s full range.

C. Stainless Steel
1. Remove or blend tool and die marks and stretch lines into finish.
2. Grind and polish surfaces to produce uniform, directionally textured, polished finish, free of cross scratches. Run grain with long dimension of each piece.
3. Bright, Directional Polish: No. 4 finish.
4. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
5.

D. Aluminum
1. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.

a. Anodized finish shall be Class I provided in accordance with AA-M12 C22 A41, clear.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine system components, substrate, and conditions where railing systems are to be installed. If unsatisfactory conditions exist, notify Engineer in writing of unsatisfactory conditions, and do not begin this Work until such conditions have been corrected.

B. Commencing installation of this Work constitutes acceptance of conditions.

3.2 PREPARATION

A. Prepare surrounding construction to receive railing system installations complying with railing manufacturer's requirements.

B. Review and coordinate setting drawings, shop drawings, templates, and instructions for assembly and installation of railing system and related items to be embedded in concrete and masonry.

3.3 DISSIMILAR MATERIALS

A. When aluminum railing components come into contact with dissimilar metals, masonry, or concrete, surfaces shall be kept from direct contact by painting the contact surface with a heavy coat of bituminous paint (cast aluminum) or two coats of clear lacquer (extruded aluminum).

3.4 INSTALLATION

A. Install railing system and related components in strict accordance with approved shop drawings and manufacturer's printed instructions.

B. Preassemble railing system, including posts, into the largest practical sections possible.
1. Align rails so that variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members, do not exceed tolerances specified in this Section. Erect work free from distortion or defects detrimental to appearance or performance.
2. Separate aluminum which might contact concrete, masonry and other dissimilar metals to prevent electrolytic action.

C. Align railings prior to securing in place to assure proper matching at abutting and expansion joints and correct alignment throughout their length.
1. Provide for thermal expansion and contraction by use of expansion joints in top rails at 20-foot maximum intervals.
2. Space posts not more than 6 feet on center.
3. Space wall brackets not more than 5 feet on center.

D. Provide anchorage for posts as indicated on Contract Drawings and in the following manner:
   1. Top of concrete and masonry walls, slabs, walkways, stairs and removable railing sections:
      a. Furnish posts with floor flange, welded or mechanically attached to post, with predrilled holes for bolting to surface.
   2. Side of concrete and masonry walls, slabs, walkways, stairs, and removable railing sections:
      a. Furnish posts with side plate, welded or mechanically attached to post, with predrilled holes for bolting to surface.
   3. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete or attached to side as indicated on Drawings.

E. Attach wall railings to wall with wall brackets except where end flanges are used. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
   1. Use type of bracket with predrilled hole for exposed bolt anchorage.

F. Gates and removable sections:
   1. Provide safety gates in railing systems where ladder tops occur and at other locations shown on the Contract Drawings. Safety chains will not be accepted. Provide gates with self-closing hinges and self-closing latch bolts.
   2. Provide removable railing sections where indicated on the Contract Drawings.
   3. Provide gate and removable railing section hardware with color to match the railing system of which it is a part.

3.5 TOLERANCES

A. Limit variation of cast-in-place inserts, sleeves, and field-drilled anchor and fastener holes to the following:
   1. Spacing: ± 3/8 inch.
   2. Alignment: ± 1/4 inch.
   3. Plumbness: ± 1/8 inch.

B. Handrails and Guardrail System Plumb Criteria:
   1. Limit variation of completed handrail and guardrail system alignment to 1/4 inch in 12 feet with posts set plumb to within 1/16 inch in 3 feet.
   2. Align rails so variations from level for horizontal members and from parallel with rake of stairs and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Provide "hairline" thin butt joints.

3.6 CLEANING

A. As installation is completed, clean the railings in accordance with the manufacturer's printed instructions.

B. If cleaning operations remove anodized finish, remove the affected rail and replace it with new material.

C. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting.
   1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

D. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

3.7 PROTECTION

A. Suitably protect rail surfaces against lime mortar stains, discoloration, surface abrasion, and other construction abuses. Remove stained or otherwise defective work and replace with material that meets specification.

END OF SECTION

DIVISION 06
WOOD, PLASTICS, AND COMPOSITES

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SECTION 06 60 00
FIBERGLASS REINFORCED PLASTIC FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install fiberglass reinforced plastic fabrications, complete and serviceable as shown on the Drawings and as specified herein.

B. Section Includes:
1. Grating.

1.2 REFERENCES

A. ASTM International (ASTM) standards, most recent editions:

ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D695	Standard Test Method for Compressive Properties of Rigid Plastics
ASTM D696	Standard Test Method for Coefficient for Coefficient of Linear Thermal Expansion of Plastics Between -30 Degrees C and 30 Degrees C with a Vitreous Silica Dilatometer
ASTM D790	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D2344	Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates
ASTM E84	Surface Burning Characteristics of Building Material

B. American Water Works Association (AWWA) standards, most recent editions:

C. National Sanitation Foundation (NSF), most recent edition:

NSF 61	Drinking Water System Components, Health Effects

D. Occupational Safety and Health Administration (OSHA), most recent editions:

OSHA 1910.27	Fixed Ladders

1.3 DEFINITIONS

A. FRP: Fiberglass reinforced plastic.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 20 – Contractor Submittals.

B. Product Data: Submit manufacturer's published literature including material specifications, structural design data, structural properties and load and deflection tables for each style and type of fabrication used, corrosion resistance tables and anchoring systems and allowable load tables as applicable.

C. Shop Drawings: Submit shop drawings of all FRP fabrications and accessories.
   1. For grating, show direction of span, type and depth of grating, size and shape of individual panels, seat angle details, and details of grating clip fasteners.

D. Structural Calculations: Provide design calculations for items and systems not sized or designed in the Contract Documents.

E. Samples: The Engineer may require sample pieces of any item specified herein for acceptance as to quality and color. When required, submit samples manufactured by the method to be used in the Work.

F. Certified Test Reports: Provide when requested by Engineer.

G. Qualification Statements: Provide qualification documents for manufacturer's experience history.

H. Warranty Documentation: Pro vide certificate of warrantees specified herein.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer having a minimum of 10 years' experience in the design and manufacture of similar products and systems to those specified herein. When requested, provide evidence of at least 5 previous successful installations in the past 5 years.

B. Maintain a continuous quality control program and provide Engineer with certified test reports of physical tests on samples when requested.

C. Provide only new FRP material for the fabrications specified.

D. Licensed Professional Engineer: When design calculations are required, they must be signed and sealed by an engineer licensed to practice in the state of Utah.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with Section 01 25 10 - Products, Materials, Equipment and Substitutions.

B. Delivery and Acceptance Requirements: Deliver manufactured materials in original, unbroken pallets, packages, containers, or bundles bearing the label of the manufacturer. Package adhesives, resins, and their catalysts and hardeners separately and not such to facilitate movement to a dry indoor storage area.

C. Storage and Handling Requirements: Store all materials carefully to prevent them from being damaged. Store adhesives, resins, and their catalysts in dry indoor facilities between 70 degrees F and 85 degrees F until they are required.

1.7 WARRANTY

A. Provide manufacturer's written 3-year warranty on all FRP products against defects in materials and workmanship.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable.
   1. Grating and Treads
      a. Fibergrate Composite Structures, Inc. (Safe-T-Span).
      b. CorGrate Fiberglass Systems (CorGrate FW).
      c. Strongwell (Duradek).
      d. Engineer approved equal.
   2. Grating Floor System
      a. American Grating LLC.
      b. Fibergrate Composite Structures, Inc.
      c. Engineer approved equal.

2.2 GENERAL

A. FRP items shall be composed of fiberglass reinforcement and resin in quantities, qualities, properties, arrangements, and dimensions as necessary to meet the design requirements and dimensions indicated.

B. Provide FRP products with tested flame spread rating of 25 or less per ASTM E84.

C. Resins for FRP products shall be vinyl ester with chemical formulation necessary to provide the corrosion resistance, strength, and other physical properties as required.

D. Finish
   1. Provide all finished surfaces of fiberglass items and fabrications smooth, resin-rich, free of voids, and without dry spots, crazes, or unreinforced areas.
   2. Provide for corrosion resistance and weathering.
   3. Outer surfaces with no glass fibers exposed.

E. Supports and Fasteners: Provide all bolts, anchor bolts, washers, nuts, and supports as required for FRP items specified in this Section, in accordance with the requirements of the manufacturers of the FRP items.
   1. Unless specified otherwise, provide connectors of Type 316 stainless steel.

F. Include an ultraviolet (UV) inhibitor in all FRP items. Additionally, provide an extra 1-mil UV coating on all FRP products located in exterior locations, exposed to the weather, or in UV facilities.

G. Design and install fiberglass items providing accommodation for expansion and contraction. Prevent shearing of bolts, screws, and other fastenings, and provide close fitting of sections. Design joints exposed to weather to exclude water.

H. Fabricate FRP products free from warps, twists, or other defects with affect appearance and serviceability.

2.3 STRUCTURAL SHAPES

A. Manufacture all structural shapes by the pultrusion process with a glass content minimum of 45 percent and a maximum of 55 percent by weight.

B. Minimum longitudinal mechanical properties are as follows.

Property	ASTM Method	Minimum Value	Units
Tensile Strength	D638	30,000	psi
Tensile Modulus	D638	2.5×10^6	psi
Flexural Strength	D790	30,000	psi
Flexural Modulus	D790	1.8×10^6	psi
Short Beam Shear	D2344	4,500	psi
Shear Modulus	N/A	4.5×10^5	psi
Coefficient of Thermal Expansion	D696	4.4×10^{-6}	In/in/deg F

2.4 GRATING

A. Furnish and install FRP grating in areas shown on the Drawings, including FRP angle supports and embeds, fasteners, and accessories.

B. Manufacture
1. Depth: As shown on Drawings.
2. Bearing bars and cross-rods manufactured by the pultrusion process having a maximum of 70 percent and a minimum of 60 percent continuous glass content (by weight).
3. Interlock bearing bars and bond to cross-rods to provide a panel that resists twisting forces and prevents internal movement of the bearing bars.
4. Non-slip Surface: Provide grating with quartz grit bonded and baked to the top surface of the finished grating product.
5. Color: Yellow

C. Load/Deflection Requirements: Provide grating capable of spanning the distances indicated without exceeding a deflection of span divided by 240 or 3/8 inch maximum when loaded at 100 psf.

D. Penetrations: Provide cutouts where needed for utility penetrations through the grating. Reinforce around such cutouts where necessary to meet the load/deflection requirements.

E. Fabricate individual grating panels into easily removable sections as large as possible, up to 80 pounds.

F. Grating Clips: Install mechanical grating clips manufactured from Type 316 stainless steel and coated with epoxy coating. Provide a minimum of 4 clips per panel at a maximum of 4 feet on center.

2.5 GRATING FLOOR SYSTEM

A. Provide grating floor system in areas shown on the Drawings. Include all FRP angle supports, FRP adjustable pedestal supports, FRP cross bracing, fasteners, and accessories as required for a complete system. Provide products from a single manufacturer.

B. Manufacture
1. Depth: As shown on Drawings.
2. Design: Bidirectional molded FRP grating.
3. Live Load: 100 psf, deflection limited to 1/4 inch.
4. Non-slip Surface: Provide grating with quartz grit bonded and baked to the top surface of the finished grating product.
5. Color: Yellow

C. Fabricate individual grating panels into easily removable sections as large as possible, up to 80 pounds.

D. Grating Clips: Install mechanical grating clips manufactured from Type 316 stainless steel and coated with epoxy coating. Fasteners shall not project above the walking surface.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Field verify all dimensions before fabrication of products and indicate such measurements on shop drawing layouts. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

3.2 INSTALLATION

A. General
1. Install FRP structures in accordance with manufacturer's assembly shop drawings. Field cut and drill FRP products with carbide or diamond tipped bits and blades only. Seal cut or drilled surfaces in accordance with manufacturer's instructions.
2. Bond FRP items with epoxy adhesive recommended by the manufacturer of the particular items. Use solvent and abrasives to sufficiently remove the surface gloss and to remove any mold release agent or other contaminants which may interfere with proper bonding. Follow adhesive manufacturer's instructions and do not stress bonded items for a minimum of 48 hours after bonding.

B. Structural Shapes
1. Mark materials for field assembly per shop drawing layouts. When finishing is required, complete field assemblies in final position before starting finishing operations.
2. Connections: Make shop and field connections by bonded or bolted as indicated.

3. Holes for Other Work: Provide holes as necessary or as indicated for securing other Work to FRP framing, and for the passage of other Work through FRP members.
4. Seal all field cuts and drilled edges sealed with a resin compatible with the original resin and recommended by the manufacturer to prevent premature fraying at the field cut edges.
5. Furnish anchor bolts and other connectors required for securing structural FRP to in-place Work and templates and other devices for presetting bolts and other anchors to accurate locations.
6. Field Assembly: Set structural frames accurately to the lines and elevations indicated. Align and adjust members to form a part of a complete frame or structure before permanent fastening. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly. Plumb and level individual members of the structure within required tolerances.
7. Misfits at Bolted Connections: Where misfits in bolting are encountered, the immediately notify the Engineer. Submit a method to remedy the misfit for review by the Engineer. Engineer will determine whether the remedy is acceptable or if the member must be refabricated. Methods of remedy may include, but are not limited to the following:
    a. Reaming holes that must be enlarged to admit oversized bolts.
    b. Drilling additional holes in the connection, to conform to manufacturer's standards for bolt spacing, end, and edge distances, and adding additional bolts.
    c. Rejecting the improperly fabricated member and fabricating a new member to ensure proper fit.
    d. Mid-sized or misaligned holes in members shall not be enlarged by burning of by the use of drift pins.

C. Grating
1. Layout: Each grating section shall be readily removable, except where indicated. As much as possible, provide openings and holes where indicated on the Contract Drawings. Make grating openings which fit around protrusions (pipes, cables, machinery, etc.) discontinuous at approximately the centerline of opening so each section of grating is readily removable.
2. Install the grating with a minimum 1.5-inch bearing surface at the support ends.
3. Tolerances Between Sections: Not more than ¼-inch clearance between adjacent sections or between grating and frames. Assemble adjacent sections to line up forming an uninterrupted straight line, where possible.
4. Provide grating free from visual defects such as foreign inclusions, delamination, blisters, resin burns, air bubbles, and pits. Except for non-slip surfaces provide a smooth finish.
5. Miter and bond seat angles corners to produce smooth, even, level seating surface.
6. Install grating so that the top surface is level and even with adjacent walking surfaces. There shall be no protrusions above the top surface.
7. Fasten all grating to supports as specified herein.

3.3 SITE QUALITY CONTROL

A. Site Tests and Inspections

1. Stop Logs: After stop logs are installed, conduct field leakage tests at specified operating conditions. Provide test results to Engineer showing that the field leakage test is with allowable leakage limits specified herein.

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DIVISION 07
THERMAL AND MOISTURE PROTECTION

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SECTION 07 14 00
FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Provide and apply single-component, fluid-applied liquid waterproofing system to below grade concrete slabs, walls, and footings, including surface preparation.

1.2 RELATED SECTIONS

A. Section 03 30 00 Cast-in-Place Concrete

B. Section 07 92 00 Joint Sealants.

1.3 REFERENCES

A. ASTM International (ASTM) standards, most recent editions:

ASTM C836	Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course
ASTM D41	Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
ASTM D1644	Standard Test Methods for Nonvolatile Content of Varnishes
ASTM D4263	Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM E96	Standard Test Methods for Water Vapor Transmission of Materials

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 20 – Submittal Procedures.

B. Product Data: For each type of product indicated. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.

C. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins to adjoining waterproofing, and other termination conditions which may be required.

D. Qualification Data: For qualified Installer.

E. Product Test Reports: For waterproofing, based on evaluation of comprehensive tests performed by a qualified testing agency.

F. Field quality-control reports.

G. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that is approved or licensed by manufacturer for installation of waterproofing required for this Project and is eligible to receive special warranties specified.

B. Source Limitations: Obtain waterproofing materials from single source from single manufacturer.

C. Preinstallation Conference: Conduct conference at Project site.
   1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, installation procedures, testing and inspection procedures, and protection and repairs.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with Section 01 25 10 - Products, Materials, Equipment and Substitutions.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.

C. Remove and replace liquid materials that cannot be applied within their stated shelf life.

D. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, or when temperature is below 0 Degrees F.
   1. Do not apply membrane when air, material, or surface temperatures are expected to fall below 30 Degrees F within four hours of completed application.
   2. Do not apply membrane if rainfall is forecast or imminent within 12 hours.
   3. Do not apply waterproofing membrane to any surfaces containing frost.
   4. Consult manufacturer for applications to green concrete.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.8 WARRANTY

A. Special Warranty: The special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents, and shall be in addition to, and run concurrent with, other warranties made under requirements of the Contract Documents.

B. Provide a written warranty signed by waterproofing manufacturer and installer agreeing to repair or replace waterproofing that does not meet requirements or that does not remain watertight within the specified warranty period.

C. Warranty Period: 3 years after date of Substantial Completion.

D. Warranty does not include failure of waterproofing due to failure of substrate or formation of new joints and cracks in substrate that exceed 1/16 inch in width.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers and products are acceptable:
   1. Fluid Applied Waterproofing:
      a. Epro Services, Inc., Ecobase Waterproofing Membrane.
      b. Tremco Barrier Solutions, Tuff-N-Dri H8 Waterproofing.
      c. Engineer approved equal.

2.2 PERFORMANCE CRITERIA

A. Waterproofing Membrane:
   1. Single-component, polymer-enhanced liquid-applied membrane with the following minimum properties:
      a. Solids content, ASTM D1644, 60% minimum.
      b. Tensile Strength, ASTM D412: 15 psi, minimum.
      c. Elongation, ASTM D412: 1100%, minimum.
      d. Water Vapor Transmission, ASTM E96: 1 perms maximum (40 mil dry coat).
      e. Hydrostatic Pressure Resistance, 8 feet water head, minimum.
      f. Adhesion, ASTM C836, minimum 11 lb/inch to peel from concrete and masonry.

B. Sealants and Accessories: Manufacturer's recommended sealants and accessories.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and prepare substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Close off penetrations to prevent spillage and migration of waterproofing fluids.

D. Remove grease, oil, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

E. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.

3.3 JOINTS, CRACKS, AND TERMINATIONS

A. Prepare and treat substrates to receive waterproofing membrane, including expansion joints, construction joints, cracks, deck drains, corners, and penetrations according to manufacturer's written instructions.

3.4 MEMBRANE APPLICATION

A. Apply using appropriate equipment and nozzles, per manufacturer’s recommendations. Start application with manufacturer's authorized representative present.

B. Membrane: Spray apply asphalt emulsion membrane to substrates and adjoining surfaces indicated. Spread to a minimum wet thickness per manufacturer’s specification to achieve listed hydrostatic resistance, minimum of 60 mils.

C. Apply waterproofing over prepared joints and up wall terminations and vertical surfaces to heights indicated or required by manufacturer.

D. Allow product to cure prior to backfilling.

E. When buried surfaces that have been waterproofed are not backfilled within 30 days of membrane applications, membrane shall be coated with whitewash. Any formula for mixing the whitewash may be used which is not detrimental to the membrane and produces a uniformly coated white surface which remains until backfill is placed.

3.5 FIELD QUALITY CONTROL

A. Engage a full-time site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions; surface preparation; and application of the membrane, flashings, protection, and drainage components; furnish daily reports to Engineer.

3.6 CLEANING AND PROTECTION

A. Protect waterproofing from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

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SECTION 07 22 16
RIGID POLYSTYRENE BOARD INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install rigid tapered polystyrene insulation board on roofs as shown on the Contract Documents

B. Furnish and install rigid polystyrene insulation board for all buried concrete vault roofs and walls as shown on the Contract Documents.

1.2 RELATED SECTIONS

A. Section 07 92 00 Joint Sealants

1.1 REFERENCES

A. ASTM International (ASTM) standards, most recent editions:

ASTM C518	Standard Test Method for Steady-State Thermal Transmission Properties by Means of Head Flow Meter Apparatus
ASTM C578	Standard Specification for Rigid, Cellular Polystyrene Insulation
ASTM D1621	Standard Test Method for Compressive Properties of Rigid Cellular Plastics
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E96	Standard Test Method for Water Vapor Transmission of Materials

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 20 – Submittal Procedures.

B. Product Data
   1. Submit manufacturer's technical data for each type of insulation supplied, including adhesive and fasteners.

C. Samples
   1. Submit 12 inch by 12 inch sample of insulation and four fasteners.

D. Manufacturers' Instructions
   1. Submit manufacturer's installation instructions for preparation and installation specific to the Work of this Section.

1.4 QUALITY ASSURANCE

A. Provide each type of insulation material specified from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with Section 01 25 10 - Products, Materials, Equipment and Substitutions.

B. Handle products carefully, ensuring board corners are not broken and boards are not damaged.

C. Protect roof insulation materials from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

1.6 FIELD CONDITIONS

A. Ambient Conditions: Apply insulation only when surfaces and ambient temperatures are within manufacturer's prescribed limits.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
   1. Rigid Polystyrene Insulation Board
      a. DuPont, Styrofoam Deckmate Plus.
      b. Owens Corning, Foamular 250.
      c. Engineer approved equal.
   1. Mechanical Insulation Anchors
      a. Hilti, IDP Poly Insulation Anchors
      b. Engineer approved equal.

2.2 MATERIALS

A. Rigid Polystyrene Insulation Board for Vaults
   1. Board: ASTM C578, Type IV, rigid, closed cell type, with integral high-density skin.
   2. Thermal Resistance: Typical 5-year aged value of R-5 per 1 inch of thickness per ASTM C518.
   3. Board Size: As necessary for application - largest practical size.
   4. Board Thickness: 2 inches thick.
   5. Color: Blue.
   6. Compressive Strength: Minimum 25 psi.
   7. Water Absorption: Maximum of 0.7% by volume in accordance with ASTM D1621
   8. Edges: Square.
   9. Water Vapor Permeance: Maximum 1.5 perms per ASTM E96.
   10. Flame Spread / Smoke Developed Values: 15/175 per ASTM E84.

B. Bonding Adhesive: Insulation manufacturer's recommended spray-applied, low-rise, two-component urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.

C. Mechanical Fasteners
   1. Vault Insulation: In addition to adhesive, use mechanical fasteners to bind insulation mechanically and permanently to the concrete and other surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that the insulation boards and adjacent materials are compatible.

B. Verify that substrate is sound, clean, and free of oil, grease, and materials or substances that may impede adhesive bond.

3.2 PREPARATION

3.3 INSTALLATION

A. Vaults
   1. Install the insulation on the vault walls, from the underside of the roof to a point 4 feet below final exterior grade.
   2. Install insulation on underside of roof slab and access hatches.
   3. Use both adhesive and mechanical anchors.
      a. Place mechanical anchors at each corner of the insulation board.
      b. Place a minimum of two rows of three anchors per board.
   4. Place insulation to lines shown on the Drawings and keep all joints and abutments moderately snug without forcing.
   5. Do not apply adhesive to insulation that will deleteriously affect it in any way.

3.4 CLEANING

A. Remove from the Site, all containers, wrappings, and scrap insulation material. Leave roofs and floors broom clean.

END OF SECTION

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SECTION 07 92 00
JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes sealant work associated with joints between similar and dissimilar materials in the Work.

B. Work included consists of, but is not necessarily limited to the following:
   1. Sealing all joints which would otherwise permit penetration of moisture, unless sealing work is specifically required under other sections.
      a. Flashing reglets and retainers.
      b. Exterior wall joints.
      c. Flooring joints.
      d. Isolation joints.
      e. Joints between paving and sidewalks and building.
      f. Concrete control and expansion joints, exterior and interior.
      g. Joints at penetrations of walls, floors, and decks by piping and other services and equipment.
      h. Exterior and interior perimeters of exterior and interior door and window frames, louvers, grilles, etc.
      i. Thresholds at exterior doors.
      j. Sealing of plumbing fixtures to floor or wall.
      k. Other joints where caulking, sealant, or compressible sealant is indicated.

1.2 REFERENCES

A. ASTM International (ASTM) standards, most recent editions:

ASTM C920	Standard Specification for Elastomeric Joint Sealants
ASTM C1087	Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems
ASTM C1193	Standard Guide for Use of Joint Sealants
ASTM C1247	Standard Test Method for Durability of Sealants Exposed to Continuous Immersion in Liquids

B. Federal Specification (FS), most recent editions:

TT-S-001543A	Sealing Compound: Silicone Rubber Base (for Caulking, Sealing, and Glazing in Buildings and Other Structures)
TT-S-00230C	Sealing Compound: Elastomeric Type, Single Component (For Caulking, Sealing, and Glazing in Buildings and Other Structures)

TT-S-00227E	Sealing Compound: Elastomeric Type, Multi-Component (for Caulking, Sealing, and Glazing in Buildings and Other Structures)

C. Underwriters Laboratories Inc. (UL):

Building Materials Directory

D. National Sanitation Foundation (NSF), most recent edition:

NSF 61	Drinking Water System Components, Health Effects

1.3 DEFINITIONS

A. Words "caulk," "sealant," and "caulking" mean sealant Work.

B. "Interior wet areas" mean toilets, showers, sinks, and similar areas.

C. "Applicator" means the individual actually on site performing the installation.

D. "Vertical" means any surface with a slope greater than 1.5 horizontal to 1.0 vertical.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 20 – Submittal Procedures.

B. Product Data
1. Letter of certification that products submitted meet requirements of standards referenced.
2. Manufacturer's installation instructions.
3. Manufacturer's recommendations for joint cleaner, primer, backer rod, tooling, and bond breaker.
4. Applicator qualifications.
5. Warranty.
6. Certification from sealant manufacturer stating that product being used is recommended for and is best suited for joint in which it is being applied.

C. Field Samples
1. Cured sample of each color for Engineer's color selection. Color chart not acceptable.

D. Preconstruction field test reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in below in QUALITY ASSURANCE.

E. Product test reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.

F. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Qualifications:
   1. Sealant applicator shall have a minimum of five years of experience on projects with similar scope.

B. Mock-ups:
   1. Before caulking work is started, a sample of each type of joint shall be caulked where directed by Engineer. The approved samples shall show the workmanship, bond, and color of caulking materials as specified or selected for the Work and shall be the minimum standard of quality on the entire Project.

C. Preconstruction compatibility and adhesion testing:
   1. Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact of affect joint sealants.
      a. Use ASTM C1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
      b. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
      c. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
      d. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
      e. Testing will not be required if sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

D. Preconstruction field-adhesion testing: Before installing elastomeric sealants, field test their adhesion to joint substrates found in the Work as follows:
   1. Locate test joints where indicated in the Work or, if not indicated, as directed by the Engineer.
   2. Conduct tests for each application indicated below:
      a. Each type of elastomeric sealant and joint substrate indicated.
   3. Notify Engineer a minimum of 7 days in advance of dates and times when test joints will be evaluated.
   4. Test method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 of ASTM C1193.
   5. Report whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
   6. Evaluation of preconstruction field-adhesion test results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with Section 01 25 10 - Products, Materials, Equipment and Substitutions.

B. Deliver material in manufacturer's original unopened containers with labels intact. Labels shall indicate contents and expiration date of material.

C. Store all materials off the ground and protect from rain, freezing, or excessive heat until ready for use.

D. Condition the specified products before use as recommended by the manufacturer.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Schedule Work to be performed when temperature and humidity are as recommended by the sealant manufacturer during and after installation until products are fully cured.

1.8 WARRANTY

A. Material and Labor Warranty:
   1. Sealant work shall be free of defects for a period of 5 years from date of final acceptance.
   2. Failure of watertightness constitutes a defect.
   3. Remove any defective work and/or materials and replace with new materials.
   4. Warranty must be signed jointly by applicator and sealant manufacturer.

B. Special installer's warranty:
   1. Installer's standard form in which installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified herein within specified warranty period.
      a. Warranty period: Five years from date of final acceptance.
   2. Special warranties herein specified exclude deterioration or failure of elastomeric joint sealants from the following:
      a. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design.
      b. Disintegration of joint substrates from natural causes exceeding design specifications.
      c. Mechanical damage by individuals, tools, or other outside agents.
      d. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
   1. Polyurethane sealants.
      a. Pecora.

b. PSI Polymeric Systems, Inc.
c. Sika Chemical Corporation.
d. BASF Master Builders.
e. Engineer approved equal.

2. Silicone sealants:
   a. Dow Corning Corporation.
   b. General Electric.
   c. Tremco
   d. Engineer approved equal.
3. Fire Resistant Sealant:
   a. 3M Corporation.
   b. Dow Corning.
   c. Engineer approved equal.

2.2 MATERIALS

A. Sealants – General:
1. Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
2. Where compound is exposed to view in finished Work, provide colors matching materials being sealed.
3. Where compound is not exposed to view in finished Work, provide manufacturer's color with best performance.
4. For joints in potable water reservoirs, provide only 2-component polyurethane sealant with NSF 61 certification.
5. Provide non sagging sealant for vertical and overhead joints.
6. Sealants for horizontal joints:
   a. Self-leveling pedestrian/traffic grade.
7. Suitability for immersion in liquids: Where elastomeric sealants are indicated for submerged use, provide products that have undergone testing according to ASTM C1247 and qualify for the length of exposure indicated by reference to ASTM C920 for Classes 1 or 2. Liquid used for testing sealants is chlorinated potable water, unless otherwise noted.

B. Polyurethane Sealant:
1. One or two components.
2. Meet ASTM C920; F.S. TT-S-00230C, Type I or Type II, Class A, or TT-S-00227E, Type I or Type II, Class A.
   a. Pecora Dynatrol I, Dynatrol II, Urexpan NR-200 or NR-201.
   b. PSI PSI-270.
   c. Sika Sikaflex-1A, Sikaflex-2C.
   d. Master Builders MasterSeal NP-1, NP-II, SL-1.

C. Silicone Sealant:
1. One component.
2. Meet F.S. TT-S-001543A, Class A:
   a. Dow Corning 790, 795, 786.
   b. General Electric Silpruf, Silglaze, Sanitary SCS 1700 sealant.
   c. Tremco Spectrem.

D. Bond breaker tape: Polyethylene tape of other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint surfaces of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.
   1. Unless specifically shown on the Drawings, bond breaker shall not be used in joints within the reservoir.

E. Joint Cleaner, Primer, Bond Breaker:
   1. As recommended by sealant manufacturer.

F. Sealant Backer Rod: Closed cell polyethylene, polyethylene jacketed polyurethane foam, or other flexible, non-absorbent, non-bituminous material recommended by sealant manufacturer to:
   1. Control joint depth
   2. Break bond of sealant oat bottom of joint
   3. Provide proper shape of sealant bead.

G. Fire-Resistant Sealant:
   1. One or two component.
   2. Furnish sealant which has been tested for use as a fire and smoke penetration seal.
      a. 3M Corporation Fire Dam 150.
      b. Dow Corning Firestop.
   3. UL approved for intended use.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before using any sealant, investigate its compatibility with adjacent joint surfaces, fillers, and other materials in the joint system.

B. Use only compatible materials.

C. Clean and prime joint surfaces in accordance with manufacturer's instructions.
   1. Limit application to surfaces to receive sealant.
   2. Mask off adjacent surfaces.

D. Commencing sealant installation constitutes acceptance of joints and surfaces.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Where finish coating or covering is to be applied to surface, wait until such coating or covering has been applied before installing sealant; e.g., paint, wall covering, glazed coatings.

C. Make all joints water and airtight.

D. Make depth of sealing compounds not more than one-half width of joint, but in no case less than 1/4 inch nor more than 5/8 inch.

E. Provide correctly sized backer rod in all joints to proper depth.

F. Apply bond breaker where required.

G. Tool sealants using sufficient pressure to fill all voids.

H. Upon completion, leave sealant with smooth even neat finish.

3.3 CLEANING

A. Clean adjacent soiled surfaces free of sealant.

3.4 PROTECTION

A. Protect finished installation.

B. Protect sealants until fully cured.

3.5 SCHEDULES

A. Furnish sealant as indicated for the following areas:
   1. Exterior areas:
      a. Joints in concrete and masonry:
         1) Use 2-component polyurethane only.
      b. All other joints:
         1) Single or 2-component Polyurethane or.
         2) Silicone.
   2. Interior wet areas:
      a. Joints in concrete and masonry:
         1) Use 2-component polyurethane only.
      b. All other joints:
         1) Single or 2-component Polyurethane or.
         2) Silicone.
   3. Interior non-wet, corrosive areas:
      a. Joints in concrete and masonry:
         1) Use 2-component polyurethane only.
      b. All other joints:
         1) Single or 2-component Polyurethane or.
         2) Silicone.
   4. Interior non-wet, drywall and plaster noncorrosive areas:
      a. All Joints:
         1) Single or 2-component Polyurethane or.
         2) Silicone.
   5. Fire-rated construction: Fire-resistant sealant.

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DIVISION 09
FINISHES

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SECTION 09 90 00
PROTECTIVE COATINGS AND LININGS

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section covers surface preparation, furnishing, and application of protective coatings, complete.

B. It is the intent of this specification that all new or existing exposed metal surfaces shall be coated with a protective coating, unless specifically excluded.

C. Shop or existing surface preparation methods, cleanliness, and existing paint, rust, and mill scale removal are not known nor documented. Contractor shall be solely responsible for determining work effort, abrasive blast requirements, and any other factors that may affect work productivity as required to provide the specified surface preparation cleanliness, regardless of prior system preparation or coating application.

1.2 ABBREVIATIONS

ANSI	American National Standards Institute
AWWA	American Water Works Association
CSP	Concrete Surface Profile
MDFT	Minimum Dry Film Thickness
MDFTPC	Minimum Dry Film Thickness Per Coat
mil	Thousandths of an Inch
OSHA	Occupational Safety and Health Act
PSDS	Paint System Data Sheet
SFPG	Square Feet Per Gallon
SFPGPC	Square Feet Per Gallon Per Coat
SP	Surface Preparation
SSPC	Steel Structures Painting Council
TLCP	Toxicity Characteristic Leaching Procedure
VOCs	Volatile Organic Compounds

1.3 REFERENCE STANDARDS

A. This specification recognizes AWWA, NACE, and SSPC standards as minimum industry standards and they are referenced for purpose of conformance, except where modified herein. The requirements of this specification section have been written to a higher design standard with the intent of achieving a long-term coating performance of 100 years.

NACE SP0188	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

NACE RP-0274	High Voltage Electrical Inspection of Pipeline Coatings Prior to Installation
SSPC-SP-1	Solvent Cleaning Surface Preparation
SSPC-SP-2	Hand Tool Cleaning Surface Preparation
SSPC-SP-3	Power Tool Cleaning Surface Preparation
SSPC-SP-5	White Metal Abrasive Blast Surface Preparation
SSPC-SP-6	Commercial Abrasive Blast Surface Preparation
SSPC-SP-10	Near-White Metal Abrasive Blast Surface Preparation
SSPC-SP-11	Power Tool Cleaning to Bare Metal Surface Preparation
SSPC-SP-13	Surface Preparation of Concrete

1.4 SUBMITTAL REQUIREMENTS

A. Submit in accordance with Section 01 33 20 – Submittal Procedures and Section 09 90 10 – Pipeline Coatings and Linings.

B. Shop Drawings: Catalog cuts and other information for all products proposed. Provide copy of approved coating system submittals to the coating applicator.

C. Quality Control Submittals: Furnish the following:
   1. Signed letter from the coating manufacturer prefacing any coating product submittal. This letter shall indicate that the coating manufacturer's representative is aware of the Project and recommends the specific products included in the submittal for use on the Project.
   2. Applicator's Experience with list of references substantiating compliance.
   3. Coating manufacturer's certification stating the individual coating applicators have met the qualification certification requirements as specified this section.
   4. The coating manufacturer shall provide a copy of the manufacturer's coating application quality assurance manual.
   5. If the manufacturer of field-applied coating differs from that of the shop applied primer, provide written confirmation from topcoat manufacturer certifying compatibility.

D. Product Data: Furnish the following Data Sheets:
   1. For each paint system used herein, furnish a Paint System Data Sheet (PSDS), Technical Data Sheets, and paint colors available (where applicable) for each product used in the paint system. A sample PSDS form is appended at the end of this section.
   2. The required information shall be submitted on a system-by-system basis.
   3. The Contractor shall also provide copies of the paint system submittals to the coating applicator following submittal approval.
   4. Indiscriminate submittal of manufacturer's literature only is not acceptable.

E. Where ANSI/NSF Standard 60 and 61 approvals is required, submit ANSI/NSF certification letter for each coating in the system indicating product application limits on size of tank or piping, dry film thickness, number of coats, specific product tested, colors certified, and approved additives.

F. Provide TCLP test data for lead and other regulated heavy metals in non-recyclable, slag type abrasive blast media to be used on the project. Acceptable abrasive test data shall indicate the abrasive manufacturer, location of manufacture, and media gradation and

type. Surface preparation will not be permitted to begin until acceptable test data has been submitted.

1.5 QUALITY ASSURANCE

A. Coating Applicator's Experience and Certification:
   1. Coating Application Company and coating application supervisor (Certified Applicator) shall have a minimum of 5 years' experience applying the specified coating system.
   2. Coating application personnel, who have direct coating application responsibility, shall have a minimum of 2 years practical experience in application of the indicated coating system.
   3. Coating applicator shall be certified by the coating manufacturer as an approved applicator.

B. Continuity of Contractor: Contractor's site supervisor shall be coordinated with the Engineer. Any replacement of the supervisor on site will require notification of Engineer 72 hours in advance and will be subject to approval by the Owner.

C. Coating and/or lining manufacturer shall provide a technical representative to visit the jobsite at intervals during surface preparation and painting as may be required for product application quality assurance, and to determine compliance with manufacturer's instructions and these Specifications, and as may be necessary to resolve field problems attributable to, or associated with, the manufacturer's products furnished under this Contract. Sales representatives are not acceptable as a technical representative unless written authorization from the coating manufacturer is provided, which states the sales representative has full authority to act in behalf of the coating manufacturer.

1.6 WARRANTY

A. The Contractor and coating manufacturer shall jointly and separately warrant to the Owner and guarantee the work under this section against defective workmanship and materials for a period of 2 year(s) commencing on the date of final acceptance of the work.

1.7 ENGINEER OBSERVATIONS

A. The Contractor shall give the Owner Representative notice a minimum of 14 days prior to start of work for scheduling shop or field observation.

B. Provide Owner Representative a minimum 3 days' notice for actual start of surface preparation and coating application work.

C. Provisions shall be made to allow Owner's representative full access to facilities and appropriate documentation regarding coating application.

D. Observation by the Owner's representative or the waiver of observation of any portion of the work shall not be construed to relieve the Contractor of his responsibility to perform the work in accordance with these Specifications.

E. Materials shall be subject to testing for conformance with this specification as the Owner's representative may elect, prior to or during incorporation into the work.

F. Perform work in the presence of ENGINEER or Owner Representative, unless prior approval to perform such work in Engineer's absence is granted. Approval to perform work in the Engineer's absence is limited to the current day unless specifically noted to extend beyond the completion of the workday

PART 2 PRODUCTS

2.1 GENERAL

A. Coatings and linings will be stored and handled per manufacturer's written directions.

B. All metallic surfaces shall be prepared and coated in accordance with referenced standards, written instructions of the coating or lining manufacturer, and these specifications, whichever is more stringent.

C. Coatings shall be the product of a single manufacturer. Product substitutions during the project will not be permitted without ENGINEER approval.

2.2 PAINT DELIVERY, STORAGE, AND HANDLING

A. Delivered paint to the project site in unopened containers that plainly show, at the time of use, the designated name, date of manufacture, color, and name of manufacturer.

B. Store paints in a suitable protected area that is heated or cooled as required to maintain temperatures within the range recommended by the paint manufacturer.

C. Shipping:
1. Where shop finish coated or primed items are to be shipped to the jobsite, protect coating from damage. Batten coated items to prevent abrasion.
2. Use nonmetallic or padded slings and straps in handling.
3. Items will be rejected for excessive damage.

2.3 PAINT AND COATINGS MANUFACTURERS

A. A manufacturer letter code as follows will be found following the generic descriptions of materials outlined in the Specifications. Address is that of the general offices. Contact these offices for information regarding the location of representative nearest the project site.

B. MANUFACTURER CODE A - COATINGS MANUFACTURERS (Able to supply most heavy-duty industrial coatings and architectural paints):

1. Carboline Coatings Company, St. Louis, MO.
2. ICI Devoe Coatings Company, Louisville, KY.
3. International Coatings, Cerritos, CA
4. Pittsburgh Paints (PPG), Pittsburgh, PA.
5. Sherwin Williams, Cleveland, OH

6. Tnemec Coatings, Kansas City, MO

2.4 PAINT MATERIALS

A. Products shall meet federal, state, and local requirements limiting the emission of VOCs. Specific information may be secured through the local office of the Air Pollution Control Officer.

B. Materials Including Primer and Finish Coats: Produced by same paint manufacturer of other components of the coating system, as previously stated.

C. Thinners, Cleaners, Driers, and Other Additives: As recommended by manufacturer of the coating system. Where coatings are required to meet ANSI/NSF Standard 60 and 61, addition of thinners, driers, and other paint additives not approved under the ANSI/NSF certification letter will not be permitted.

D. Paint products are listed according to their approximate order of appearance in the paint systems. The letter designating the manufacturer code refers to Article PAINT AND COATING MANUFACTURERS.

Products	**Description**
Epoxy, NSF	Amine or polyamine epoxy coating, two parts, suitable for immersion service, 75% volume solids minimum, capable of 4 to 8 MDFT per coat, approved for potable water contact in conformance to ANSI/NSF Standard 60 and 61, and suitable for the application temperatures and conditions. MANUFACTURER CODE: A
Epoxy	Polyamine or polyamide epoxy, two parts, suitable for immersion service, 75% volume solids minimum, capable of 4 to 8 MDFT per coat, and suitable for the application temperatures and conditions. MANUFACTURER CODE: A
Epoxy Siloxane	Epoxy siloxane hybrid coating, high solids, semi-gloss or high gloss, tintable colors. Tinted colors shall be capable of storage for 30 days or longer prior to application. Coating shall be capable of spray, roller, or brush application on all metal substrates and specified prime and intermediate coats. Abrasion, corrosion, and UV resistant. MANUFACTURER CODE: A
Inorganic Zinc Primer	Solvent or water based, 14 lbs. metallic zinc content per gallon minimum; unlimited recoat window, conform to manufacturer's recommended topcoats as specified herein. MANUFACTURER CODE: A
Wash Primer	Vinyl butyral acid or equivalent coating for enhancing finish coat adhesion to galvanized steel surfaces. MANUFACTURER CODE: A
Polyurethane Enamel	Two-component, aliphatic or acrylic based polyurethane; high gloss finish, suitable for continuous dry service at 200 degrees F without discoloration or peeling. MANUFACTURER CODE: A

2.5 COLORS

A. Provide as selected by the Owner.

B. Formulated with colorants free of lead, lead compounds, or other materials which might be affected by the presence of hydrogen sulfide or other gas likely to be present at the project.

C. Proprietary identification of colors is for identification only. Any authorized manufacturer may supply matches.

D. Equipment Colors:
   1. Equipment shall be meant to include the machinery or vessel itself plus the structural supports and fasteners and attached electrical conduits.
   2. Paint non-submerged portions of equipment in the same color as the process piping it serves, except as itemized below:
      a. Dangerous parts of equipment and machinery: OSHA Orange
      b. Fire protection equipment and Apparatus: OSHA Red
      c. Radiation hazards: OSHA Purple
      d. Physical hazards in normal operating area: OSHA Yellow
   3. Fiberglass reinforced plastic (FRP) equipment with an integral-colored gel coat does not require painting, provided the color is as specified.

2.6 QA/QC TESTING AND INSPECTION

A. General
   1. Applicator shall inspect and test the coating system in accordance with referenced standards and these specifications, whichever is more stringent.
   2. Quality control testing as specified in AWWA standards are minimum industry standards and it is the intent of this specification to provide a higher level of quality control for the objective of achieving maximum coating performance.
   3. If any conflict between this specification and referenced standards occurs, the more stringent requirement shall apply, and any interpretation of this requirement or results shall be with the objective of achieving maximum coating performance.
   4. The frequency of the testing shall be determined by the applicator but shall not be less than the requirements of this specification.

B. Surface Profile Testing
   1. Surface profile of abrasive blasted surfaces to be tested with “Press-O-Film” tester tape or equivalent in accordance with NACE RP287.
   2. Tester tape shall be suitable for the intended profile height.
   3. Profile shall be measured to a minimum tolerance of 0.1 mils, maximum.
   4. Electronic surface profilometer shall be used, where deemed necessary, to verify tester tape measurements.

C. Adhesion testing: As specified in Section 09 90 10, where directed by the Engineer for assessing coating application problems.

D. Holiday Testing

1. Holiday tests on epoxy coatings or linings will be conducted on the completed coating or lining after cure or 24-hours, whichever is less, using a high voltage spark test in accordance with NACE SP-0188 and these specifications.
2. Coating thickness used for high voltage holiday testing setting shall be the average dry coating thickness.

E. Dry Film Thickness Testing
1. Coatings shall be tested for dry film thickness using a properly calibrated magnetic pull off, eddy current, or ultrasonic equipment.
2. Coating thickness measurements shall be conducted as necessary and without limitation. Testing conformance to the requirements of SSPC PA-2 is specifically excluded from this specification.

PART 3 EXECUTION

3.1 GENERAL

A. The intention of this specification is for all existing and new, interior and exterior surfaces to be painted, whether specifically mentioned or not, except as modified herein. Concealed structural steel surfaces shall receive prime coat only unless modified herein. Exterior concrete surfaces will not be painted unless specifically indicated hereinafter.

B. Surface preparation and coating application shall be in conformance with these specifications and the coating manufacturer's written product data sheets and written recommendations of the manufacturer's technical representative. Where conflicts occur between the manufacturer's recommendations and these specifications, the more stringent of the two shall apply unless otherwise approved by the Engineer.

C. For coatings subject to immersion, obtain full cure for completed system. Consult coatings manufacturer's written instructions for these requirements. Do not immerse coating for any purpose until completion of curing cycle.

3.2 REGULATORY REQUIREMENTS

A. Meet federal, state, and local requirements limiting the emission of VOCs and worker exposures.

B. Protect workers and comply with applicable federal, state, and local air pollution and environmental regulations for surface preparation, blast cleaning, disposition of spent aggregate and debris, coating application and dust prevention including, but not limited to the following Acts, Regulations, Standards, and Guidelines:
1. Clean Air Act
2. National Ambient Air Quality Standard
3. Resource Conservation and Recovery Act (RCRA)

C. Comply with applicable federal, state, and local regulations for confined space entry.

D. Provide and operate equipment that meets explosion proof requirements.

3.3 ENVIRONMENTAL CONDITIONS

A. Do not perform abrasive blast cleaning whenever the relative humidity exceeds 85 percent, whenever surface temperature is less than 5 degrees F above the dew point of the ambient air.

B. Surface preparation power tools and blast equipment shall contain dust collection equipment that will prevent discharge of dust particles into the atmosphere.

C. Do not apply paint when:
   1. Surface temperatures exceed the maximum or minimum temperature recommended by the paint manufacturer,
   2. In dust, smoke-laden atmosphere, damp or humid weather, or under conditions which could cause icing on the metal surface.
   3. When it is expected that surface temperatures will drop below 5 degrees above dew point within 8 hours after application of coating.

3.4 DEHUMIDIFICATION

A. Where environmental conditions cannot be met or controlled, Contractor shall provide and operate desiccant dehumidification equipment to maintain environmental conditions for 24 hours a day during abrasive blasting and coating application and cure. Liquid, granular, or loose lithium chloride drying systems will not be acceptable.

B. Contractor shall provide dehumidification equipment sized to maintain dew point temperature 17 degrees or more below surface temperature of metal surfaces to be cleaned and coated. System shall provide ventilation within the environmentally controlled areas as required for the following requirements:
   1. One air exchange per hour, minimum,
   2. Maintenance of personnel exposures limits (PEL) at 50 percent of OSHA PEL limits for all chemicals used in the performance of the work, and
   3. Maintenance of lower explosive limits (LEL) to less than 50 percent of the most volatile solvent used in the performance of the work.

C. Dehumidification equipment type, size, air flow, and power requirements shall be designed by a qualified company knowledgeable in dehumidification equipment, and its operation based on project requirements and anticipated seasonal weather conditions for the project schedule. Design to include evaluation of existing conditions, humidity, and temperature, proper air exchange requirements, ventilation requirements, ducting requirements for adequate air flow, and any other issues necessary to achieve the specified performance and environmental conditions throughout the duration of the project.

D. Contractor to submit written recommendations from dehumidification subcontractor for bulkhead locations, bulkhead venting, duct work for each bulkhead section, any secondary ventilation requirements for coating cure, dust collection equipment CFM requirements, and drying requirements for blast hose compressed air necessary to maintain environmental control as specified herein.

E. Dehumidification subcontractor shall either operate the equipment or provide training to Contractor on the proper operation and setup of dehumidification equipment. Dehumidification subcontractor shall provide a technical representative on site for a minimum of two 8-hour days to ensure proper operation of the equipment, achievement

of desired environmental control, and to ensure Contractor can properly set up, operate, monitor, and maintain the equipment.

F. Dehumidification shall be operated in a manner that prevents all condensation or icing throughout surface preparation and coating application and cure.

G. Reblasting of flash rusted metal surfaces or removal of damaged coatings, as a result of equipment malfunction, shutdown, or other events that result in the loss of environmental control, will be at the sole expense of the Contractor. Cleaned metal surfaces subject to flash rusting shall be cleaned to the same cleanliness as prior to the flash rust formation and shall be approved by the Engineer.

H. Contractor shall monitor ambient temperature, humidity, dew point temperature, and pipe surface temperature both outdoors and within the work area at the start, midpoint, and end of each work shift, minimum, but not greater than 5 hours between measurements.

I. Daily environmental condition monitoring and maintenance of the equipment shall be documented in writing and provided to the Engineer.

3.5 VENTILATION AND ILLUMINATION

A. Adequate illumination shall be provided while work is in progress. Whenever required by the inspector, the Contractor shall provide additional illumination and necessary supports to cover all areas to be inspected. The level of illumination for inspection purposes shall be determined by the inspector.

B. Ventilation shall be used to control potential dust and hazardous conditions within the tank. Ventilation flow rates shall be in accordance with OSHA regulations and as required to reduce air contamination to nonhazardous conditions.

3.6 SURFACES NOT REQUIRING PAINTING

A. Unless otherwise stated herein or shown, the following areas or items will not require painting:
   1. Concrete and masonry surfaces except where indicated on the Drawings.
   2. Nonferrous and corrosion-resistant ferrous alloys such as copper, bronze, monel, aluminum, chromium plate, atmospherically exposed weathering steel, and stainless steel, except where:
      a. Required for electrical insulation between dissimilar metals.
      b. Aluminum and stainless steel are embedded in concrete or masonry, or aluminum is in contact with concrete or masonry.
      c. Color coding of equipment and piping is required.
   3. Nonmetallic materials such as glass, PVC, wood, porcelain, and plastic (FRP) except as required for architectural painting or color coding.
   4. Prefinished electrical and architectural items such as motor control centers, switchboards, switchgear, panel boards, transformers, disconnect switches, acoustical tile, cabinets, elevators, building louvers, wall panels, etc.; color coding of equipment is required.
   5. Non-submerged electrical conduits attached to unpainted concrete surfaces.
   6. Cathodic protection anodes.

7. Items specified to be galvanized after fabrication unless specifically required elsewhere or subject to immersion.
8. Insulated piping and/or insulated piping with jacket will not require exterior coating, except as required for architectural painting or color coding.

3.7 PREPARATION OF SURFACES

A. Surface Preparation Inspection:
   1. Inspect and provide substrate surfaces prepared in accordance with these Specifications and the printed directions and recommendations of paint manufacturer whose product is to be applied.
   2. Provide Engineer minimum 3 days' notice prior to start of surface preparation work or coating application work.
   3. Perform such work only in the presence of Engineer, unless Engineer grants prior approval to perform such work in Engineer's absence.

B. Metal Surface Preparation:
   1. General:
      a. Do not perform a surface preparation blast prior to submission of samples. Workmanship for metal surface preparation as specified shall meet current Steel Structures Painting Council (SSPC) Specifications as follows:
         (1) Solvent Cleaning: SP 1
         (2) Hand Tool Cleaning: SP 2
         (3) Power Tool Cleaning: SP 3
         (4) White Metal Blast Cleaning: SP 5
         (5) Commercial Blast Cleaning: SP 6
         (6) Brush-Off Blast Cleaning: SP 7
         (7) Pickling: SP 8
         (8) Near-White Blast Cleaning: SP 10
         (9) Bare Metal Power Tool Cleaning: SP 11
      b. All surface preparation shall be assumed to be on a SSPC Grade A steel surface condition, unless specifically noted otherwise.
      c. Wherever the words "solvent cleaning", "hand tool cleaning", "wire brushing", or "blast cleaning", or similar words of equal intent are used in these Specifications or in paint manufacturer's specifications, they shall be understood to refer to the applicable SSPC Specifications listed above.
      d. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacu-blast methods may be required. Coating manufacturers' recommendations for wet blast additives and first coat application shall apply. Wet blasting methods shall be approved by the Engineer.
      e. Hand tool clean areas that cannot be cleaned by power tool cleaning.
   2. Welds and adjacent areas:
      a. Prepared such that there is:
         (1) No undercutting or reverse ridges on the weld bead.
         (2) No weld spatter on or adjacent to the weld or any other area to be painted.
         (3) No sharp peaks or ridges along the weld bead.
      b. Grind embedded pieces of electrode or wire flush with the adjacent surface of the weld bead.
   3. Preblast Cleaning Requirements:
      a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.

b. Cleaning methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
c. Clean small, isolated areas as above or solvent cleaned with suitable solvents and clean cloths.
d. Round or chamfered all sharp edges and grind smooth burrs, jagged edges, and surface defects.

4. Blast Cleaning Requirements:
   a. General:
      (1) Type of Equipment and Speed of Travel: Designed to obtain specified degree of cleanliness.
      (2) Select type and size of abrasive to produce a surface profile that meets the coating manufacturer's recommendations for the particular coating to be applied or not less than 20 percent of the specified coating thickness, whichever is more stringent.
      (3) Meet applicable federal, state, and local air pollution control regulations for blast cleaning and disposition of spent aggregate and debris.
      (4) Do not reuse abrasive, unless abrasive is recyclable steel grit or shot abrasive.
   b. Shop Blasting
      (1) Notify Engineer at least 7 days prior to start of shop blast cleaning to allow for inspection of the work during surface preparation and shop application of paints. Work shall be subject to the Engineer's approval before shipment to the jobsite.
      (2) Items such as structural steel, metal doors and frames, metal louvers, and similar items as reviewed by the Engineer may be shop prepared and primed. Centrifugal wheel blast cleaning is an acceptable alternative to shop blast cleaning. Blast clean and prime in accordance with these Specifications.
   c. Field Blasting
      (1) Perform sandblasting for items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed. Materials, equipment, and procedures shall meet requirements of Steel Structures Painting Council.
      (2) Field blasting in areas with electrical or mechanical equipment, within buildings, or on coated surfaces with lead paint greater than 2,000 mg/L total lead shall be performed with dustless abrasive systems such as “Sponge-Jet”, dry ice abrasive blasting.
5. Post-Blast Cleaning and Other Cleaning Requirements:
   a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wiped with a tack cloth.
   b. Paint surfaces the same day they are sandblasted. Reblast surfaces that have started to rust before they are painted.

C. Concrete Surface Preparation:
1. Do not begin until 30 days after the concrete has been placed.
2. Remove grease, oil, dirt, salts, or other chemicals, loose materials or other foreign matter by solvent, detergent, or other suitable cleaning methods.
3. Clean concrete using mechanical or chemical methods for the degree of cleaning specified for the coating system in accordance with SSPC SP-13, Surface preparation of Concrete.

4. Unless otherwise required for proper adhesion, ensure surfaces are dry prior to coating.
5. Prepare concrete surface to CSP 5 as verified by Engineer.
6. Bug holes, air pockets, and other voids in the concrete will be filled or patched in chemical exposure areas, secondary containment, and where specifically required.
7. Concrete Surface Preparation Inspection:
    a. Adhesion Testing:
        (1) Tensile testing of the surface preparation shall be performed by the Engineer as necessary using Type 4 or Type 5 pneumatic adhesion testing equipment in accordance with ASTM D4541 using 2-inch diameter dollies for concrete surface adhesion testing.
        (2) Applied coating greater than 20 mils in thickness or with a tensile strength greater than 2,500 psi shall be scored for concrete adhesion testing.
        (3) Adhesive failure greater than 50 percent of the dolly surface area shall indicate inadequate surface preparation.
        (4) Cohesive failures which result in loss of sound concrete will be acceptable provided the loss is greater than 50 percent of the dolly surface area.
        (5) Low adhesion cohesive failures with a thin layer of concrete due to weak concrete or laitance over 50 percent of the dolly surface will be rejected.
    b. Concrete Soundness:
        (1) Concrete soundness shall be determined using the scratching or hammer impact methods as defined in SSPC SP-13.
    c. Moisture Content:
        (1) Moisture shall be tested as Specified in SSPC SP-13 and shall not exceed the moisture content recommended by the coating manufacturer.

D. Brush-off Blast Cleaning:
1. Equipment, procedure, and degree of cleaning shall meet SSPC-SP 7, Brush-off Blast Cleaning and shall achieve a profile on the coating equivalent to 80 grit sandpaper with no exposed metal. Profile shall be uniform over the surface with no glossy areas visible.
2. Where metal substrate is exposed, Contractor shall apply full coating system as specified for new metal surfaces.
3. Repair or replace surfaces damaged by blast cleaning, where damage is defined as visible metal substrate. If less than 5 percent of prepared surface has the metal substrate visible, the coating shall be repaired by application of a brush applied intermediate coat. If greater than 5 percent the coating shall be fully removed to meet the specified surface cleanliness and recoated with the specified coating system.
4. Abrasive: Either conventional abrasive blasting with sand, grit, or nut shells or specialized abrasive blasting. Abrasives shall be 60 mesh grit, maximum.
5. Select various surface preparation parameters such as size and hardness of the abrasive, nozzle size, air pressure, and nozzle distance from the surface such that the surface is cleaned without pitting, chipping, or other damage.
6. Verify parameter selection by blast cleaning a trial area that will not be exposed to view.
7. The Engineer shall approve trial blast cleaned area and shall use area as a representative sample of surface preparation.

E. Solvent Cleaning:

1. Consists of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants using solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods which involve a solvent or cleaning action.
2. Method meets SSPC-SP 1.

3.8 PROTECTION OF MATERIALS NOT TO BE PAINTED

A. Remove, mask, or otherwise protect hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted.

B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.

C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.

D. Mask openings in motors to prevent paint and other materials from entering the motors.

3.9 PAINT MIXING

A. Multiple-component coatings:
1. Prepare using all the contents of the container for each component as packaged by the paint manufacturer.
2. No partial batches will be permitted.
3. Do not use multiple-component coatings that have been mixed shall not be used beyond their pot life.
4. Provide small quantity kits for touchup painting and for painting other small areas.
5. Mix only components specified and furnished by the paint manufacturer.
6. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.
7. Fast set or plural component products shall be applied using an appropriate multipart pump that properly mixes both components at the recommended ratio using equipment recommended by the coating manufacturer. Hot mixing of fast set or plural component products will not be permitted.

B. Keep paint materials sealed when not in use and provide nitrogen blanket on fast set, plural, or moisture cured coatings on opened product containers when stored or not in use more than 8 hours.

C. Where more than one coat of a material is applied within a given system, alternate color to provide a visual reference that the required number of coats have been applied.

3.10 APPLICATION OF PAINT

A. General:
1. Schedule and attend a Pre-Application Conference with Engineer prior to proceeding with application of field applied coatings. Attendees should include any subcontractors intended to participate in the application of coatings on the Project.
2. Inspection: Schedule with Engineer in advance for cleaned surfaces and all coats prior to the succeeding coat.

3. Apply coatings in accordance with the paint manufacturer's recommendations. Allow sufficient time between coats to ensure thorough drying of previously applied paint.
4. Fusion Bonded Coatings Method Application: Electrostatic, fluidized bed, or flocking.
5. Paint units to be bolted together and to structures prior to assembly or installation.
6. Shop Primed or Factory Finished Surfaces:
    a. Inspection: Schedule with Engineer in advance for shop primed or factory-finished items delivered to jobsite for compliance with these Specifications.
    b. Hand or power sand areas of chipped, peeled, or abraded coating, feathering the edges. Follow with a spot primer using specified primer.
    c. For two-package or converted coatings, consult the coatings manufacturer for specific procedures as relates to top coating of these products.
    d. Prior to application of finish coats, clean shop primed surfaces of dirt, oil, and grease, and apply a mist coat of specified primer, 1.0 mil dry film thickness.
    e. After welding, prepare and prime holdback areas as required for the specified paint system. Apply primer in accordance with manufacturer's instructions.
7. Manufacturer Applied Paint Systems:
    a. Repair abraded areas on factory-finished items in accordance with the equipment manufacturer's directions.
    b. Carefully blend repaired areas into the original finish.

B. Application Safety
1. Performed painting in accordance with recommendations of the following:
    a. Paint manufacturer's instructions.
    b. NACE publication, Manual for Painter Safety.
    c. Federal, state, and local agencies having jurisdiction.
2. Contractor will be solely and completely responsible for condition of the project site, including safety of all persons (including employees) and property during performance of the work. This requirement will apply continuously and not be limited to normal working hours. Safety provisions will conform to U.S. Department of Labor, Occupational Safety and Health Act, any equivalent state law, and all other applicable federal, state, county, and local laws, ordinances, and codes.
3. Contractor will comply with all safety training requirements promulgated or required for this project.

C. Film Thickness:
1. Coverage is listed as either total minimum dry film thickness in mils (MDFT) or the spreading rate in square feet per gallon (SFPG). Per coat determinations are listed as MDFTPC or SFPGPC.
2. Applied coating system film thickness per coat shall be applied at the specified coating thickness or the manufacturer’s recommended minimum thickness, whichever is greater. Where the manufacturer has not specified a minimum coating thickness on the product data sheets, the minimum recommended coating application thickness shall apply.
3. Maximum film build per coat shall not exceed the coating manufacturer's recommendations.

D. Stripe Coats:
1. Surfaces that are subject to immersion, condensing environments, or where specifically specified shall be stripe coated on all angles, edges, corners, threads, welds, and similar type surfaces.

2. Stripe coat shall be an extra coat of the intermediate coating material and shall be applied between the prime and intermediate coats.
3. The stripe coat shall be a separate coat from coats specified under the coating system.
4. Stripe coats shall be alternated in color like a full coat.

E. Number of coats:
1. Apply specified number of coats, minimum, irrespective of the coating thickness.
2. Additional coats may be required to obtain the minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.

F. Porous Surfaces, Such as Concrete, Masonry:
1. Prime Coat:
   a. May be thinned to provide maximum penetration and adhesion.
   b. Type and Amount of Thinning: Determined by the paint manufacturer and is dependent on surface density and type of coating.
   c. Surfaces Specified to Receive Water Base Coating: Damp, but free of running water, just prior to application of the coating.

G. Existing Coated Surfaces:
1. General:
   a. Equipment or components with shop primer or shop finish coated surfaces shall be reviewed with the Engineer to determine coating damage, repair methods, surface preparation requirements, and conformance with color uniformity, where required.
   b. All shop primed or finished coated surfaces shall be verified to be chemically compatible with field applied finish coats.
   c. If a cured epoxy, polyurethane, or plural-component material is to be top coated, contact the coating manufacturer for additional surface preparation requirements. Existing coated surfaces shall be prepared as follows"
      (1) Existing coated surfaces shall be brush-off blasted as specified herein to remove all gloss and provide a uniform profile on existing coating for adhesion of subsequent coats.
      (2) Power or hand sanding will not be allowed as a surface preparation procedure for existing coatings, unless reviewed and approved by the Engineer.
      (3) Where coating manufacturer surface preparation recommendations conflict with this section, the more stringent requirements shall apply.
      (4) Profile shall be as specified by the manufacturer or equivalent of 80 grit sandpaper; whichever is more stringent. Profile shall be visible and uniform over existing coated surfaces.
   d. All existing coated surfaces, where demolition of equipment was specified or required, shall be surface prepared, touch-up coating repairs completed, and a cosmetic overcoat applied using the specified coating system on all existing coated surfaces associated with the demolition work, unless otherwise specified.
   e. Existing coatings on immersed equipment shall be removed to bare metal and recoated with the specified coating system where demolition work was specified.
   f. Apply sealer/primer where recommended by coating manufacturer for coating compatibility.

2. To be Recoated or Final Coated:
    a. Detergent wash and freshwater rinse.
    b. Perform touch-up repairs of existing coating.
    c. Asphaltic varnish coated ductile iron pipe will require an application of a seal coat prior to the application of a cosmetic finish coat.
3. Touch-up Repairs:
    a. Clean loose, abraded, or damaged coatings to substrate by Power Tool (SP 3).
    b. Feather surrounding intact coating.
    c. Apply one spot coat of the specified primer to bare areas overlapping the prepared existing coating.
    d. Apply one full finish coat of the specified primer or finish coat(s) overall.
4. Application of a Cosmetic Coat:
    a. The exact nature of shop-applied coatings is not known in all cases.
    b. Check compatibility by application to a small area prior to starting the coating.
    c. If lifting or other problems occur, request disposition from the Engineer.
    d. Cured epoxy, polyurethane, plural component materials or any other coating system that has exceeded its maximum recoat window shall be prepared as specified in this section.

H. Damaged Coatings, Pinholes, and Holidays:
1. Feather edges and repair in accordance with the recommendations of the paint manufacturer.
2. Repair fusion bonded coatings as recommended by the original applicator. Applicator shall provide liquid repair kits for this purpose as recommended by the coating manufacturer.
3. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.

I. Unsatisfactory Application:
1. If the item has an improper finish color, or insufficient film thickness, clean and topcoat surface with specified paint material to obtain the specified color and coverage. Obtain specific surface preparation information from the coating manufacturer.
2. Hand or power sand visible areas of chipped, peeled, or abraded paint and feather the edges. Follow with primer and finish coat in accordance with the Specifications. Depending on the extent of repair and its appearance, a finish sanding and topcoat may be required.
3. Evidence of runs, bridges, shiners, laps, or other imperfections shall be cause for rejection.
4. Repair defects in coating system per written recommendations of coating manufacturer.
5. Leave all staging up until the Engineer has inspected the surface or coating. Replace staging removed prior to approval by Engineer.

3.11 COATING INSPECTION

A. General
1. Film thickness measurements and electrical inspection of the coated surfaces:
2. Perform with properly calibrated instruments.
3. Recoat and repair as necessary for compliance with the Specifications.
4. All coats will be subject to inspection by the Engineer and the coating manufacturer's representative.

5. Visually inspect concrete, nonferrous metal, plastic, and wood surfaces to ensure proper and complete coverage has been attained.
6. Give particular attention to edges, angles, flanges, and other areas where insufficient film thicknesses are likely to be present and ensure proper milage in these areas.

B. Coating Thickness Testing:
1. Engineer shall conduct coating thickness testing as necessary and without limitation. Testing conformance to the requirements of SSPC PA-2 is specifically excluded from this specification.
2. Measure coating thickness specified in mils with a magnetic type dry film thickness gauge as specified.
3. Check each coat for the correct milage. Do not make measurement before a minimum of 8 hours after application of the coating.
4. Tests for concrete coating thickness shall be with a Tooke Gauge, a destructive test. Contractor shall repair coating after thickness testing.

C. Coating Continuity Testing
1. Holiday detect coatings with high voltage units in accordance with NACE SP-0188. High voltage detector shall have adjustable voltages in 100 volt increments and shall be operated in accordance with the manufacturer's instructions and the specified standard.
2. Use of an electrical holiday detector, low voltage, wet sponge type holiday detector will be permitted for coating systems less than 20 mils total dry film thickness and are not for immersion or condensing environments.
3. Holiday detect coatings on pipe for buried application with high voltage spark tester in accordance with NACE RP0274.

3.12 CLEANUP

A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroyed at the end of each day.

B. Upon completion of the work, remove staging, scaffolding, and containers from the site or destroyed in a legal manner.

C. Completely remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.

D. Damages due to over spray on buildings, vehicles, trees, or other surfaces not specified to be painted would be the responsibility of the Contractor.

3.13 MANUFACTURER'S SERVICES

A. Furnish paint manufacturer's representative to visit jobsite at intervals during surface preparation and painting as may be required for product application quality assurance, and to determine compliance with manufacturer's instructions and these specifications, and as may be necessary to resolve field problems attributable to, or associated with, manufacturer's products furnished under this Contract.

3.14 PROTECTIVE COATING SYSTEMS AND APPLICATION SCHEDULE

A. Unless otherwise shown or specified in these Specifications painted or coated the work in accordance with the following application schedule.

B. In the event of discrepancies or omissions in the following, request clarification from the Engineer before starting the work in question.

System No.	Title
1	SUBMERGED METAL - IMMERSION
4	EXPOSED METAL – HIGHLY CORROSIVE
5	EXPOSED METAL – ATMOSPHERIC
8	BURIED METAL - MISCELLANEOUS
10	GALVANIZED METAL
21	EPOXY FLOOR, CONCRETE
27	ALUMINUM AND DISSIMILAR METAL INSULATION
29	FUSION BONDED COATING

C. System No. 1 - Submerge Metal, Immersion

1. Surface Preparation and Coating System

Surface Prep.	Coating Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 5) Cement Mortar Prep: see Interior Linings, this section	Epoxy, NSF	3 coats, 16 MDFT

2. Application:
   a. All metal surfaces subject to immersion or contact with potable water.
   b. Use on the following areas:
      (1) Interior lining of all pipe inside vaults, manways, or other structures.
      (2) Coat the exposed portion of pipe ends at flexible pipe couplings with high solids epoxy lining, this section.
      (3) Access manhole interior surfaces.
      (4) All steel pipe without a cement mortar lining.
      (5) Epoxy overcoat over mortar lining on each side of isolation flanges as specified.
3. Material Requirements:
   a. Polyamide Epoxy: Amine or polyamine epoxy coating, two parts, suitable for immersion, application temperatures, and environmental exposures and conditions, 75% volume solids minimum, capable of 4 to 8 MDFT per coat.
   b. Epoxy coating shall be NSF certified for potable water contact in conformance to ANSI/NSF Standard 60 and 61.
4. Special Requirements:
   a. Epoxy coating applied to immersed surfaces that contact potable water shall be NSF certified for potable water contact.

b. NSF certified fusion bonded epoxy linings will be permitted as alterative lining for small diameter pipes, valves, and couplings. FBE coating to be applied as specified for FBE coatings this section and in accordance with the manufacturer's recommendations.
c. All welds, angles, edges, and bolted connections shall be stripe coated as specified this section.

D. System No. 4 - Exposed Metal, Highly Corrosive

1. Surface Preparation and Coating System

Surface Prep.	Coating Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 10)	Inorganic Zinc Rich Primer	1 coat, 3.0 to 4.0 DFT
	Epoxy	1 coat, 4 MDFT
	Polyurethane Enamel	2 coats, 6 to 8 DFT
	Or	
	Epoxy Siloxane	2 coats, 4 to 6 DFT

2. Application:
   a. All exposed metal surfaces, new and existing, located inside of vaults or structures.
   b. Use on the following areas:
      (1) Exterior of all vault piping.
      (2) Manways and miscellaneous exposed piping.
   c. Contractor choice of topcoat material shall not be changed. Only one topcoat material will be permitted on the project.
3. Special Requirements:
   a. Surface preparation and primer shall be shop applied to all surfaces prior to installation.
   b. DFT thicknesses greater than manufacturer's recommendations shall be subject to rejection and removal.
   c. Intermediate and topcoats shall be field applied after installation.
   d. All shop primed or finish coated surfaces shall be prepared as an existing coated surface as specified herein and shall be top coated with intermediate and/or finish coats as required to provide color uniformity throughout the vault or structure.
   e. Color uniformity requirements shall apply to all components installed within the vault and visibly part of completed installation regardless of shop applied coating system.
   f. Buried dielectrically coated pipe and fittings passing through a concrete structure wall or floor shall be dielectrically coated for a minimum of 4-inches beyond the interior wall or floor surface before transitioning to Coating System No. 4.

E. System No. 5 - Exposed Metal, Atmospheric:

1. Surface Preparation and Coating System

Surface Prep.	Paint Material	Min. Coats, Cover

Abrasive Blast, or Centrifugal Wheel Blast (SP 10)	Inorganic Zinc Rich Primer Epoxy Siloxane	1 coat, 2.5 MDFT 2 coats, 6 MDFT

2. Application:
   a. Exposed metal surfaces, new and existing, located outside of structures and exposed to weather and the following specific surfaces unless otherwise specified.
   b. Use on the following items or surfaces:
      (1) Exposed surfaces of blowoff piping, unless hot dipped galvanized
      (2) Exposed surfaces of air vent piping, unless hot dipped galvanized.
3. Special Requirements:
   a. All shop primed or finish coated surfaces shall be prepared as an existing coated surface as specified herein and shall be top coated with intermediate and/or finish coats as required to provide color uniformity.
   b. Color uniformity requirements shall apply to all components visibly part of the completed installation regardless of shop applied coating system.
   c. Galvanized steel surfaces shall be coated per the coating manufacturer's requirements.
   d. Polysiloxane coating to overlap buried pipe coating a minimum of 4 inches below top of concrete.
   e. Aliphatic polyurethane will not be allowed as a substitute for polysiloxane due to restrictive overcoat requirements.
   f. Dry film coating thickness of polysiloxane, including touch up repairs, shall not exceed the manufacturer's recommended maximum film thickness.

F. System No. 8 - Buried Metal, General:

1. Surface Preparation and Coating System

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast or Centrifugal Wheel Blast (SP 10)	Wax Tape Coating	Wax tape as specified in Section 09 90 10, Pipeline Coatings and Linings

2. Application:
   a. All buried miscellaneous pipe, joints, fittings, and other pipe appurtenances shall be coated as specified under Section 09 90 10, Pipeline Coatings and Linings.
   b. All buried, below grade portions of steel items, except buried stainless steel or ductile iron, unless otherwise specified.

3. Special Requirements:
   a. Metallic air vent pipe, buried, may be coated with System No. 1 at Contractor's option.

G. System No. 10 - Galvanized Metal Conditioning:

1. Surface Preparation and Coating System

Surface Prep.	Paint Material	Min. Coats, Cover

Solvent Clean (SP 1) Followed by Hand Tool (SP 2) or Power Tool (SP 3)	Wash Primer Finish Coats to Match Existing Paint	1 Coat, 0.4 MDFT As Required to Match Surrounding Area

2. Application:
   a. All galvanized surfaces requiring painting and the following specific surfaces unless otherwise specified.
3. Special Requirements:
   a. Sweep blast as specified this section, may be used in lieu of hand or power tool cleaning of galvanized surfaces provided Contractor can demonstrate that damage to the zinc coating will not result. Engineer approval of sweep blasting locations, methods, and surface cleanliness and profile results is required.
   b. See applicable coating systems for finish coating system and coating requirements based on area and/or surface to be coated.

H. System No. 21 Epoxy Floor, Concrete:

1. Surface Preparation and Coating System

Surface Prep.	Paint Materials	Min. Coats, Cover
Concrete	Epoxy	1st coat (thinned) 2 coats (unthinned) Total system 80 SFPG

2. Application:
   a. Use on the following areas:
      (1) The floors of cast-in-place concrete vaults where indicated in the Drawings.
3. Special Requirements:
   a. Epoxy coating to be applied a minimum of 6-inches onto walls, pipe supports, and any other metallic component attached to the floor or wall within the 6-inch limit.
   b. All areas above the 6-inch limit shall be masked, provide a straight-line demarking coated versus uncoated areas.
   c. Abrasively blast miscellaneous metal surfaces to an SSPC SP-10, near white blast, as specified this section.
   d. Prime coat of epoxy shall be a thinned coat of the epoxy coating to fill and seal the concrete before the final coats applied, per the coating manufacturer's requirements.
   e. Apply non-skid aggregate between coats where specified or shown.

I. System No. 27 Aluminum and Dissimilar Metal Insulation:

1. Surface Preparation and Coating System

Surface Prep.	Paint Material	Min. Coats, Cover
Solvent Clean (SP 1)	Wash Primer Epoxy	1 coat, 0.4 MDFT 1 coat, 8 MDFT

2. Application:
    a. Use on all non-submerged concrete embedded aluminum surfaces, and the following specific surfaces unless otherwise specified.
    b. Use on the following surfaces:
        (1) All concrete embedded components of vault hatches
        (2) All concrete embedded surfaces where electrical isolation from concrete reinforcement is required.

J. System No. 29 Fusion Bonded Coating:

1. Surface Preparation and Coating System

Surface Prep.	Paint Material	Min. Coats, Cover
Abrasive Blast, or Centrifugal Wheel Blast (SP 10) or Acid Pickling (SP 8)	Fusion Bonded 100% solids Epoxy or Polyurethane	1 or 2 coats, 10 MDFT

2. Application:
    a. Use where specified.
    b. Use on the following items or surfaces:
        (1) Concrete embedded anchor bolts, except threads.
        (2) Removable handrail sleeves.

3. Special Requirements:
    a. System 1 may be used as alternative coating system at Contractor's option

(See PSDS form following this section)

PAINT SYSTEM DATA SHEET

Attached products' Technical Data Sheet (if applicable) to this sheet for each paint system submittal.

Paint System Number (from spec.):
Paint System Title (from spec.):
Coatings Manufacturer:
Representative:
Surface Preparation:

Paint Material (Generic)	**Product Name/Number Proprietary)**	**Min. Coats, Coverage**

Additional Information Required (check applicable items):

☐ ANSI/NSF Certification letter for each paint material listed above requiring ANSI/NSF Standard 60 and 61 approvals.

☐ Manufacturer's minimum and maximum recommended coating thickness per coat and for total coating system.

☐ Immersion coating cure requirements from minimum coating application temperature to 100 degrees in 15-degree temperature increments.

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SECTION 09 90 10
PIPELINE COATINGS AND LININGS

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section covers the work necessary to apply external coating and internal lining on steel pipe, field coating of joints, and shop and field repair of coating damage, complete.

B. Exposed steel pipe will be shop coated as specified in Section 09 90 00, Protective Coatings and Linings.

1.2 ABBREVIATIONS

ANSI	American National Standards Institute
AWWA	American Water Works Association
CSP	Concrete Surface Profile
MDFT	Minimum Dry Film Thickness
MDFTPC	Minimum Dry Film Thickness Per Coat
mil	Thousandths of an Inch
OSHA	Occupational Safety and Health Act
PSDS	Paint System Data Sheet
SFPG	Square Feet Per Gallon
SFPGPC	Square Feet Per Gallon Per Coat
SP	Surface Preparation
SSPC	Steel Structures Painting Council
TLCP	Toxicity Characteristic Leaching Procedure
VOCs	Volatile Organic Compounds

1.3 REFERENCE STANDARDS

A. This specification recognizes AWWA, NACE, and SSPC standards as minimum industry standards and they are referenced for purpose of conformance, except where modified herein. The requirements of this specification section have been written to a higher design standard with the intent of achieving a long-term coating performance of 100 years.

AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe-4-inch and Larger- Shop Applied
AWWA C210	Liquid-Epoxy Coatings and Linings for Steel Water Pipe and Fittings
AWWA C214	Tape Coatings for Steel Water Pipe
AWWA C215	Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines

AWWA C216	Heat-shrinkable Crosslinked Polyolefin Coatings for Steel Water Pipe and Fittings
AWWA C217	Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines
NACE SP0188	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
NACE RP-0274	High Voltage Electrical Inspection of Pipeline Coatings Prior to Installation
NACE RP0303	Field-Applied Heat-Shrinkable Sleeves for Pipelines: Application, Performance, and Quality Control
NACE SP0394	Application, Performance, and Quality Control of Plant-Applied Single-Layer Fusion-Bonded Epoxy External Pipe Coating
SSPC-SP-1	Solvent Cleaning Surface Preparation
SSPC-SP-2	Hand Tool Cleaning Surface Preparation
SSPC-SP-3	Power Tool Cleaning Surface Preparation
SSPC-SP-5	White Metal Abrasive Blast Surface Preparation
SSPC-SP-6	Commercial Abrasive Blast Surface Preparation
SSPC-SP-10	Near-White Metal Abrasive Blast Surface Preparation
SSPC-SP-11	Power Tool Cleaning to Bare Metal Surface Preparation

1.4 SUBMITTAL REQUIREMENTS

A. Submittal requirements as specified in Section 09 90 00, Protective Coatings and Linings.

1.5 QUALITY ASSURANCE

A. Coating Applicator's Experience and Certification:
   1. Coating Application Company and coating application supervisor (Certified Applicator) shall have a minimum of 5 years' experience applying the specified coating system.
   2. Coating application personnel, who have direct coating application responsibility, shall have a minimum of 2 years practical experience in application of the indicated coating system.
   3. Coating applicator shall be certified by the coating manufacturer as an approved applicator.

B. Coating and/or lining manufacturer technical representative shall be present for a minimum of three days technical assistance and instruction at the start of coating and/or lining operations within the shop. During this visit, the technical representative shall observe surface preparation and coating application and conduct tests of the coating to ensure conformance with application instructions, recommended methods, and conditions.

C. Coating and/or lining manufacturers technical representative shall be onsite for three working days, minimum, at the start of each construction season to inspect coating application and procedures in the field. During this visit, the technical representative shall observe surface preparation and coating application and conduct tests of the coating to ensure conformance with application instructions, recommended methods, and conditions.

D. Coating and/or lining manufacturer shall include 8 hours per month of field or shop coating technical support when requested by the Engineer.

E. Technical representative shall provide a written report to the Engineer for each visit. Report shall include copies of test data collected, description of observations, and all recommended corrective actions. Report shall be submitted within 5 working days after the visit. When deemed necessary by the Engineer, work will not be permitted to proceed until the recommended corrective actions have been implemented. After all corrective recommendations have been completed, the manufacturer representative shall return and certify that the application complies with the manufacturer's coating application recommendations.

F. Additional visits by the manufacturer's representative shall be made at sufficient intervals during surface preparation and coating or lining as may be required for product application quality assurance, and to determine compliance with manufacturer's instructions, and as may be necessary to resolve problems attributable to, or associated with, manufacturer's products furnished for this project.

1.6 DEFINITIONS

A. MANUFACTURER'S REPRESENTATIVE: Employee of coating manufacturer who is factory trained and knowledgeable in all technical aspects of their products and systems. Sales representatives are not acceptable as a technical representative unless written authorization from the coating manufacturer is provided, which states the sales representative has full authority to act on behalf of the coating manufacturer.

B. SPECIALS FITTINGS AND CONNECTIONS: Defined as any joint of pipe with turnout, blowoff, fabricated tee, cross, wye, manhole, mitered angles or elbows, crotch plates, butt straps, or fabricated pipe that cannot be coated using through put or straight pipe coating application equipment and the following specific items:
   1. All pipe joint sections entering a structure.
   2. Pipe joints with weld lead pass through holes.

C. SHOP: A shop is defined as a permanent, fully enclosed building with a concrete floor that can be power washed with a potable water supply and floor drains.

1.7 WARRANTY

A. The Contractor and coating applicator shall jointly and separately warrant to the Owner and guarantee the work under this section against defective workmanship and materials for a period of two (2) years commencing on the date of final acceptance of the work.

1.8 ENGINEER OBSERVATIONS

A. As specified in Section 09 90 00, Protective Coatings and Linings.

PART 2 PRODUCTS

2.1 GENERAL

A. Coatings and linings will be stored and handled per manufacturer's written directions.

B. Exterior and interior pipe and fitting surfaces shall be prepared and coated in accordance with referenced standards, written instructions of the coating or lining manufacturer, and these specifications, whichever is more stringent.

C. Coatings shall be the product of a single manufacturer. Product substitutions during the project will not be permitted without ENGINEER approval.

2.2 SHOP-APPLIED, BURIED PIPE COATINGS

A. General
   1. Buried steel pipe, consisting of straight lengths of pipe, shall be coated with one of the following coating systems at the Contractors option, except where noted otherwise.
      a. Polyethylene Tape Wrap and cement overcoat (AWWA C214 and C205)
      b. Plural Component Epoxy and cement overcoat (AWWA C210 and C205)
   2. Buried Steel pipe specials, fittings, and other complex shapes that are not suitable for machine applied tape wrap coating application and are below finished grade or concrete encased shall be coated with Plural Component Epoxy only (AWWA C210).
   3. Vault or manhole piping and miscellaneous pipeline components, such as coupling plain ends, access manholes, blowoff piping, or piping less than 12-inches in diameter, shall be coated as specified under Shop Applied, Atmospheric and Immersion Coatings, this section.
   4. Mortar over coat shall be provided over tape wrap coating system and where specified. Cement mortar overcoat shall be shop-applied and 1-inch thick, ±1/4-inch, as specified herein.
   5. Buried dielectrically coated pipe and fittings passing through a concrete structure wall or floor shall be dielectrically coated for a minimum of 4-inches beyond the interior wall or floor surface.
   6. Exterior surfaces of all butt straps shall be prepared to SSPC-SP-5, white metal, and coated with inorganic zinc suitable for temperatures over 750 degrees as specified for holdback corrosion protection.

B. Polyethylene Tape Wrap:
   1. General Coating Requirements:
      a. Tape wrap coating system shall be machine applied. Hand applied tape coatings will not be permitted.
      b. Tape width shall be 12-inches maximum. Wider tape will be conditionally allowed if the coating applicator can demonstrate that proper maintenance of tension and prevention of mechanical wrinkling throughout the coating application. If at any time during the pipe fabrication tape quality becomes inconsistent with wider tape, the Engineer can require the remainder of the pipe to be coated using the maximum specified tape width.

c. Tape layers shall have adhesive for the full width of the tape. Adhesive shall have the ability to stick to itself and to the proceeding tape layer or pipe.
d. Each layer shall be a different color or shade with the outer layer white.
e. Outer wrap shall be white and have sufficient ultraviolet (UV) inhibitors to resist above grade exposure for a minimum of 12 months or the proposed storage and construction time, whichever is greater.

2. Steel Pipe:
   a. Surface Preparation:
      1) Comply with salt contamination and surface cleanliness (dust) requirements as specified for Quality Control testing.
      2) Steel Pipe: SSPC-SP5, White Metal blast, 2.5 mils blast profile, minimum.
   b. Coating System
      1) Pipe shall be coated with an 80 mil (nominal), tape-coating systems applied in accordance with AWWA C214, except as modified herein.
      2) Steel pipe with cement mortar overcoat shall be coated with 50 mil (nominal), tape-coating systems applied in accordance with AWWA C214, except as modified herein.
      3) Primer: Polyken 1019, 1027, 1029, or as recommended by the coating manufacturer.
      4) Weld Stripe Tape: Polyken 931 (no backing), 25 mils nominal, 4-inches wide minimum.
      5) Inner Wrap: Polyken 989 YGIII, 20 mils nominal, corrosion protection layer.
      6) Outer Wrap: Polyken 956 YGIII, 30 mils nominal, mechanical protection layer.
      7) Mechanical Protection: Cement mortar overcoat in accordance with AWWA C205, except as modified herein.

C. Plural Component Epoxy:
1. General:
   a. Plural component, epoxy coating system shall be applied in accordance with AWWA C210, and as modified herein.
   b. All steel pipe specials, fittings, complex shapes, and other surfaces that are not suitable for machine applied tape wrap coating application and are below finished grade or concrete encased shall be coated with this coating system. Plural component epoxy coating system is not suitable for interior of pipe or where contact with potable water may occur, see Section 09 90 00, Protective Coatings and Linings, for applicable protective coating systems.
2. Shop Surface Preparation:
   a. Steel pipe:
      1) Comply with salt contamination and surface cleanliness requirements as specified for Quality Control Testing.
      2) SSPC-SP5, White Metal blast, 3.00 mil profile, minimum, or as required by the manufacturer, whichever is greater.
3. Shop Applied Coating Requirements:
   a. Thickness: One coat, 35 mils total dry film thickness, minimum, or as required to meet limits specified for holiday and coating defects, this section.
   b. Cement Mortar Overcoat:

1) Mechanical Protection: Cement mortar overcoat in accordance with AWWA C205, except as modified herein.

4. Product Acceptance:
   a. Self-priming, plural component, 100 percent solids, non-extended epoxy, suitable for burial or immersion, and meeting the requirements of AWWA C210 and the following, whichever is more stringent:
      1) Resistance to Water Immersion (ASTM D870) or Wet Adhesion
         a) Acceptance criteria:
            (1) Not greater than 10 percent loss of substrate adhesion when compared to substrate adhesion in an unexposed area of the same sample with adhesion tests completed within 12 to 24 hours after test termination. Average of three pulls per exposure area.
            (2) No blistering or underfilm corrosion when viewed at 10x magnification.
         b) Adhesion Testing:
            (1) Method: ASTM D4541, Method E
            (2) Equipment: Type V, Delfesko Automatic AT Positest
            (3) Dollies: 20 mm and 14 mm, scored to metal substrate
            (4) Test Speed: 100 psi per second (both 14 and 20 mm)
         c) Test Duration: 30 and 60 days
      2) Cathodic Disbondment (ASTM G95)
         a) Acceptance criteria: 8 mm, maximum
         b) Potential: -3.00 volts
         c) Test Duration: 28 days
         d) Evaluation: Measured from original holiday radius to edge of staining on metal surface.
      3) Water Absorption (ASTM D570)
         a) Acceptance Criteria: 1.80 percent, maximum
         b) Test Duration: 30 day and 60 day
   b. Shall be one of the following products:
      1) Tnemec Series 431, Kansas City, MO
      2) Or Engineer approved equal

D. Cement Mortar Coating or Cement Mortar Overcoat
   1. Apply cement mortar coating system on steel pipe, where specifically shown on the Drawings, in accordance with AWWA C205, except as modified herein.
   2. Cement mortar overcoat shall be applied over dielectric coating system on all steel pipe and fittings in accordance with AWWA C205, except as modified herein. Holdback:
      a. Mortar overcoat shall be held back of dielectric coating a minimum of 3 inches for overlap of field applied joint coating onto dielectric coating system.
      b. Mortar overcoat shall not extend into structures unless otherwise noted.
   3. Shop Applied Coating System:

a. Cement: Conform to ASTM C150, Type II.
b. Aggregate shall be silica sand or other aggregate that is not subject to leaching. Conform to ASTM C33.
c. Cement mortar mixture shall consist of 1-part cement to not more than 3 parts aggregate.
d. Water for cement mortar: Clean and free from organic matter, strong alkalis, vegetable matter, and other impurities. Use no more than 4-1/2 gallons of water per sack of cement.
e. Cement mortar coating: Nominal 1-inch-thick coating with permitted tolerance of ±1/4-inch.

4. Joint Coating:
a. Joints of cement mortar overcoat dielectrically coated pipe do not require field application of cement mortar overcoat when properly coated with heat shrink sleeve joint coating system.

2.3 SHOP-APPLIED INTERIOR LININGS

A. General
1. Clean and cement mortar line steel pipe and fittings 6-inches or greater in diameter in accordance with AWWA C205.
2. Apply liquid epoxy coating over cement mortar lining at insulating joints as specified this section.
3. Epoxy line pipe 12-inches diameter or smaller per System No. 1 or fusion bonded epoxy lining at contractor's option. Fusion bonded epoxy lining shall be NSF 61 certified.

B. Cement Mortar Lining:
1. Cement: Conform to ASTM C150, Type II.
2. Shop applied cement mortar lining shall be uniform in thickness over the full length of the pipe joint.
3. Aggregate shall be silica sand or other aggregate that is not subject to leaching. Conform to ASTM C33.
4. Water for cement mortar: Clean and free from organic matter, strong alkalis, vegetable matter, and other impurities.

C. Liquid Applied Epoxy Coating:
1. Epoxy Overcoat of Cement Mortar Lining:
a. Provide liquid epoxy primer and lining in all cement mortar lined metallic pipe at insulating joints for a minimum of one pipe diameters on each side of the insulated joint. If other side of joint is an existing pipe, apply epoxy lining for two pipe diameters in fabricated pipe only.
b. Epoxy lining shall be polyamine or polyamide cured, NSF approved for potable water contact in accordance with ANSI/NSF Standards 60 and 61, and capable of achieving full cure before placement in service or exposure to water.
c. Application:
1) Apply in two coats at equivalent spread rate for 6 mils dry film thickness per coat.

2) Epoxy shall be applied over the cement mortar lining where specified for the pipeline lining material.
3) Cement mortar shall be allowed to cure for a minimum of 15 days prior to surface preparation and coating application or 7 days with steam curing. Mortar lining shall be dry when epoxy lining is applied.
4) Prepare the cement mortar lining by abrasive blasting to remove all laitance and provide a surface profile equivalent to 80 grit sandpaper.

d. Acceptable manufacturers:
1) Carboline
2) ICI Devoe
3) Tnemec
4) Sherwin Williams
5) PPG
6) Or approved equal

2.4 SHOP APPLIED, ATMOSPHERIC OR IMMERSION COATINGS

A. General
1. All atmospherically exposed or vault piping shall be shop primed and field coated with the applicable Exposed Metal coating system as specified in Section 09 90 00, Protective Coatings and Linings.
2. Interior of pipe or surfaces in contact with potable water shall be coated with System No. 1.
3. Shop applied inorganic zinc primer shall not be applied at thickness greater than recommended by manufacturer. Excess primer to be removed using method recommended by coating manufacturer.
4. Intermediate and finish coats shall be applied in the field after installation, except where metal surfaces will be concealed after installation.
5. All concealed surfaces of bolted or mechanically secured surfaces shall be finished coated in the shop.
6. Manufacturer of shop-applied primer shall be coordinated with field application to provide a completed system by a single manufacturer. Engineer approval of a coating system with two or more coating manufacturers' will require written approval from the topcoat manufacturer certifying compatibility.

2.5 FIELD APPLIED COATING SYSTEMS

A. General
1. Miscellaneous Metals
a. All buried miscellaneous metal components installed on the pipeline and that is supplied bare or with a shop coating system that is not equal to the specified pipeline coating shall be coated in the field with one of the following coating systems.
1) Petrolatum or Wax Tape Coating
2) Heat Shrink Sleeve
b. Miscellaneous metal components shall include, but not be limited too, all exposed metals surfaces, including bolts, couplings, flanges, valves, adapters, pipe spools, and other miscellaneous metal components.

c. Coating system applied shall conform to the manufacturer's requirements and shall be applied in accordance with the application requirements of the coating system.

d. Filler material shall be applied for all field applied coating systems to provide sufficient transition at welds and other dimensional changes to prevent all tenting or voids under the applied coating, regardless of manufacturer's recommendations.

2. Pipe Joints General:

a. Pipe joints shall be field coated after pipe assembly with one of the following coating systems as specified.

1) Petrolatum or wax tape coating system

2) Heat Shrink Sleeves.

b. Steel pipe joints shall be coated with a heat shrink coating, unless specified otherwise.

c. Joints of cement mortar overcoated tape wrap steel pipe shall be cement mortar overcoated after application of the specified field applied joint coating, unless specified otherwise.

d. Flanges, couplings, ductile iron pipe joints, and all bolted or threaded joints are classified as complex shapes and shall be wax tape coated with filler material to ensure complete encapsulation and filling of all bolts, crevices, gaps, and dimensional transitions as required to prevent tenting of the finished coating.

B. Petroleum or Wax Tape Coating:

1. Application:

a. Coating shall be applied in accordance with AWWA C217, except as modified herein.

b. Wax tape coatings shall be field applied on all buried couplings, thrust restraint rods and brackets, valves, and on joints, fittings, or irregular shapes or complex configurations that could cause tenting of heat shrink coating system.

c. Provide wax filler material for all complex shapes, bolts, flanges, gaps, and dimensional transitions to completely fill and encapsulate the metal surfaces and prevent tenting of the applied tape coating.

d. Buried wax tape coated surfaces shall be overcoated with plastic shrink film as recommended by the manufacturer.

e. Do not use wax tape coating systems on vault piping, atmospherically exposed piping and appurtenances, or where subject to UV exposures.

f. Use sand backfill to protect wax coating from damage.

2. Surface Preparation: SSPC-SP11 or SSPC-SP10.

3. Coating System:

a. Primer: Wax tape primer consisting of microcrystalline waxes and corrosion inhibitors with no clay fillers. Primer shall be manufactured by the same manufacturer as the wax tape.

b. Filler Material:

1) Filler materials shall be petroleum or petrolatum wax sealer/filler with closed cell plastic filler

2) Provide filler material to fill and smooth all irregular surfaces, such that no tenting or voids remain under the applied wax tape.

c. Wax Tape: Non-firming anti-corrosion wrap consisting of a microcrystalline wax blend saturated into a non-woven bonded synthetic fabric, forming a tape wrapper. Shall contain no siliceous mineral fibers and be intended for belowground use.

d. Wrap: Multi-layered plastic wrap. Shall be manufactured by the same manufacturer as the wax tape.

e. Polyethylene Encasement: Wax tape coated couplings, fittings, elbows, restraints, valves, etc. shall be encased in 8-mil polyethylene sheeting installed in accordance with manufacturer's recommendations. Loose polyethylene sheeting shall be secured with PVC pipe wrap tape. Install encasement as otherwise indicated in these Specifications.

4. Manufacturers: Wax tape coating system shall be as manufactured by:
   a. Denso North American
   b. Trenton
   c. Or approved equal.

C. Heat Shrink Sleeves:

1. Application:
   a. Heat shrink sleeves are restricted to pipeline joints and couplings under buried or concrete encased applications only.
   b. Application inside vaults or where exposed to the weather will not be allowed.
   c. Provide filler material for all welded joints, rolled or Carnegie joints, and at all dimensional changes that could result in tenting or voids under the applied heat shrink sleeve.
   d. Pipe joints that have been shop prepared as specified for heat shrink sleeves and shop coated with holdback primer as specified this section, shall be field prepared in accordance with SSPC-SP1 and SSPC-SP3 to remove all dirt, mud, oil, and grease prior to application of heat shrink sleeve.
   e. Filler material shall be applied in a manner and of sufficient thickness that no tenting or voids remain under the heat shrink sleeve.
   f. Contractor to consider sleeve shrinkage and joint profile in determining sleeve width required. Overlapping of two or more heat shrink sleeves to achieve the necessary width on pipe joints will not be permitted without Engineer approval.
2. Surface preparation: As specified for pipe joint surface preparation.
3. Coating System:
   a. Filler Material:
      1) Filler material shall adhere to the pipe and heat shrink sleeve. Size and type shall be as recommended by the sleeve manufacturer for type of pipe and joint.
      2) Filler materials shall be applied as necessary to prevent all tenting or voids under the applied heat shrink sleeve, regardless of manufacturer’s written recommendations.
      3) Filler mastic for joints subject to weld after backfill shall have a melt temperature exceeding 500 degrees F.
   b. Heat Shrink Sleeve:

1) Heat shrink, cross-linked polyolefin sleeve with a mastic sealant, 85-mil nominal thickness or greater, suitable for pipeline operating temperature, as recommended by the manufacturer.
2) Provide standard recovery sleeve for welded or bell and spigot steel pipe joints. High recovery sleeves shall be provided for mechanical or bell and spigot ductile iron pipe, flange joints, and coupling style joints.
3) Width of heat shrink sleeves shall be sufficient to overlap existing coating 2-inches minimum, except extruded polyolefin coated pipe shall have a minimum overlap of 3-inches. Overlap on tape coated steel pipe shall be based on a sequential 2-inch wide step from outer wrap to middle wrap to inner wrap.
4) Sleeve shall meet requirements for "Well After Backfill" when procedure is allowed and approved by Engineer.

4. Coating Manufacturer's:
   a. Canusa,
   b. Raychem-Covalence,
   c. Or equal.

D. Epoxy Coating:
1. Application:
   a. Epoxy coatings shall be NSF approved and suitable for water contact in accordance with ANSI/NSF Standards 60 and 61, unless otherwise approved by the Engineer.
   b. Contractor shall ensure that epoxy coating selected is suitable for the application temperatures anticipated and that project schedule will allow adequate cure time before backfilling or immersion based on surface temperatures at the time of application.
   c. Epoxy coating shall be used to coat concrete embedded pipe penetrations for 6 inches outside of interior and exterior surfaces of concrete walls or floors. Epoxy coating at concrete penetrations shall be a minimum of 16 mils dry film thickness.
   d. Buried transitions from epoxy to tape wrap coating systems shall be coated with Heat Shrink Sleeve as specified below. Heat shrink sleeves shall be buried within 72-hours of application to prevent thermal creep of sleeve. Sleeves subject wrinkling due to thermal exposure shall be removed and replaced by the Contractor.
2. Surface Preparation: SSPC-SP11 or SSPC-SP10
3. Coating System:
   a. Primer: As required by the coating manufacturer.
   b. High Build Epoxy Coating:
      1) Two component, high build polyamide or polyamine cured epoxy coating, suitable for direct burial or immersion, dries to touch in 2 or more hours, suitable for immersion or burial after full cure of coating.
      2) Acceptable manufacturers:
         a) ICI Devoe
         b) Sherwin Williams
         c) Carboline

d) Or approved equal

c. Fast Cure Epoxy Coating:

1) Two components, 100% solids by volume, fast cure epoxy coating suitable for direct burial or immersion, dry to touch in less than 1 hour at 72 degrees, capable of curing while immersed or buried.

4. Manufacturers:
   a. TC 7010, Tapecoat Inc
   b. Protal 7125 or Protal 7200, North American Denso
   c. Or approved equal.

E. Cement Mortar Coating or Overcoat:
1. Joints of cement mortar coated or cement mortar overcoated steel pipe shall be mortar coated as specified herein after application of the specified joint coating materials, where applicable.
2. Polyethylene foam-lined fabric with steel strapping of sufficient strength to hold the fresh mortar, resist rodding of the mortar and allow excess water to escape.
   a. 100 percent closed-cell
   b. Chemically inert, insoluble in water, resistant to acids, alkalis, and solvents.
   c. Manufacturer and Product: Dow Chemical Company; Ethafoam 222.
3. Fabric Backing:
   a. Cut and sewn into strips wide enough to overlap shop-coated areas by 4 inches on either side.
   b. Strips shall have slots for steel strapping on outer edges.
4. Joint Coating:
   a. Joints of cement mortar overcoat dielectrically coated pipe do not require field application of cement mortar overcoat when properly coated with heat shrink sleeve or wax tape joint coating system.

2.6 FIELD APPLIED INTERIOR JOINT LINING

A. Epoxy Lining:
1. Surface preparation and field lining of pipe joints shall be with the same coating system as the shop-applied lining.
2. Field application shall be performed by a qualified contractor with equipment that meets the application requirements of the coating system and personnel trained and certified by the coating system manufacturer on the proper application of the coating system. Qualified field applicator shall have completed at least three other projects of similar size and magnitude within the last three years using the same or similar coating system.
3. Coating applicator that does not meet the qualifications requirements can be rejected by the Engineer.
4. Field coating application requirements shall be the same as the shop-applied coating requirements. Provide heating and/or dehumidification equipment as required to meet the environmental conditions necessary for proper coating application.

B. Mortar Lining:
1. After the backfill has been completed to final grade, the interior joint recess shall be filled with grout. The grout shall be tightly packed into the joint recess and trowelled flush with the interior surface. Excess shall be removed.

2. At no point shall there be an indentation or projection of the mortar exceeding 1/16-inch.
3. With pipe smaller than 24-inches in diameter, before the spigot is inserted into the bell, the bell shall be daubed with grout. The joint shall be completed and excess mortar on the inside of the joint shall be swabbed out.

2.7 REPAIR OF COATINGS AND LININGS

A. General
1. Coating or lining repair materials shall be compatible with the shop-applied coating or lining system and shall be approved by the coating or lining manufacturer.
2. Coating repair materials shall be as required for the coating system and repair classification as defined this section.

B. Coating Repair Materials
1. Heat Shrink Sleeves (major repair):
   a. Filler Mastic: Provide mastic filler to fill tape void as required.
   b. Shrink Sleeve: See Field Applied Coatings, Heat Shrink Sleeves, this section.
2. Heat-Applied Patches (minor repair)
   a. Heat applied adhesive, polyolefin backed, mastic coated tape, 12-inches maximum size.
   b. Patch shall provide a minimum of 2 inches overlap onto intact pipe coating; except for extruded polyolefin coated pipe shall have a minimum overlap of 3-inches in the circumferential direction.
   c. CRP patch as manufactured by Canusa, PERP patch as manufactured by Raychem (Polyken), or equal.
3. Plural Component Epoxy Coating or Lining
   a. Major Repairs:
      1) Shop repairs shall be completed using the same material as the pipe coating. Coating shall be reapplied using plural component spray equipment in accordance with manufacturer's written requirements.
      2) Field repairs shall be completed using heat shrink sleeves as specified for field applied coatings, this section.
      3) Shop or field major repairs to NSF linings shall be with single use kits matching the existing lining.
   b. Minor Repairs:
      1) Shop minor repairs shall be single use kits matching the existing coating. Pinholes, holidays, or adhesion test repairs are classified as minor repairs.
      2) Field minor repairs shall be with fast cure epoxy, such as Protal 7125 as manufactured by North American Denso, Inc.
      3) Shop or field minor repairs to NSF linings shall be with single use kits matching the existing lining.

2.8 HOLDBACK CORROSION PROTECTION

A. Primer for corrosion protection of cutbacks or holdbacks shall be compatible with the specified joint coating system and high heat resistant or weld after backfill requirements, where applicable.

B. Approved holdback primers are:
   1. Tnemec Omnithane – Suitable for all joints, except joints subject to high heat resistant or weld after backfill
   2. Tnemec 90E-92 Ethyl Silicate Inorganic Zinc Primer – suitable for all joints, including high heat resistant or weld after backfill joints.
   3. ICI Devoe Cathacoat 304V Ethyl Silicate Inorganic Zinc Primer – suitable for all joints including high heat resistant or weld after backfill joints.
   4. Polyken Tape Primers – Not allowed

C. Primer shall not result in running or melting of the coating or cause toxic fumes when heated during welding of "weld after backfill" joints.

D. Application and thickness of holding primer shall be in accordance with the coating manufacturer's recommendations but shall not impair the clearances required for proper joint installation.

E. Holdback requirements shall be as specified this section.

PART 3 EXECUTION

3.1 ENVIRONMENTAL LIMITATIONS

A. General
   1. Products shall comply with federal, state, and local requirements limiting the emission of volatile organic compounds and worker exposure.
   2. Comply with applicable federal, state, and local, air pollution and environmental control regulations for surface preparation, blast cleaning, disposition of spent aggregate and debris, and coating application.
   3. Do not perform abrasive blast cleaning whenever the relative humidity exceeds 85 percent, whenever surface temperature is less than 5 degrees above the dew point of the ambient air.
   4. Do not apply coatings when:
      a. Surface and ambient temperatures exceed the maximum or minimum temperatures recommended by the coating manufacturer or these specifications,
      b. In dust or smoke-laden atmosphere, blowing dust or debris, damp or humid weather, or under conditions that could cause icing on the metal surface.
      c. When it is expected that surface temperatures would drop below 5 degrees above dew point within 4 hours after application of coating.
      d. Whenever relative humidity exceeds 85 percent.
   5. Where weather conditions or project requirements dictate, Contractor shall provide and operate heaters and/or dehumidification equipment to allow pipe surfaces to be abrasive blasted and coated as specified and in accordance with the manufacturers coating application recommendations.
   6. Work activities can be restricted by the Engineer until adequate temperature and humidity controls are in place and functioning within the environmental limits specified.

7. Coating applicators shall provide a monitoring system approved by the coating manufacturer that constantly records pipe and coating conditions during coating application. Recorded monitoring parameters shall include pipe temperature, line speed, holiday test and other parameters applicable to the type of coating.

B. Temperature Control
1. In cold weather or if moisture collects on the pipe, preheat pipe to a temperature between 45 and 90 degrees or 5 degrees above dew point, whichever is greater.
2. When temperatures are above or below the coating manufacturers recommended application temperatures, the Contractor will provide temperature controls as necessary to permit work to precede within the manufacturer's temperature limitations.
3. Provide tenting, insulating blankets, baffles, or bulkheads as required to zone and control heating or cooling effectiveness.
4. Heating shall be with indirect fired heaters that do not increase humidity levels within the work area. Heaters shall be sized for the area to be heated.

C. Dehumidification
1. Contractor shall provide and operate desiccant dehumidification equipment to maintain environmental conditions during abrasive blasting and coating application and cure. Liquid, granular, or loose lithium chloride drying systems will not be acceptable.
2. Contractor shall provide dehumidification equipment sized to maintain dew point temperature 17 degrees or more below surface temperature of metal surfaces to be cleaned and coated. System shall provide ventilation within the environmentally controlled areas to meet the following requirements:
    a. Two air exchanges per hour, minimum,
    b. Maintenance of personnel exposure limits (PEL) at 50 percent of OSHA PEL limits for all chemicals used in the performance of the work, and
    c. Maintenance of lower explosive limits (LEL) to less than 50 percent of the most volatile solvent used in the performance of the work.
3. Dehumidification equipment type, size, air flow, and power requirements shall be designed by a qualified company knowledgeable in dehumidification equipment, and its operation based on project requirements and anticipated seasonal weather conditions for the project schedule. Design to include evaluation of existing conditions, humidity, and temperature, proper air exchange requirements, ventilation requirements, ducting requirements for adequate air flow, and any other issues necessary to achieve the specified performance and environmental conditions throughout the duration of the project.
4. Contractor to submit written recommendations from dehumidification subcontractor for enclosure work area size, bulkhead venting, duct work for each bulkhead section, any secondary ventilation requirements for coating cure, dust collection equipment CFM requirements, and drying requirements for blast hose compressed air necessary to maintain environmental control as specified herein.
5. Dehumidification subcontractor shall either operate the equipment or provide training to Contractor on the proper operation and setup of dehumidification equipment. Dehumidification subcontractor shall provide a technical representative on site for a minimum of two 8-hour days to ensure proper operation of the

equipment, achievement of desired environmental control, and to ensure Contractor can properly set up, operate, monitor, and maintain the equipment.

6. Dehumidification shall be operated in a manner that prevents all condensation or icing throughout surface preparation, coating application, and coating cure.
7. Reblasting of flash rusted metal surfaces or removal of damaged coatings, because of equipment malfunction, shutdown, or other events that result in the loss of environmental control, will be at the sole expense of the Contractor. Cleaned metal surfaces subject to flash rusting shall be cleaned to the same cleanliness as prior to the flash rust formation and shall be approved by the Engineer.
8. Contractor shall monitor ambient temperature, humidity, dew point temperature, and pipe surface temperature (work area only) both outdoors and within the work area at the start, midpoint, and end of each work shift, minimum, but not greater than 5 hours between measurements.
9. Daily environmental condition monitoring and maintenance of the equipment shall be documented in writing and provided to the Engineer.

3.2 SURFACE PREPARATION

A. General

1. Inspect and provide substrate surfaces prepared in accordance with these Specifications and the printed directions and recommendations of coating manufacturer whose product is to be applied.
2. Visible oil, grease, dirt, and contamination shall be removed in accordance with SSPC-SP1, solvent cleaning.
3. Surface imperfections such as metal slivers, burrs, weld splatter, gouges, or delaminations in the metal shall be removed by filing or grinding prior to abrasive surface preparation.
4. Protect prepared pipe from humidity, moisture, and rain. All flash rust, imperfections, or contamination on cleaned pipe surface shall be removed by blasting.
5. Priming and coating of pipe shall be completed the same day as surface preparation.

B. Weld Surface Preparation

1. Requirements:
   a. Spray applied coating systems do not require weld grinding.
   b. Grind welds flush on extruded polyolefin coated pipe as specified herein.
   c. Welds on tape wrap coated pipe shall be either ground flush or a weld stripe tape applied over the weld, at the pipe fabricator's option, unless otherwise specified.
2. Weld Grinding:
   a. Under the weld grinding option, welds higher than 1/32 inch above pipe surface shall be ground to a tolerance of +1/32 inch to 0-inch above the pipe surface as measured on the lowest side of the weld.
3. Weld Stripe Tape:
   a. Weld stripe tape will be applied to primed metal.
   b. Tape will either have no polyethylene backing or will be double sided adhesive tape to permit adhesion of the inner corrosion protection layer to the weld stripe tape.

c. Apply tape with a pressure roller to fully conform the tape to the weld surface.
d. Adhesion of the weld stripe tape shall be as specified for the coating system.

C. Salt Contamination Removal
1. All bare or shop coated or primed surfaces that will be coated in the field shall be pressure-washed with potable water not greater than 8 hours before coating application, including pipeline joints.
2. Residual soluble salt contamination (SSC) shall be tested as specified under Quality Control testing.
3. Surfaces to be Abrasive Blasted:
   a. Surfaces that fail the soluble salt contamination test prior to abrasive blasting shall be cleaned by pressure washing and/or abrasive blasting and retested.
   b. Surfaces that fail the SSC test after surface preparation shall be recleaned and/or abrasive blasting and retested.
   c. Surfaces which still exceed the specified SSC level after recleaning shall be subject to determination by the Engineer if addition work will be required.
   d. Contractor shall remove all surface rust caused by SSC testing in accordance with SP-11, Power Tool to Bare Metal or abrasive blasting to the specified cleanliness.
4. Existing or Shop Primed Surfaces:
   a. All previously coated surfaces shall be tested for SCC prior to application of additional coats.
   b. Surfaces exceeding the specified SSC level after pressure washing shall be subject to additional cleaning as determined by the Engineer.
   c. Any coating applied before SCC testing is completed and accepted by the Engineer will be rejected and removed.

D. Steel Surface Preparation
1. Surface preparation of steel pipe shall be in accordance with SSPC surface preparation standards utilizing the degree of cleanliness specified for the coating system to be applied or as specified herein, whichever is more stringent.
2. Grit and/or shot abrasive mixture and gradation shall be as required to achieve the degree of cleanliness and coating adhesion specified.
3. Pipe cleaned by abrasive blasting with recyclable steel grit and/or shot or other abrasive shall be cleaned of debris and spent abrasive in an air wash separator.
4. Epoxy coated steel shall have a sharp angular surface profile of the minimum depth specified.
5. After abrasive blasting surfaces and before coating application, the metal surface shall be cleaned of residual dust to a minimum of Grade 2 per ISO Standard 8502-3, Test for the Assessment of Surface Cleanliness.
6. Work shall be performed in a manner that does not permit the cleaned metal surface to rust back or flash rust.
7. Rust back or flash rust shall be fully removed with the steel surface cleanliness equal to the metal surface cleanliness prior to rust back or flash rusting. Determination of the equivalent surface cleanliness shall be at the Engineer's sole discretion.

E. Concrete Surface Preparation:

1. Cement Mortar or Concrete Cure:
    a. Cement mortar linings shall be allowed to cure for a minimum of 15 days prior to surface preparation and coating application or 7 days with steam curing.
    b. Concrete surfaces shall be cured for 30 days.
2. Preparation Requirements:
    a. Remove grease, oil, dirt, salts, or other chemicals, loose materials or other foreign matter by solvent, detergent, or other suitable cleaning methods.
    b. Clean concrete using mechanical or chemical methods for the degree of cleaning specified for the coating system in accordance with SSPC SP-13, Surface preparation of Concrete.
    c. Abrasive blast to remove all laitance and provide a surface profile equivalent to 80 grit sandpaper.
    d. Unless otherwise required for proper adhesion, ensure surfaces are dry prior to coating.
3. Inspection:
    a. Concrete Soundness: Determined using scratching or hammer impact methods as defined in SSPC SP-13.
    b. Moisture Content: Moisture shall be tested as Specified in SSPC SP-13 and shall not exceed the moisture content recommended by the coating manufacturer.

3.3 SHOP -APPLIED COATING APPLICATION

A. Tape Wrap Coating

1. Applicator shall provide a monitoring system approved by the tape manufacturer that constantly records pipe and tape conditions during coating application. Recorded monitoring parameters shall include, but not be limited too, pipe temperature, line speed, primer and tape roll body temperature, and tape tension.
2. Pipe surface temperature shall be between 45 and 120 degrees and 5 degrees above dew point, whichever is greater.
3. Tape roll temperature shall be in accordance with the manufacturer's recommendations but shall not be less than 55 degrees for the inner wrap and 65 degrees for the outer wraps.
4. Apply a uniform coat of primer as recommended by the manufacturer without skips, runs, or sags. Allow to properly dry prior to applying the tape as required by the tape manufacturer and as necessary to achieve maximum tape adhesion. Rug type application will not be allowed.
5. If welds are not ground flush, apply a weld stripe tape to longitudinal or spiral pipe welds prior to application of the inner wrap.
6. Tape layers shall be applied continuously with the use of hydro-tension tape stands. Tension shall be maintained between the manufacturer's minimum and maximum tension recommendations or as required to achieve approximately 2.0 percent reduction in tape width.
7. Inner tape wrap shall adhere tightly to the pipe surface. Coating shall be 100 percent adhering to the metal surface and shall not have any visible damage, wrinkles, voids, disbondment, contamination, or holidays.

8. Tape coating adhesion testing shall be performed on the pipe as specified in this section.
9. Holidays testing shall be conducted on the inner layer tape prior to proceeding with subsequent tape layers. All holidays detected shall be primed and patch using coating repair procedures specified herein.
10. Perform coating and lining repairs as specified in this section.

B. Plural Component Epoxy Coating
1. Applicator Qualifications:
   a. Equipment will be certified by the coating manufacturer to meet the requirements for material mixing, temperature control, application rate, and ratio control for multi-part coatings.
   b. Equipment not meeting the written requirements of the coating manufacturer shall be rejected for coating application until repairs or replacement of the equipment is made to the satisfaction of the Engineer.
   c. Personnel responsible for the application of the coating system shall have certification of attendance at the coating manufacturer's training class within the last three years. The certified applicator shall be present during all coating application work and shall have responsibility for controlling all aspects of the coating application.
2. Pipe surface temperature shall be between 50 and 100 degrees or 5 degrees above dew point, whichever is greater.
3. Coating application shall be performed in an environmentally controlled shop area that meets or exceeds the written environmental application requirements of the coating manufacturer. Application in outdoor conditions will not be acceptable without adequate environmental shelter, environmental controls, and/or dehumidification.
4. Coating adhesion and holidays testing shall be tested as specified this section except adhesion testing is not required on overcoated CCP.
5. Coating manufacturer shall provide to the Engineer a copy of the manufacturer's coating application quality assurance manual prior to beginning coating application. Strict conformance to the requirements of the manual will be required. Deviation from the requirements of the manual will be grounds for the Engineer to reject the applied coating.
6. Unacceptable Coating Application
   a. Coating applied under improper environmental conditions will be rejected.
   b. Pipes that exceed the allowable quantity of coating defects, regardless of size or cause, shall be rejected.
   c. Coating which fails the adhesion or holiday testing as specified in this section shall be rejected.
   d. Pipe coating that is subject to off ratio application, blistering, or is not applied in conformance with the coating manufacturer's written instructions or recommendations shall be rejected.
7. Rejected coating shall be removed from the full length of the pipe to bare metal and reapplied using proper application methods in accordance with the coating manufacturer's written instruction and the requirements of these specifications.
8. Perform coating and lining repairs as specified in this section.

C. Cement Mortar Coatings

1. Steel pipe shall have a cement mortar coating applied in accordance with AWWA C205, except as modified herein.
2. Tape wrap coated steel pipe shall have a cement mortar overcoat applied over the tape wrap or epoxy coating in accordance with AWWA C205, except as modified herein.
3. Cement Mortar Coating:
    a. Reinforcement:
        1) For pipe and specials smaller than 48 inches in diameter, reinforce coating with spirally wound No. 12 gage steel wire spaced at 1-inch centers or with No. 14 gage steel wire at 1/2-inch centers positioned approximately in center of mortar coating.
        2) For pipe and specials 48 inches in diameter and larger, reinforce coating with 2 layers of spirally wound No. 12 gage wire spaced at 1-inch centers or with No. 14 gage steel wire spaced at 1/2-inch centers positioned at the third points of mortar coating.
        3) Lap ends of reinforcement strips 4 inches and tie or loop free ends to assure continuity of reinforcement.
        4) All steel wire reinforcement placed in the mortar coating shall be electrically isolated from the pipe. Electrical isolation will be tested using high voltage spark test by the manufacturer prior to shipment to the project site. Provide certification that electrical isolation of reinforcement wire from steel pipe.
    b. Special Fittings:
        1) Coating for steel plate specials may be reinforced with 2-inch by 4-inch No. 13 gage welded wire mesh in lieu of reinforcing specified above.
        2) One layer of mesh shall be positioned approximately in center of coating for specials smaller than 48 inches in diameter; 2 layers of mesh shall be positioned at the third points of coating for specials 48 inches in diameter and larger.
    c. Coating Defects:
        1) Coating defects shall be repaired as specified in AWWA C205, except as specified in this section.
4. Cement Mortar Overcoat:
    a. Cement mortar overcoat tape wrapped coated steel pipe as specified in AWWA C205, except mortar coating shall be applied over exterior pipe coating.
    b. Mortar coating shall be held back 3 inches, minimum, behind dielectric coating system cut back at joints.
    c. Cement mortar overcoat holdback shall be increased with extruded polyethylene coating as required for coating shrinkage and as required to maintain the minimum overlap specified for joint coating application.
    d. Coating Defects:
        1) Cracking in the mortar “armor” coat less than 1/8-inch in width will be acceptable.
        2) Disbondment of the cement coating over a dielectric coating system should be anticipated and will not be grounds for repair or rejection of the pipe.

3) Losses of cement mortar coating due to impact, movement, or shipping damage shall be repaired in accordance with C205.

e. Joint Coating:

1) Joints of cement mortar overcoat dielectrically coated pipe do not require field application of cement mortar overcoat when properly coated with heat shrink sleeve joint coating system.

3.4 SHOP-APPLIED LINING APPLICATION

A. Shop-applied Cement Mortar Lining:

1. Place mortar lining used in steel piping and steel plate specials in pipe to thickness below.

Pipe Diameter, Inches	Lining Thickness, Inches	Tolerances, Inches
4 through 10	3/8	-1/16, +1/8
11 through 24	5/16	-1/16, +1/8
24 through 36	3/8	-1/16, +1/8
Greater than 36	1/2	-1/16, +3/16

2. Centrifugally line straight sections of pipe. Lining of special pieces or fittings shall be by mechanical, pneumatic, or hand placement. Provide cement mortar lining of uniform thickness. Finish to a smooth dense surface.

a. Steel plate specials larger than 16 inches in diameter shall have lining reinforced with 2-inch by 4-inch No. 13-gage welded steel wire mesh.

b. Brace and support pipe during lining application to minimize pipe distortion or vibration. Bracing and supports shall not damage the pipe, coating, or lining.

c. Tightly close ends of pipe and fittings with plastic sheet caps. Plastic end caps shall be of sufficient thickness and strength to resist shipping, handling, and storage stresses.

d. Damage to the cement mortar lining, including disbondment, cracking, or blistering, caused by improper curing, shipping, handling, or installation shall be repaired in accordance with AWWA specifications and to the satisfaction of the Engineer.

3. Other requirements of mortar lining materials and processes: As specified in AWWA C205.

B. Liquid Epoxy Lining:

1. Pipe Lining, Direct to Metal

a. Where epoxy lining on steel pipe is specified or shown on drawings or where the pipe is not cement mortar lined, an epoxy lining shall be applied directly to the steel surface as specified in Section 09 90 00, Protective Coatings and Linings.

b. Immersion System specified in Section 09 90 00, shall be modified to three coats, minimum, at a total coating thickness of 20 mils dry film thickness.

2. Pipe Lining, Insulating Joints:
   a. Coating applied over cement mortar lining shall be applied in a manner that will minimize gassing and pinholes in the completed lining.
   b. Clean and coat the interior of cement mortar lined pipe at insulating joints with two coats of epoxy coating.
   c. Epoxy coating applied at insulating joints shall be applied to both sides of the insulating joint for a minimum of one pipe diameter. If only one side of the joint can be coated the coating shall be applied for a minimum of two pipe diameters.
   d. Mortar lining shall be allowed to cure 15 days or steam cured not less than 7 days prior to surface preparation of the mortar and epoxy coating application. Hand applied mortar lining shall be allowed to cure a minimum of 15 days or as required to meet the coating manufacturer's requirements for application on cement or concrete, whichever is greater.
   e. Prepared mortar lining by abrasive blasting to remove all laitance and create a suitable anchor profile
   f. Mortar lining shall be dry during epoxy lining application.

3.5 COATING AND LINING HOLDBACK

A. All coating and lining holdback areas shall be prepared as specified for the pipeline coating and protected from corrosion during storage and installation with a specified holdback coating system.

B. Internal holdback for cement mortar lined pipe shall be left unprepared and unprimed.

C. Internal holdbacks for dielectrically lined pipe shall be left bare and prepared and lined in the field as specified for field lining of joints after joint assembly.

D. External holdbacks shall be as listed below with all dimensions based on end of bell or spigot. Pipe manufacturer may adjust holdback limits as required for special joint assemblies, and with consideration for the joint coating provided and joint welding requirements. All dimensions from end of pipe.

Tape wrap coating	
Push-on joint, spigot	1-inch, minimum after centerline of gasket.
Push-on, bell	Flush with bell end
Welded, spigot	1 inches, minimum
Welded, Bell	Stab Depth + 2-inches, minimum
Epoxy coating	
Push-on joint, spigot	1-inch after centerline of gasket
Push-on, bell	Flush with bell end
Welded, spigot	3 inches, minimum

Welded, Bell	Stab Depth + 2-inches, minimum
Extruded polyolefin	
Welded joints, spigot	3-inch Minimum
Welded joints, Bell	Stab Depth + 2-inches, Minimum
Push-on joints	Not applied to bell or spigot

E. Coating holdbacks shall be straight and cut through the full thickness of the coating.

F. Cutbacks shall be completed in a manner that permits field coating of joints in accordance with the manufacturer's recommendations and as specified herein.

3.6 FIELD COATING JOINTS

A. General:
1. Joint bonds shall be installed, as required, before application of joint coating as specified in Section 13 11 40, Corrosion Monitoring System.
2. Joint bonds shall be low profile bonds and all gaps and crevices around the bonds shall be filled with filler mastic.
3. Filler mastic shall be placed under copper strap bonds and extended ½ inch minimum beyond edges of bond to allow for sealing with heat shrink sleeve.
4. Contractor to electrically test completed joint coating for holidays with high voltage spark tester at Engineer's direction or if damage to the joint coating occurs.

B. Field Surface Preparation:
1. Pipe joints with hold back corrosion protection:
   a. Perform salt contamination removal as specified under Surface Preparation.
   b. Field prepare joints in accordance with SSPC-SP1, solvent cleaning, and SP3, Power tool cleaning, to remove all dirt, mud, oil, and grease prior to application of heat shrink sleeve.
   c. Any visible rusting areas shall be spot prepared in accordance with SP-11, power tool to bare metal.
2. Pipe joints without hold back corrosion protection:
   a. Perform salt contamination removal as specified under Surface Preparation.
   b. Abrasively blast joint in field in accordance with SSPC-SP5, white metal blast.
   c. Sweep blast epoxy coating for 2-inches for 80-grit sandpaper equivalent profile for coating adhesion.
3. All loose or damaged coating shall be removed and repaired per specified coating repair procedures.

C. Weld After Backfill' Joint Requirements:
1. Post-welded or 'Weld after Backfill' joints are defined as welded pipe joints that have been coated and backfilled prior to completing interior welds.
2. Post welded joints shall be coated and protected as follows:
   a. Joint coating shall be heat shrink joint sleeves only with a minimum coating thickness over the weld heat affected zone of not less than 120 mils before welding. Tape wrapped joints or heat-resistant tape will not be acceptable.

b. Manufacturer's recommendations for heat shrink sleeves selection and application and this specification shall govern WAB joints. If a conflict occurs, the more stringent requirement shall apply.
c. Hold back primer shall be suitable for post weld conditions as specified this section and shall not exhibit any binder breakdown in the heat affected zone that causes loss of joint coating adhesion to the holdback primer.
d. Filler mastic materials shall be high temperature material with 500 degree F melting point.
e. Joints shall be fully buried prior to welding, with not less than 12-inch soil cover or flowable fill material on all sides. Sand or flowable fill backfill is preferred for weld after backfill joints. Crush rock or angular gravel backfill can be detrimental to the heat shrink sleeve when using WAB procedures.
f. Heat shrink sleeves after WAB shall exhibit no holidays, burn through of coating, creasing, carbonization of the sleeve adhesive, or disbondment of the sleeve or holdback primer.

3. Welding of the joints shall be in conformance with Section 33 11 11, Steel Pipe, and as modified herein:
   a. All welding shall be with two or more weld passes as required to meet the specified AWS qualified welding procedures and maximum coating temperature limitations. 'Weld after Backfill' procedures on wall thicknesses of ¼ inch or less must be approved by the Engineer based on field testing demonstrating the welding procedures can comply with the requirements of this specification.
   b. Welding speed, amperage, and voltage shall be as required to maintain a maximum heat input of 23,000 joules or a maximum surface temperature at the coating/steel interface of 750 degrees F, whichever is least.
   c. Maximum weld temperature and duration shall not result in carbonization of the joint coating adhesive. Carbonization is defined as the loss of volatile organic compounds that result in loss of tackiness, adhesion to the steel, and corrosion protection properties.
   d. Finished joint coating shall not have any visual creases or folds in the joint coating backing material that extends through both the inner protective layer and outer joint sleeve.
4. If Contractor elects to post-weld any joints, Contractor shall demonstrate that the joint welding procedures will not significantly damage the coating by fully excavating the first two joints for evaluation of the joint coating condition. Engineer will randomly select up to three additional post-welded joints for excavation by Contractor for evaluation of joint coating condition. Joint coating will be destructively evaluated by the Engineer. Contractor will remove and replace joint heat shrink sleeve upon completion of the evaluation.
5. If any excavated post welded joint exhibits any heat related damage as defined herein, Contractor shall modify and test a new post welding procedure prior to completing any additional post-welded joints. Contractor shall demonstrate that the revised joint welding procedure will not significantly damage the coating by repeating the weld after backfill evaluation requirements defined this Section, including excavation of the three additional randomly selected joints for destructive evaluation.

D. Heat Shrink Sleeve Joint Coating:

1. Store, handle, and apply field heat shrink sleeve coatings in accordance with AWWA C216 and these specifications.
2. Store sleeves in shipping box until use is required. Keep dry and sheltered from exposure to direct sunlight. Store off the ground or concrete floors and maintain at a temperature between 60 and 100 degrees as recommended by the sleeve manufacturer.
3. Joint shall be prepared as specified in Pipe Joint Surface Preparation.
4. Preheat pipe uniformly as recommended by the sleeve manufacturer. Monitor pipe temperature using a surface temperature gauge, infrared thermometer, or color changing crayons. Protect preheated pipe from rain, snow, frost, or moisture with tenting or shields and do not permit the joint to cool.
5. Apply filler material as specified in Field Applied Coating Systems.
6. Apply heat shrink sleeve when sleeve has a minimum temperature of 60 degrees and while maintaining the pipe temperature above the preheat temperature specified. Apply sleeve in accordance with the manufacturer's instructions and center the sleeve over the joint to provide a minimum 2-inch overlap onto the existing pipe coating.
7. Acceptable joint sleeve installations shall meet the following requirements:
    a. Shall be fully bonded to the pipe and existing coating surface without tenting or voids.
    b. Mastic beading shall be visible along the full circumference of the sleeve.
    c. There shall be no wrinkling or excessive burns on the sleeves.
8. Sleeves that do not meet these requirements shall be removed and the joint recoated as directed by the Engineer. Minor repairs may be repaired using heat applied patch material specified for minor coating repairs.
9. Allow the sleeve to cool before backfilling. Water quenching will be allowed if permitted by the sleeve manufacturer.
10. Heat shrink joint coatings which have become wrinkled or disbonded because of prolonged exposure to UV light or thermal cycling shall be removed and replaced.
11. Double coating of defective or damaged heat shrink coatings will not be permitted. Any double coated heat shrink sleeves shall be immediately rejected and Contractor shall remove the existing coating and recoat the joint.

E. Cement Mortar Overcoat Coating:
1. Joints of cement mortar coated pipe shall be cement mortar coated in accordance with AWWA C205.
2. Polyethylene Foam Joint Diapers:
    a. Cut into strips wide enough to match uncoated field joint area.
    b. Slit to thickness of 1/4 inch that will expose a hollow or open cell surface on one side.
    c. Foam liner shall be attached to fabric backing with open or hollow cells facing towards pipe.
    d. Foam strip shall cover full interior circumference of grout band with sufficient length to permit 8-inch overlap of foam at or near top of joint.
    e. Splices to provide continuity of material will be permitted.
    f. Protect polyethylene foam material from direct sunlight.
3. Field repair cement mortar coating in accordance with AWWA C205.

3.7 FIELD APPLIED INTERIOR JOINT LINING

A. Mortar Lining:
   1. After backfilling pipe, interior joint recess shall be filled with grout.
   2. The grout shall be tightly packed into the joint recess and troweled flush with the interior surface. Excess material shall be removed from pipe.
   3. At no point shall there be an indentation or projection of the mortar exceeding 1/16-inch.
   4. On pipe smaller than 24-inches in diameter, bell shall be daubed with grout before the spigot is inserted into the bell. The joint shall be completed and excess mortar on the inside of the joint shall be swabbed.

3.8 REPAIR OF COATING AND LININGS

A. General:
   1. All areas where holidays are detected or coating is visually damaged, such as blisters, tears, rips, bubbles, wrinkles, cuts, or other defects, shall be repaired. Areas where no holidays are detected, but are visually damaged shall also be repaired.
   2. Maximum defects allowable shall be as specified herein for the coating system.

B. Tape Wrap Coating Repairs:
   1. General:
      a. No more than five repairs per joint of pipe will be permitted with tape wrap coating, excluding adhesion test damage. The coating on any pipe with more than five coating repairs or with more than two areas of coating damage greater than five square feet will be rejected.
      b. Pipes exceeding the maximum number or size of coating defects shall be stripped, reblasted, and recoated.
      c. Pipe arriving in the field with defects or repairs exceeding the maximum number or size of coating defects will be returned to the shop for recoating at the Contractor's expense.
      d. The number of layers and total thickness of the tape repair coating shall be the same as the shop-applied coating; unless heat applied coating materials is used.
      e. Wipe the area to be repaired with solvent for a minimum distance of 4 inches outside the damaged area.
   2. Defect Size:
      a. Minor repairs - repairs that are less than 8 inches in the greatest dimension, measured after cutout of damaged tape layers. Damage to the inner tape layer will be considered minor only if repairs are made using heat applied patch materials.
      b. Major repairs - repairs that exceed 8-inches in the greatest dimension or where damage to the inner tape layer has occurred and hand applied tape repairs will be used.
   3. Minor Repairs:
      a. Complete minor repairs using a heat applied coating patch material.
      b. Cut patch material to overlap onto the undamaged coating a minimum of 2 inches on all sides with 1-inch radius on each corner of the patch.
      c. Carefully remove damaged layers by cutting the coating with a sharp knife without cutting or damaging the inner wrap.

d. Cut middle and outer layers in stepped fashion to expose 1-inch or more of the underlying tape layer for the circumference of the repair.

4. Major Repairs (Over 24-inches Diameter):
   a. Cigarette wrap coating repairs shall be with heat shrink sleeves as specified for joints.
   b. Carefully remove damaged layers by cutting the coating with a sharp knife without cutting or damaging the inner wrap.
   c. Holiday test the inner wrap and if a holiday is detected cut outer layers back to fully exposed the holiday(s) and retest for holidays.
   d. Cut middle and outer layers in stepped fashion to expose 1-inch or more of the underlying tape layer for the circumference of the repair.
   e. Width of sleeve shall be the width of the damaged area plus 4-inch overlap. Multiple sleeves may be used for larger repairs but must be overlapped a minimum of 2 inches.
5. Major Repairs (24-inch Diameter or Less)
   a. Cigarette wrap repairs on pipe less than 24-inches with either hand applied tape wrap or heat shrink sleeves as specified at the Contractor's option.
   b. Carefully remove damaged layers by cutting the coating with a sharp knife without cutting or damaging the inner wrap.
   c. Holiday test the inner wrap and if a holiday is detected apply one extra layer of repair tape.
   d. Clean surfaces by solvent wiping and applying primer over the inner tape layer for a minimum of 6-inches onto the outer wrap in all directions.
   e. Apply first layer of repair coating, over lapping 1-inch or more onto undamaged coating in all directions. On larger areas, lap the repair tape within a minimum of 1-inch overlap, offsetting the overlap from the previous layer overlap, until the area is properly covered.
   f. Repeat for each tape layer damaged with each succeeding layer applied at 90 degrees to the preceding layers and overlapping onto the undamaged coating a minimum of 2-inches.
   g. Apply the last tape layer, use the cigarette wrap method for the full pipeline circumference covering all previous repair layers and overlapping a minimum of 2-inches onto undamaged coating. The ends of the cigarette wrap shall be pointed downward.

C. Epoxy Coating or Lining Repairs
1. General
   a. Complete coating or lining repairs in accordance with the coating manufacturer's written instructions and these specifications, whichever is stricter.
2. Defect Size:
   a. Minor repairs - repairs that are less than 8-inches in the greatest dimension.
   b. Major repairs - repairs that exceed 8-inches in the greatest dimension.
3. Maximum Quantity of Defects Allowed:
   a. Coating or lining repairs on any joint of pipe shall not exceed 1.5 per 100 square feet of surface area.
      1) Two or more minor repairs within an 8-inches diameter circle will be considered a single repair.

2) Repairs for adhesion testing will not be included in the total number of repairs.

b. Major repairs shall not exceed three per pipe joint and the combined area shall not be greater than 30 percent of the pipe.

c. Pipes exceeding the maximum number or size of coating defects shall be stripped of coating, reblasted, and recoated.

d. Pipe arriving in the field with defects or repairs exceeding the maximum number or size of coating defects will be returned to the shop for recoating at the contractor's expense.

4. Minor Repairs:

a. Minor repairs

1) Surface Preparation: Clean and feather the defect by power tool sanding with 80 grit or coarser sandpaper to roughen the existing coat and feather the edges of the defect for a minimum of 2-inches around the defect.

2) Shop repair Materials:

a) Single use coating kits to match the pipe coating.

b) Two component, fast cure epoxy coating, in controlled mix ratio packaging.

(1) Protal 7125, North American Denso Inc, or equal

(2) Or equal.

c) Coating Manufacturer's coating repair products are subject to Engineer approval.

3) Field Repair Materials:

a) Heat applied coating materials; CRP Patch, Canusa; PERP Patch, Tyco Adhesives, or approved equal.

b) Two component, fast cure epoxy coating, in controlled mix ratio packaging.

(1) Protal 7125, North American Denso, Inc,

(2) Or equal.

c) Single use coating kits to match pipe coating.

d) Coating Manufacturer's coating repair products are subject to Engineer approval.

4) Clean and feather the defect by power tool sanding with 80 grit or coarser sandpaper to roughen the existing coating and feather defect edges minimum of 2-inches.

5) Apply a single coat of the specified patch coating material at the specified coating thickness.

6) Repair coating adhesion shall be 50 percent of the specified coating adhesion.

5. Major Repairs:

a. Major repairs:

1) Surface Preparation:

a) The metal surface and surrounding coating shall be abrasively blasted in accordance with SSPC-SP10, near white metal, or to equal in cleanliness and profile as the original surface preparation.

b) Existing coating shall be feathered and roughened to the equivalent of 40 grit sandpaper.

2) Shop Repair Materials:
   a) Same material as the pipeline coating or lining and shall be applied by using plural component spray equipment.
3) Field Repair Materials:
   a) Same material as the pipeline coating or lining and shall be applied by using plural component spray equipment.
   b) Heat shrink sleeves as specified for pipeline joints.

b. One coat of the specified original coating material shall be applied over the repaired surface at the specified thickness.

c. Repair adhesion shall be equal to the specified coating adhesion.

D. Cement Mortar Coating

1. Cement mortar coating that is cracked or disbonded shall be repaired in accordance with AWWA C205, except for mortar overcoat on tape wrapped steel.
2. Disbonded mortar coating shall be removed and patched.
3. Mortar coating with disbondment greater than 25 percent of the pipe surface shall be rejected and recoated.
4. Cracks in mortar coating shall be repaired in accordance with AWWA C205.

3.9 QUALITY CONTROL TESTING AND INSPECTION

A. General

1. Applicator shall inspect and test the coating system in accordance with referenced standards and these specifications, whichever is more stringent.
2. Quality control testing as specified in AWWA standards are minimum industry standards and it is the intent of this specification to provide a higher level of quality control for the objective of achieving maximum coating performance. If any conflict between this specification and referenced standards occurs, the more stringent requirement shall apply, and any interpretation of this requirement or results shall be with the objective of achieving maximum coating performance.
3. The frequency of the testing shall be determined by the applicator but shall not be less than the requirements of this specification.

B. Soluble Salt Contamination (SSC) Testing

1. Residual soluble salt contamination (SSC) shall be verified using an Elcometer Model E130-TC Salt Contamination Meter before and after surface preparation.
2. Testing after blasting is not required if the preblast test passes the maximum soluble salt contamination criteria.
3. Maximum soluble salt contamination levels shall be:
   a. 2.0 µg/cm^2 – Immersion or buried
   b. 5.0 µg/cm^2 – non-immersion
4. Compliance with SSC limits shall be based on the average of three tests at three locations, which can be on multiple pipes or components at the Engineer's discretion.

C. Surface Profile Testing

1. Surface profile of abrasive blasted surfaces to be tested with "Press-O-Film" tester tape or equivalent in accordance with NACE RP287.
2. Tester tape shall be suitable for the intended profile height.

3. Profile shall be measured to a minimum tolerance of 0.1 mils, maximum.
4. Electronic surface profilometer shall be used, where deemed necessary, to verify tester tape measurements.

D. Adhesion Testing
1. General
   a. Adhesion testing shall be conducted at the shop prior to shipment. Pipe shipped without adhesion testing will be field-tested. Pipe rejected in the field will be returned to the shop for repair at the sole expense of the Contractor.
   b. Coating adhesion testing shall be conducted on each pipe lot coated. The quantity of coating adhesion tests shall be the greater of the following:
      1) Two pipes will be tested for the first 3,000 square feet of coating application plus an additional pipe for each. increment of 2,000 square feet of coating application in excess of the first 3,000 square feet.
      2) Not less than 33 percent of each pipe produced within a lot.
   c. A pipe lot is defined as the quantity of pipe that is coated by a single crew within a 12 hour or less work shift.
   d. The pipe coating applicator shall repair all coating damage from shop adhesion testing. Contractor shall be responsible for coating repairs for all field adhesion testing.
   e. Adhesion tests will be performed not less than 24 hours after coating application. Tests conducted prior to 24-hours will be acceptable only if the test meets or exceeds the adhesion criteria specified and the test was requested by the pipe fabricator.
   f. Pipe will be randomly selected for adhesion testing.
   g. Owner or the Owner's Representative has the right to conduct additional adhesion testing as deemed necessary to assure the pipe meets or exceeds the requirements of this specification at any time and location.
   h. Prior to beginning any QA/QC testing, the pipe fabricator, coating manufacturer, and Engineer shall review dolly attachment procedures, adhesion test procedures, and data recording requirements for the project and ensure that test personnel are qualified and capable of performing the testing in accordance with required test standards and these specifications.
2. Rejection of Pipeline Coating or Lining
   a. Each pipe that fails the adhesion criteria, as defined in this section, shall be rejected.
   b. If any pipe within a lot fails to meet the adhesion criteria specified for the coating type, the pipe coating will be rejected and all pipes within the lot will be classified as rejected. Each remaining pipe within the rejected pipe lot will then be individually tested and rejected on a pipe-by-pipe basis in conformance with the test procedures and criteria specific to the coating type.
   c. All rejected pipe shall have the coating fully removed from the pipe and the pipe abrasive blasted and recoated.
3. Tape Coating Adhesion Testing:
   a. Adhesion Acceptance Criteria:

1) Inner tape coating shall have an adhesion to substrate of 20 pounds per inch width, minimum, for steel pipe when tape is pulled in a continuous manner at an angle of 180 degrees to the pipe surface.
2) Inner tape coating shall have an adhesion to substrate of 15 pounds per inch width, minimum, for ductile iron pipe when tape is pulled in a continuous manner at an angle of 180 degrees to the pipe surface.
3) Extruded polyolefin coating shall have an adhesion to substrate of 30 pounds per inch width, minimum, when coating is pulled in a continuous manner at an angle of 180 degrees to the pipe surface. Adhesion testing for extruded polyolefin shall be performed as specified for tape wrap coating.

b. Test Procedures
1) Adhesion testing shall be conducted prior to application of the cement mortar overcoat, where applicable. Pipe that has been mortar coated prior to adhesion testing shall have the mortar coating removed by the Contractor as directed by the Engineer and of sufficient dimensional area to permit the adhesion test to be conducted.
2) Adhesion tests shall be conducted at temperatures above 60 degrees and less than 75 degrees.
3) Pulling tension shall be continuous, without stopping, and monitored throughout the length of the pull, which shall be not less than 12-inches in length.
4) Adhesion test shall be prepared by making two parallel cuts through the coating, 1-inch apart, of sufficient length for the test pull. Peel the coating back at one end and attach the tension scale to the coating with a suitable clamp. Mark the coating at one (1) inch increments from 0 to 12-inches.
5) The pull tension shall be recorded for each inch of pull. The two highest and two lowest readings shall be discarded and the remaining values averaged. Pull speed shall be not less than 5 seconds per inch or greater than 10 seconds per inch. If significant elongation of the tape backing occurs, pull speeds may exceed 10 seconds per inch provided the minimum adhesion rating can still be achieved.

c. Adhesion Pull Records and Evaluation
1) Failure shall be by cohesive failure of the adhesive only. Delamination failure, defined as separation of the adhesive from the backing material, will result in rejection of the tape lot.
2) Intermittent skip failures will be counted as zero pounds of adhesion and included in the calculations for average coating adhesion.
3) Adhesive failure, defined as separation of the adhesive from the metal substrate, will be rejected.
4) Pipe that fails the test by delamination will be retested on two other pipes within the same lot of coated pipe. Failure of any two pipes within the lot will result in rejection of all pipes coated with the rejected tape lot.

4. Plural Component Epoxy Adhesion Testing:

a. Adhesion testing shall be performed in accordance with this specification section. Adhesion testing procedures and evaluations per AWWA C210 or C222 are specifically excluded under this specification.

b. Test Procedures

1) Coating adhesion testing shall be with self-aligning pneumatic pull off equipment, such as the Delfesko Positest AT-A, and test procedures in accordance with ASTM D4541, except as modified in this section.

a) All adhesion tests shall be performed at an applied load rate of 100 psi per second, plus or minus 10 psi. Automatic adhesion test equipment shall be used.

b) Tests shall be performed to coating or glue failure or maximum test load, whichever is greater.

c) Adhesion tests shall be based on the ASTM D4541 using standard 20 mm dollies.

d) Adhesion testing shall be based on three tests. All three tests shall be conducted by the same person, test equipment, and test procedure, and must be completed within a 30-minute period.

e) All adhesion tests shall be conducted within an area not to exceed 6-inches by 6-inches.

f) All coatings with more than 10 percent elongation or 25 mils thick shall be scored around dolly to metal substrate using manual methods and tools, normal to the pipe surface, and in a manner that does not stress or overheat the coating.

g) All adhesion tests shall be performed to coating or glue failure or test termination, whichever comes first.

2) Dollies for adhesion testing shall be attached to the coating surface using a two-part epoxy or cyanoacrylate glue and allowed to cure for a minimum of 12 hours before testing or until full cure, whichever is greater. Glue type used shall be determined by the pipe fabricator and coating manufacturer for the pipe diameter, temperatures, and environmental conditions.

3) Adhesion testing shall be performed at temperatures between 55- and 90-degrees F or at temperatures as recommended by the coating manufacturer. Testing up to 115 degrees F or below 55 degrees will be permitted if tests can demonstrate no statistically detectable effect on test results and with coating manufacturer and Engineer approval.

c. Epoxy Coating and Lining Adhesion Criteria

1) Coating is acceptable if first dolly pull test exceeds 1,750 psi, minimum.

2) If first dolly pull is less than 1,750 psi, two additional tests shall be performed with acceptance based on “Best of Three” evaluation method as defined herein.

d. Pipe Lot Performance Criteria:

1) Each lot of coated pipe shall be evaluated for general coating application based on a median value for all coating or lining

adhesion tests performed on a lot of pipe, which shall be greater than 2,000 psi.

2) Any pipe lot failing the Pipe Lot Performance Criteria shall be classified as rejected until 100 percent of the pipe within the pipe lot has been tested for adhesion. Each pipe that fails the coating adhesion criteria shall be rejected.

e. Adhesion Test Evaluation and Records

1) The "Best of three" evaluation method shall be defined as two of three test values less than the Acceptance Criteria, which shall result in rejection of the pipe coating.

2) All adhesion tests shall be considered as valid and suitable for acceptance or rejection of the coating, except where retesting is allowed.

3) Adhesion test failure shall be by adhesive or substrate and cohesive failure as defined below:

a) Adhesive or substrate failure is defined as a percentage of separation of the coating from the steel substrate or between distinct coating layers.

b) Cohesive failure is defined as a percentage of failure within the coating, resulting in coating remaining both on the steel substrate and test dolly.

4) Retesting of coating adhesion tests will be allowed when any test is glue failure at 25 percent or more of dolly surface area and the test value is less than the Acceptance Criteria or the Minimum Criteria.

5) All coating adhesion retesting shall be within the same 6-inch by 6-inch test area as the original adhesion testing.

6) Disputed adhesion tests shall be retested as defined for adhesion retesting. Dolly attachment and adhesion retesting shall be witnessed by the Owner's representative.

7) Adhesion tests will be conducted on pipe coating and lining independently and will be accepted or rejected independently.

8) Records of all adhesion tests shall be maintained in an electronic spreadsheet that includes the following information:

a) Pipe identification,
b) Pipe coating date,
c) Adhesion test date,
d) Surface tested (interior or exterior),
e) Surface temperature at time of test,
f) Coating thickness,
g) tensile force applied,
h) Applied load rate per second,
i) Mode of failure, and
j) Percentage of failure types, previously defined, relative to dolly surface area,
k) Dolly size and attachment glue used.
l) If different coatings are tested, the records shall include coating manufacturer and product number.

f. Adhesion Test Repairs

1) Fabricator or contractor to complete adhesion repairs as specified in this section.
2) Repair patches on epoxy coating shall be randomly selected for adhesion testing in a manner as described herein and at the discretion of the coating inspector conducting the adhesion tests. Adhesion of repairs shall be as specified for the type of repair.

E. Holiday Testing
1. Holiday test the inner layer of tape wrap coatings after application and prior to subsequent tape layer in accordance with AWWA C214 and NACE RP-0274.
2. Holiday test extruded polyolefin coating after application in accordance with AWWA C215 and NACE Standard RP-0274, whichever is more stringent.
3. Holiday tests on epoxy coatings or linings over 15 mils DFT shall be conducted on the completed coating or lining after cure or 24-hours, whichever is less, using a high voltage spark test in accordance with NACE SP0274 and these specifications.
4. Holiday testing on epoxy coatings or linings less than 15 mils DFT shall be high voltage spark tested in accordance with NACE SP0188, except as modified herein.
5. High voltage setting shall be the average measured coating thickness in mils times 125 volts, minimum.
6. Wet sponge or low voltage holiday testing will not be permitted.

F. Dry Film Thickness Testing
1. Coatings shall be tested for dry film thickness using a properly calibrated magnetic pull off, eddy current, or ultrasonic equipment.
2. Coating thickness measurements shall be conducted as necessary and without limitation. Testing conformance to the requirements of SSPC PA-2 is specifically excluded from this specification.

3.10 HANDLING, TRANSPORTATION, AND STORAGE

A. Pipe shall be handled in such a manner as to protect the pipe and coating from damage.

B. Coated pipe shall not be shipped or installed until coating has developed full adhesion and cure.

C. During coating application, storage, loading, transportation, unloading, laying and installation, every precaution shall be taken to protect and prevent damage to pipe, lining, and coating. Forklift equipment shall have all bearing surfaces padded with suitable padding material. Lift pipe with web slings a minimum of 12-inch wide and of a type that will not damage the coating. Metal chains, cable, tongs, forklifts or other equipment likely to damage the coating will not be permitted. Dragging or skidding of pipe on grade or in the trench will not be permitted.

D. Provide transportation vehicles with padded bolsters between each layer of pipe and heavy padding under load ties. Bolsters shall be curved to fit the outside of the pipe and 12 inches wide, minimum. All pipe contact locations shall be heavily padded with carpet and strips of the outer tape wrap material (adhesive side against the carpet) during shipment to the project site and from the storage yard to the point of installation.

E. Pipe shall not be stored on rocks, gravel, or other hard materials that might damage the coating. Provide padded 12-inch-wide skids and chucks, sandbags, select loamy or sand berms, or suspended from cutback ends, where possible, to minimize coating damage. Pipe shall not be laid on asphalt without suitable padding at all contact points.

F. Pipe shall be inspected by the Contractor at the project site for damage. Any damage to the pipe, lining, or coating shall be repaired as directed if, in the opinion of the Engineer, a satisfactory repair can be made; otherwise, the damaged section shall be replaced at the sole expense to the Contractor.

G. No metal tools or heavy objects shall be permitted to come into contact unnecessarily with the finished coating. Workmen shall not be permitted to walk on the coating except when necessary and approved by the Engineer. When permitted, shoes with rubber or composition soles and heels or other suitable footwear that will not damage coating shall be used.

H. Long-term Exposure:
   1. Pipe shall either be provided with UV inhibitor for lengthy of above grade exposure or covered to prevent UV degradation of outer wrap.
   2. Amount of UV stabilizers required will depend on the project location, laying schedule, anticipated length of exposure, and type of coating.
   3. Manufacturer shall be consulted for recommended UV inhibitors requirements.
   4. Protective covering can be colored plastic sheeting, canvas, or other UV blocking material. Clear plastic sheets are not acceptable.
   5. Areas of coating that display UV degradation shall be removed and repaired at sole cost of the Contractor.

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SPECIAL CONSTRUCTION

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SECTION 13 11 40
CORROSION MONITORING AND CATHODIC PROTECTION

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. This section covers the work necessary to furnish and install corrosion monitoring and cathodic protection on all buried steel piping, which includes test stations, electrical isolation, pipe joint bonds for electrical continuity, and installation of galvanic anode groundbeds, complete.

B. Third-party Corrosion Expert to perform Contractor required quality control testing as defined in this section.

1.2 STANDARDS

A. The following standards are included by:
   1. NACE SP-0169
   2. NACE SP-0177

1.3 QUALITY CONTROL

A. All CONTRACTOR specified testing shall be performed by a third-party Corrosion Expert who holds a current NACE/AMPP accreditation as a Cathodic Protection Specialist (CP-4) or Cathodic Protection Technologist (CP-3), and/or a registered professional engineer with verifiable expertise in corrosion control and cathodic protection.

B. Perform quality control testing shall include the following tests, which shall be performed as defined in this section.
   1. Joint Bond Resistance test
   2. Insulating Joint Testing (before burial and filling the pipeline)
   3. Other testing as specified in contract documents

C. Connection of galvanic anodes at test stations, testing of cathodic protection system, and other tests as defined under “System Tests and Inspections” shall be performed by the ENGINEER unless specifically stated otherwise this section.

1.4 DEFINITIONS

A. Ferrous Metal Pipe: Pipe made of steel or iron, or pipe containing steel or iron as a principal structural material, except reinforced concrete pipe.

B. Foreign-Owned: Buried pipe or cable not specifically owned or operated by the OWNER.

C. Electrically Continuous Pipeline: A pipeline which has a linear electrical resistance equal to or less than the sum of the resistance of the pipe plus the maximum allowable joint bond resistance for each bonded pipe joint as specified in this section.

D. Electrical Isolation: The condition of being electrically isolated from other metallic structures (including, but not limited to, piping, reinforcement, casings) and the environment as defined in NACE Recommended Practice SP-0169.

E. Lead, Lead Wire, Joint Bonds, Pipe Connecting Wires, Cables: Insulated copper conductor; the same as wire.

1.5 SUBMITTALS

A. Shop Drawings: Catalog cuts and other information for products proposed for use.

B. Quality Assurance Submittals:
1. Manufacturers' Certificates of Compliance.
2. Field Test Reports.
3. Qualifications of NACE Accredited Testing Personnel.

PART 2 – MATERIALS

2.1 GENERAL

A. Like items of materials provided hereunder shall be the product of one manufacturer to achieve standardization for appearance, maintenance, and replacement.

B. The use of a manufacturer's name and model or catalog number is for establishing the standard of quality and general configuration desired only. Products of other manufacturers will be considered in accordance with the General Conditions.

C. Materials and workmanship as specified in this section shall be installed concurrently with pipe installation. Coordinate all work specified herein with related sections.

2.2 SUPPLIERS

A. Alternate suppliers will be considered, subject to approval of the ENGINEER. Address given is that of the general office; contact these offices for information regarding the location of their representative nearest the project site.

1. Corrpro, Inc., Chicago, IL www.corrpro.com
2. Farwest Corrosion Control, Gardena, CA www.farwestcorrosion.com
3. MESA Products, Tulsa, OK www.mesaproducts.com

2.3 PREPACKAGED GALVANIC ANODES

A. High-Potential Magnesium Alloy:
1. Composition:
   a. Aluminum: 0.01 percent maximum.
   b. Manganese: 0.5 to 1.3 percent.
   c. Silicon: 0.05 percent maximum
   d. Copper: 0.02 percent maximum.
   e. Nickel: 0.001 percent maximum.

f. Iron: 0.03 percent maximum.
g. Total Others: 0.05 percent each or 0.3 percent maximum.
h. Magnesium: Remainder.

2. Dimensions:
   a. Bare Weight: per the Drawings.
3. Manufacturers and Products:
   a. Dow; Galvomag.
   b. Amax; Maxmag.

B. Anode Wire:
1. Wire: Furnish each anode with black No. 12 AWG solid copper wire with THWN-2 insulation, 10 feet long.
2. Wire-to-Anode Connection: Manufacturer's standard. The anode connection shall be stronger than the wire.

C. Backfill:
1. Composition:
   a. Ground Hydrated Gypsum: 75 percent.
   b. Powdered Wyoming Bentonite: 20 percent.
   c. Anhydrous Sodium Sulfate: 5 percent.
2. Grain Size: 100 percent passing through a 20-mesh screen and 50 percent retained by a 100-mesh screen.
3. Mixture: Thoroughly mixed and firmly packaged around the galvanic anode within the cloth bag or cardboard tube by means of adequate vibration.
4. The quantity of backfill shall be sufficient to cover surfaces of the anode to a depth of 1 inch.

2.4 JOINT BONDS

A. General:
1. All joint bonds provided by pipe manufacturer or Contractor shall meet the following minimum requirements:
   a. All connections shall be welded or soldered.
   b. Mechanical or compression type connections will not be permitted.
   c. Bonds and welds shall exhibit sufficient strength and flexibility to allow thermal movement of the pipe after pipe backfill without cracking or breakage.
   d. Bond connections to pipe shall be with an Engineer approved welding method.
2. All installed bonds shall be insulated or coated copper with all exposed copper field coated to prevent galvanic corrosion of pipe.

B. Ductile or Cast Iron Pipe, External Bonds:
1. Single-conductor, No. 2 AWG stranded copper wire with 600-volt HMWPE insulation, 18 inches long, with formed copper sleeve on each end of the wire.
2. Quantity of joint bonds per pipe joint by pipe diameter shall be as defined below:

Bond Type	Two Bonds	Three Bonds
#2 AWG Wire	16” or less	42” or less

3. Connection of wire joint bonds to pipe shall be with the thermite weld method using molds and cartridges as recommended by the welder manufacturer for bond type used.
4. Bonds shall be as manufactured by Erico Products, Continental Industries, or approved equal. Third party manufactured bonds shall be approved by the Engineer for conformance with the requirements of this specification and proper thermite welding.

C. Coated Steel Pipe, External Bonds:
1. Rolled joint or Carnegie joint bonds shall be one of the following types at the CONTRACTOR’s option:
   a. Wire Bond: Single-conductor, No. 2 AWG stranded copper wire with 600-volt HMWPE or THWN insulation, 18 inches long, with a formed copper sleeve on each end of the wire.
   b. Strap Bond:
      (1) Solid copper strap, 1-1/4-inch wide by 1/16-inch thick, equivalent to 1/0 AWG wire, with two punched holes for thermite welding to the pipe. Strap holes shall be sized for the thermite weld mold and shall provide for physical centering of the mold over the hole.
      (2) Strap bond shall be 12-inches long with dielectric coating applied to the center 8-inches of the strap bond. Strap bonds provided without a dielectric coating shall be coated prior to installation with filler mastic as specified for heat shrink sleeves in Section 09 90 10, Pipeline Coating and Lining.
      (3) Strap bonds shall be as manufactured by Erico Products, Continental Industries, Hoff Company, or approved equal. Third party manufactured strap bonds shall be approved by the Engineer for conformance with the requirements of this specification and proper thermite welding.
   c. Use of manufactured steel bonding clips will not be permitted with heat shrink sleeve coated joints.

D. Flange joints:
1. Flanged joint bonds shall be one of the following types at the CONTRACTOR’s option:
   a. Steel flanges only: Steel rod, 5/8-inch diameter, length as required, arc welded to flange. Steel rod bonds will not be allowed where welding to the flange is not approved by the Engineer.
   b. Single-conductor, No. 2 AWG stranded copper wire with 600-volt HMWPE insulation, 18 inches long, with a formed copper sleeve on each end of the wire.
2. Quantity of joint bonds per pipe joint shall be as defined below per pipe diameter:

Bond Type	Two Bonds	Three Bonds
Steel Rod	36” or less	72” or less
#2 AWG Wire	NA	30” or less

3. Connection of wire joint bonds to pipe shall be with the thermite weld method using molds and cartridges as recommended by the welder manufacturer for bond type used.
4. Coat steel rod bonds with fast curing epoxy after welding to joint as specified in this Section, except when pipe is specified to be coated in accordance with Specification Section 09 90 01 Protective Coatings.

E. Sleeve Coupling, Flanged Coupling Adapter, and Other Non-standard Joints:
1. Ductile Iron Pipe:
   a. Bond: No. 2 AWG wires, 24 inches long, HMWPE insulation, with two 12-inch long THWN-2 insulated No. 12 AWG wire pigtails,
   b. Manufacturer: Erico Products Inc. (Cadweld), Cleveland, OH, Hoff Company, Denver, Colorado, or equal.
2. Steel Pipe:
   a. Solid copper strap, 1-1/4-inch wide by 1/16-inch thick, equivalent to 1/0 AWG wire, with five punched holes for thermite welding to the coupling follower rings, middle, ring, and pipe. Strap bond shall be fabricated for the length of the coupling with sufficient additional length for 1 inch of joint movement. Strap holes shall be sized for the thermite weld mold and shall provide for physical centering of the mold over the hole.
   b. Strap bond shall be as manufactured by Erico Products, Continental Industries, Hoff Company, or approved equal. Third party manufactured copper strap bonds shall be approved by the Engineer for conformance with the requirements of this specification and proper thermite welding.
3. Bond Quantity per Joint: Provide the quantity of bonds per pipe diameter as defined below:

Bond Type	Three Bonds	Four Bonds
Copper Strap	54” or less	Over 54”
No. 2 Wire Bond	54” or less	Over 54”

4. Connection of wire or copper strap joint bonds to pipe shall be with the thermite weld method using molds and cartridges as recommended by the welder manufacturer for the bond type used.

F. Insulated Sleeve Coupling Joints:
1. Ductile Iron Pipe:
   a. No. 8 AWG wire, 18-inch long, with one 12-inch long THWN-2 insulated No. 12 AWG wire pigtail.
   b. Manufacturer: Erico Products Inc. (Cadweld), Cleveland, OH, Hoff Company, Denver, Colorado, or equal.
2. Steel Pipe:
   a. Solid copper strap, 1-1/4-inch wide by 1/16-inch thick, equivalent to 1/0

AWGwire, with four punched holes for thermite welding to the coupling and pipe. Strap bond shall be fabricated for the length of the coupling with sufficient additional length for 1 inch of joint movement. . Strap holes shall be sized for the thermite weld mold and shall provide for physical centering of the mold over the hole.

b. Strap bond shall be as manufactured by Erico Products, Continental Industries, Hoff Company, or approved equal. Third party manufactured bonds shall be approved by the Engineer for conformance with the requirements of this specification and proper thermite welding.

3. Bond Quality per Joint: Provide the quantity of bonds per pipe diameter as defined below:

Bond Type	One Bonds	Two Bonds	Three Bonds
Copper Strap	Up to 36”	36” to 60”	Over 60”
No. 2 Wire Bond	Up to 36”	36” to 60”	Over 60”

2.5 CATHODIC PROTECTION TEST STATIONS

A. Post Style, Steel Conduit:

1. Test Box:
   a. Cast aluminum with thread hub suitable for mounting to a 2-inch x 3-inch reducer. Reducing bushings will not be permitted.
   b. Manufacturer and Product:
      (1) Type T, C, and I Stations: Gerome Manufacturing, Testox 700 series (rectangle) with 2-inch threaded hub.
      (2) Type F and A Stations: Gerome Manufacturing, Testox 2000 series (rectangle) with 2 or 3-inch threaded hub.
2. Street Reducer:
   a. Hot dipped galvanized 2-inch x 3-inch reducer and close nipple. Not required with 3-inch threaded hub.
3. Terminal Block:
   a. Plastic or glass-reinforced laminated, 1/4-inch thick with seven terminals for Type T, C, and I test stations.
   b. Plastic or glass-reinforced laminated, 1/4-inch thick with eleven terminals for Type F, and A test stations.
   c. Terminal heads shall have special heads to keep them from turning or shall be easily accessible from both sides of the terminal block without requiring its removal.
   d. Terminal studs, washers, and nuts shall be stainless steel.
4. Mounting Structure:
   a. Rigid hot dipped galvanized steel conduit 3-inches diameter, threaded at one end (minimum), 5-feet long or as required for installation requirements.
   b. PVC long radius sweep elbow, 1-inch diameter, for wire protection as shown on Drawings.

2.6 REFERENCE ELECTRODES:

A. Prepackaged Copper-Copper Sulfate Reference Electrodes:

1. Material: Permanent type, copper-copper sulfate reference electrode suitable for direct burial with a minimum design life of 25 years.
2. Lead Wire:
   a. As specified under wire, this section,
   b. Length of 25 feet or as required for splice free installation.
3. Backfill: As recommended by the reference electrode manufacturer.

2.7 CORROSION COUPON

A. Application: Provide at all remote monitoring capable test stations, Type F test stations, and where shown on the Drawings.

B. Coupon:
1. Steel corrosion coupon with IR drop free measurement capability.
2. Exposed steel area to be 0.01 square feet.
3. Provide with two #12 or #14 AWG stranded copper wires leads, green insulation.

C. Switch:
1. Magnetic reed switch, normally closed, with connecting leads and terminals.
2. EDI Model UI-MS, board or adjustable mount as required, with activating magnet.

D. Manufacturers:
1. Cott Manufacturing,
2. M. C. Miller,
3. Or equal.

2.8 WIRE:

A. Pipe and Test Lead Wires:
1. Pipe Test Wires: No. 10 AWG wire, single-conductor, stranded copper with 600-volt, THWN-2 or HMWPE insulation. Color coded insulation as specified.
2. Insulation Color: Color shall indicate the function of each test wire and shall be as follows:

a.	Pipe:	White
b.	Reference electrodes:	Yellow
c.	Casings:	Orange
d.	Foreign Pipe:	Blue (Water) or Red (Gas or Oil)
e.	Insulating Joints:	White and Green as shown on drawings
f.	Corrosion Coupons:	Green
g.	Galvanic Anode:	Black

3. Reference Electrode Wires: No. 14 or 12 AWG wire single-conductor, stranded copper with 600-volt, THWN-2 or HMWPE insulation. Color code insulation as specified. Wire length of 25 feet or as required for splice free installation.

B. Anode Header Wires:
1. No. 8 AWG wire, single-conductor, stranded copper with 600-volt, THWN-2 or HMWPE insulation. Color coded insulation as specified.

2.9 CONDUIT, LOCKNUTS, AND STRAPS:

A. Outdoors, Exposed Conduit
   1. Rigid conduit shall be rigid galvanized steel.
   2. Fittings, junction boxes, pull boxes, and outlet bodies shall be hot-dipped galvanized iron.
   3. Locknuts, conduit clamps, and other miscellaneous hardware shall be hot dipped galvanized steel. Galvanized items shall be hot-dipped galvanized in accordance with ASTM A153.
   4. Conduit clamps shall be two piece, malleable iron, one hole, strap and clamp back spacer, O. Z. Gedney 14-100G and 143G or similar, for mounting to surfaces with either lag bolts or concrete wedge anchors, as shown on the Drawings.

B. Buried Conduit:
   1. Conduit and fittings shall be PVC coated rigid steel.

2.10 WIRE SPLICE INSULATING KIT:

A. Tap Splice: Tap splice insulating kit for the connection of the anode wire to the anode header wire shall be 3M Company Scotchcast 90-B1; Hexcel Kit No. 7K53; Raychem Corp. Thermofit No. ASE-4**,** or equal.

B. In-Line Splice: In-line splice insulating kit for the connection of the anode wire to the anode header wire shall be 3M Company Scotchcast 82-A2; Hexcel Kit No. 7K32; Raychem Corp. Thermofit No. ASE-4**,** or equal.

2.11 THERMITE WELD MATERIALS:

A. General:
   1. Thermite weld materials consist of wire sleeves, welders, and weld cartridges according to the weld manufacturer's recommendations for each wire size and pipe or fitting size and material.
   2. Welding materials and equipment shall be the product of a single manufacturer. Interchanging materials of different manufacturers is not acceptable.

B. Molds: Graphite, as recommended by manufacture for pipe and wire size.

C. Adapter Sleeves:
   1. For No. 12 AWG and No. 2 AWG wires.
   2. Prefabricated factory sleeve joint bonds or bond wires with formed sleeves made in the field are acceptable. Attach field-formed joint bonds sleeves with the appropriate size and type of hammer die furnished by the thermite weld manufacturer.
   3. Extend wire conductor 1/8 inch beyond the end of the adapter sleeve.

D. Cartridges:
   1. Steel: 32 grams, maximum.
   2. Cast and Ductile Iron: 45 grams, maximum, XF-19 Alloy

E. Welders and Cartridges: For attaching copper wire to pipe material:

Pipe Material	Weld Type	Cartridge Size, Max.
No. 6 AWG Wire & Smaller		
Steel	HA, VS, HC	15 gm
Ductile or Cast Iron	HB, VH, HE	25 gm
No. 2 Wire Joint Bonds		
Steel	FS	32 gm
Ductile or Cast Iron	FC	45 gm
Copper Strap Joint Bonds		
Steel	M-128	15 gm

F. Welding Materials Manufacturers:
   1. Erico Products Inc. (Cadweld), Cleveland, OH.
   2. Continental Industries, Inc. (Thermo-Weld), Tulsa, OK.

2.12 COATING REPAIR MATERIAL FOR PIPE AND FITTINGS

A. General:
   1. Complete coating repairs in accordance with recommendations of the pipe or fitting manufacturer.

B. Coating Requirements:
   1. Steel Pipes:
      a. Polyurethane or Epoxy Coatings: Fast cure epoxy, 20 mils dry film thickness, minimum
      b. Tape Wrap Coating: Thermite Weld Cap, Canusa CRP Patch, or Raychem PERP patch, or equal
   2. Ductile iron Pipe:
      a. Fast cure epoxy
      b. Thermite weld cap

C. Coating Materials:
   1. Thermite Weld Caps:
      a. Royston Laboratories Handi-Cap IP, prefabricated primerless thermite weld cap and coating system.
      b. Provide primer unless specifically stated in product data sheet that no primer is required.
   2. Fast Cure Epoxy Coating:
      a. 100 percent solids, fast curing epoxy suitable for submerged or buried conditions.
      b. Acceptable products or equal:
         (1) Denso Protal 7125 (low temperature) or Protal 7300
         (2) Tapecoat TC 7010
         (3) 3M ScotchKote 323

2.13 INSULATING JOINTS

A. General: Insulating joints shall be dielectric unions, flanges, or couplings. The complete assembly shall have an ANSI rating equal to or higher than that of the joint and pipeline. All materials shall be resistant for the intended exposure, operating temperatures, and products in the pipeline.

B. Insulating Flanges:
   1. Flange:
      a. As specified in applicable pipe sections or in conformance with AWWA C207, whichever is more stringent.
      b. Bolt holes may be oversized not more 1/4 inch over nominal bolt diameter where required for insulating flange assembly.
   2. Gaskets:
      a. Full-face, fiberglass (G10) with O-ring seal gasket. Buried insulating flanges shall be full face gaskets only.
      b. Complete assembly shall have an ANSI rating equal to the flanged joint.
      c. Gasket materials shall be resistant to intended chemical exposure, operating temperatures, and pressures in the pipeline.
   3. Insulating Sleeves: Full-length Mylar or fiberglass reinforced epoxy (NEMA G-10 grade).
   4. Insulating Washers: Fiberglass reinforced epoxy (NEMA G-10 grade).
   5. Steel Washers: Plated, hot-rolled steel, 1/8-inch thick.
   6. Manufacturers:
      a. GPT Industries, Houston, Texas
      b. Advanced Products and Systems, Scott, LA
      c. Central Plastics Co., Shawnee, OK.

C. Insulating Unions: O-ring sealed with molded and bonded insulating bushing to union body, as manufactured by Central Plastics Company, Shawnee, OK; or equal.

2.14 CONCRETE

A. ASTM C94-90, Option A

B. Cement: ASTM C150-89, type II or V with minimum cement content of 6.5 bags (611 pounds) per cubic yard.

C. Coarse Aggregate Size: ¾ inches

D. Minimum Compressive Strength: 4,000 psi at 28 days with maximum water-cement ratio of 0.45.

E. Air Entrainment:
   1. ASTM C260, nontoxic after 30 days and containing no chlorides.
   2. Not less than 5 nor more than 7.5 percent entrained air at the project site.

2.15 OTHER MISCELLANEOUS MATERIALS

A. Test Station Wire Terminations: One-piece, tin-plated crimp-on ring tongue connector as manufactured by Burndy Co. or Thomas and Betts.

B. Shunts: Shunts shall be 0.01-ohm Holloway Type RS.

C. Compression Connectors:
   1. Compression connectors for in-line and tap splices shall be "C" taps made of conductive wrought copper, sized to fit the wires being spliced.
   2. Compression connectors shall be applied with the crimp tool and die recommended by the manufacturer for the wire and tap connector size. Connectors shall be Burndy Type "YC", or equal.

D. Electrical Tape:
   1. Linerless rubber high-voltage splicing tape and vinyl electrical tape suitable for moist and wet environments.
   2. Use Scotch 130 C and Scotch 88 as manufactured by 3M Products.

PART 3 – WORKMANSHIP

3.1 GENERAL:

A. The installation of the facilities herein specified and described shall conform to the latest applicable NEC rules.

B. The workmanship shall be of the highest grade and shall be in strict accordance with material manufacturer's instructions. Equipment or materials damaged in shipment or during installation shall be replaced.

C. The CONTRACTOR shall examine all Drawings and coordinate his work to avoid conflicts, errors, delays, and unnecessary interference with the construction of the facilities and to avoid duplication of the work such as excavation, filling, etc. In the event of any conflicts in the Specifications, the ENGINEER shall be consulted.

3.2 STORAGE AND HANDLING:

A. Store all prepackaged anodes off the ground and keep them dry until after installation. Protect against weather, condensation, and mechanical damage.

B. Immediately remove from the project site all mechanically damaged anodes.

C. Galvanic anodes shall not be lifted or held by the lead wire.

D. Anode backfill material that has become wet prior to installation shall not be acceptable.

3.3 PIPE JOINT BONDING, NEW PIPE

A. To form an electrically continuous pipeline and associated appurtenances, all metallic pipe joints shall be electrically bonded; including buried, vault, and manhole pipe, fittings, and restrained joints; except threaded, welded, or insulated joints.

B. All buried pipe shall be electrically continuous from test station to test station and from test station to fire hydrant or blowoff. Contractor shall locate and repair any joint that is found to be discontinuous during ENGINEER performed electrical continuity testing.

C. Install the quantity of joint bonds at each joint required to be bonded as specified this section or shown on the Drawings. Should the specifications and drawings conflict, the larger quantity shall apply.

D. Electrical connection of bonds to pipe and fittings shall be by thermite or arc welding process. Bolted, compression, or mechanical connections will not be permitted.

E. CONTRACTOR shall test each bonded joint for electrical resistance as specified under CONTRACTOR QUALITY CONTROL TESTING, this section.

3.4 TEST STATION INSTALLATION

A. General:
1. Test station location, type, and style shall be as shown on the Drawings.
2. CONTRACTOR may relocate test station up to ±25 feet for site conditions without ENGINEER approval. Relocation greater than ±25 feet must be approved by the ENGINEER.
3. CONTRACTOR shall maintain records showing actual pipeline stationing of test station wire connections to the pipe.
4. Records of actual pipeline stationing shall be provided to ENGINEER prior to electrical continuity testing by ENGINEER.
5. Test stations shall be generally located as follows:
   a. Install Type T test stations or other type test stations as required or at 1/4 mile intervals, but not greater than 1,500 feet.
   b. Install a Type F test station where pipe crosses a foreign-owned metallic pipeline under cathodic protection.
   c. Install a Type C test station at both end of cased crossings, unless shown otherwise on the Drawings.
   d. Install a Type I test station at all buried insulated joints.
6. Locate post-mounted test stations directly over the pipe and, where possible, at protected locations such as structures, fences, manholes, power poles, or edges of cultivated land.
7. Locate flush mounted test stations directly over the pipeline, except in areas of heavy traffic conditions. When heavy traffic conditions exist, offset the test stations to the side of the street.
8. All offset test stations shall protect the test wires with PVC coated rigid steel conduit from pipeline centerline to within 6-inches of test station as shown on the Drawings. Do not connect rigid steel conduit to test station.

B. Style:
1. Test station style shall be as shown on the Drawings and as follows:
2. Post mount style test stations shall be steel conduit style as shown on the Drawings.
3. Flush mount style test stations shall be as shown on the Drawings and used where directed by the ENGINEER.

C. Installation:

1. Post mounted test station:
   a. Height shall be between 36 to 42 inches above finish grade.
   b. Buried steel posts shall be concrete encased as shown on the Drawings.
2. Flush Mounted Test Stations
   a. Place in concrete pad or sidewalk with cast iron cover as shown on Drawings.
   b. Place concrete box on top of 3-inch base of compacted sand.
   c. In unimproved areas provide blue "Carsonite" utility marker with yellow reflector on each side 1 foot from test box or as directed by the ENGINEER.

D. Test Wires:
1. Wires shall be attached to the pipe as specified under WIRE CONNECTIONS, this section.
2. Wire connections shall be an individual connection with not less than 6-inches separation from other connections. Common connections will not be allowed. Where a steel tab is welded to pipe for test wire connections, a separate tab shall be provided for each wire connection.
3. Wires to foreign-owned pipelines shall be connected to the pipe by the CONTRACTOR unless the foreign pipeline owner has indicated otherwise in writing. The CONTRACTOR shall coordinate this work with the owner of the foreign pipeline.
4. Where foreign owners refuse test wire installation to their pipe, the Bidder shall obtain a written refusal from the field representative and install a Type T test station.
5. Wires shall be buried a minimum of 24 inches below finished grade, except in undeveloped or cultivated areas where test wires shall be a minimum of 30-inches below finished grade.
6. Wires shall be direct buried except where test station offset is required. Offset wires shall be installed in PVC coated rigid steel conduit from the centerline of the pipeline to 6-inches from test station. Rigid conduit shall not be connected to the test station.
7. Provide 12-inch diameter loop in wires at the pipeline connection, at each end of rigid conduit when required, and below post mounted test stations to prevent wires from being stressed or broken.
8. Maintain sufficient slack in flush mount test wires to permit extension of terminal block 18-inches above test station. Connect all wires to a terminal board as specified.
9. Make wire connections to test station terminals with crimp-on ring tongue terminals, except where solid wire is specified.

3.5 REFERENCE ELECTRODE INSTALLATION

A. Remove plastic or paper wrapper and place reference electrode within the pipeline trench excavation inches from pipe in a vertical position and activate reference electrode per manufacturer's written instructions.

B. Install reference electrode centered between foreign pipelines and OWNER's pipeline at pipe crossing location as shown on Drawings.

C. Backfill hole with select native material in 6-inch layers and hand tamp each layer around anode. Use only native soil for backfill; do not use sand or flowable fill.

Exercise care not to strike reference cell or lead wire with tamper.

D. Terminate reference electrode wire in test station on separate terminal.

3.6 CORROSION COUPON INSTALLATION

A. Place corrosion coupons within 6-inches of pipe and reference electrode.

B. Install reference electrode centered between foreign pipelines and OWNER's pipeline at pipe crossing locations.

C. Terminate corrosion coupon lead wires in test station on separate terminals.

D. Connect coupon to pipeline with magnetic switch as specified and shown on drawings.

3.7 THERMITE WELD WIRE CONNECTIONS:

A. Use thermite weld method for electrical connection of copper wire to steel, ductile iron, and cast iron surfaces. Observe proper safety precautions, welding procedures, thermite weld material selection, and surface preparation as recommended by the material manufacturer. Assure that pipe or fitting wall thickness is of sufficient thickness that the thermite weld process will not damage the pipe or fitting wall's integrity or damage the lining in any way.

B. Before the connection is made, the surface shall be cleaned to bare metal by making a 2-inch by 2-inch window in the coating, and then filing or grinding the surface with a vitrified wheel to produce a bright metal finish. Wire sleeves shall be installed on the ends of the wire before welding to the metal surface.

C. After the weld connection is cooled, remove slag, visually inspect, and physically test wire connection by hitting with a hammer. Remove and replace any defective connections.

D. Make wire connections to concrete cylinder pipe by thermite welding to the shop welded steel plates provided on the pipe for this purpose.

E. Coat each completed wire connection as specified, this section. If lining is damaged by welding, repaired in accordance with the lining applicator's recommendations.

3.8 TRENCHING AND BACKFILL

A. General

1. Complete excavations and trenching regardless of the type, nature, or condition of materials encountered, and as required to accomplish specified construction to lines and grades shown.

2. CONTRACTOR shall complete all utility notifications prior to performing trenching and excavations work.

3. Take care to avoid damage to existing structures and utilities during excavating

and trenching process. CONTRACTOR may modify location, where approved by the ENGINEER, to minimize possible damage to existing structures. Trench shall be of uniform depth and width, level, smooth, and free of sharp objects.

B. Trench Depths:

1. Trench depths vary for conditions and requirements. Trench depths provided are minimum requirements. CONTRACTOR to meet minimum requirements or that required by local utilities, ordinances, or regulations, whichever is more stringent.
2. Minimum depths for cathodic protection or corrosion monitoring work shall be as defined herein or shown on the Drawings. If in conflict, the more stringent shall apply.

a.	Pipeline Test wires, undeveloped	24-inches (direct bury)
b.	Pipeline Test wires, roadways	30-inches (conduit)
c.	All other	30-inches

C. Safety

1. Slope, shore, or brace excavations and trenches in accordance with OSHA regulations as necessary to prevent caving during excavation in unstable material, or to protect adjacent structures, property, workers, and the public.
2. CONTRACTOR shall have sole responsibility for ensuring safety of trenches and conformance to OSHA trench safety requirements.

D. Backfill and Compaction

1. Backfill trench with excavated backfill materials, unless otherwise specified.
2. Compaction requirements shall be as specified for the pipeline or 90 percent compaction, whichever is more stringent. Backfill within 5 feet of roadways, paved areas, or other traffic areas shall be compacted to 95 percent.
3. Do not use backfill material of frozen or consolidated debris. Leave the trench with the excess backfill material neatly mounded, but not more than 4 inches above the existing ground level, for the entire width of the trench in undeveloped areas.
4. Replace topsoil in developed, landscaped, or cultivated areas.

3.9 SURFACE RESTORATION:

A. Contractor shall restore all existing surface improvements within the pipeline easement removed in the performance of this work.

B. Contractor to complete surface restoration as specified and shown on the Drawings.

3.10 CONCRETE:

A. Concrete used for slabs shall conform to the requirements for concrete in Section CONCRETE.

B. CONTRACTOR shall finish all concrete work to a smooth trowel finish with radius edges.

C. Concrete flatwork shall be sloped to drain water away from conduits and posts.

D. All forms shall be removed from concrete work prior to final acceptance and removed from the project site.

3.11 WIRE INSULATION REPAIR

A. Underground splicing of wire will not be permitted, except where specifically shown on the drawings and approved by the ENGINEER.

B. Where splicing is approved by the ENGINEER, splices shall mechanically secure and soldered with rosin cored 50/50 solder. Compression connectors will not be permitted.

C. Splices or insulation damage to test station wires shall be spirally wrapped with two coats of high-voltage self-vulcanizing rubber splice tape and two layers of vinyl electrical tape.

3.12 INSULATED JOINTS

A. Install insulated joints to electrically isolate the pipeline from other pipes or structures where shown on the Drawings.

B. Install insulated joints as shown on the Drawings.

C. Align and install insulating joints according to the manufacturer's recommendations to avoid damaging insulating materials.

D. Install a Type I test station at each buried insulated joint.

E. Provide a DC blocking device on all insulating joints, except buried joints, as specified herein and shown on the Drawings.

F. The CONTRACTOR shall test each insulated joint for electrical insulation as specified this section. Defective insulating joints shall be repaired by the CONTRACTOR at his sole expense. All damaged or defective insulation parts shall be replaced.

3.13 QUALITY CONTROL TESTING

A. General:
   1. Contractor shall correct all construction defects identified during testing.
   2. Provide engineer with 7 days advance notice of completion for Engineer acceptance testing.
   3. Contractor required testing as defined in QUALITY CONTROL TESTING shall be performed by a Corrosion Expert, with qualifications as specified this section, whom is an employee or subcontractor to the Contractor.

B. Joint Bond Resistance Test:
   1. General
      a. Test completed joint bonds for electrical continuity using a digital low resistance ohmmeter.
      b. Joint bond quality control test shall be performed on all bonded joints after the bonds are installed but before backfilling of the pipe.
      c. Furnish all equipment and materials as required for test.

   2. Digital Low Resistance Ohmmeter Test Method:
      a. Required Equipment and Materials:

(1) One AVO Model DLRO10, digital low resistance ohmmeter or equivalent instrument.
(2) Two duplex, helical spring point leads with current and potential points, AVO Model No. 242011-7, or equivalent wire lead set.

b. Test Procedure:
(1) Measure the resistance of joint bonds with the low resistance ohmmeter in accordance with the manufacturer's written instructions.
(2) Use the helical handspikes to contact the pipe on each side of the joint, without touching the thermite weld or the bond. The contact area shall be cleaned to bright metal by filing or grinding and without any surface rusting or oxidation.
(3) Record the measured joint bond resistance on the test form described herein.
(4) Repair any damaged pipe coating in accordance with WIRE CONNECTIONS, this section.

3. Joint Bond Acceptance:
a. Joint bond resistance shall be less than or equal to the maximum allowable bond resistance values shown below.

	Max. Allowable Resistance (micro-ohms)		
Joint Type	**Two Bonds/Joint**	**Three Bonds/Joint**	**Four Bonds/Joint**
No. 2 AWG wire (Steel)	162	108	81
No. 2 AWG wire (DIP)	185	123	93
Copper Strap (12-inch)	64	43	32
Copper Strap (9-inch)	48	32	24
Coupling, 24" No. 2 AWG	212	142	106
Coupling, 24" Copper Strap	128	85	64
MLC Steel Pipe Clips	N/A	55	42

b. For bond quantities greater than shown above. Obtain maximum allowable bond resistance from the Engineer.
c. Remove and replace all joint bonds on a joint that exceeds the maximum allowable resistance. R eplacement joint bonds shall be retested for compliance with the specified bond resistance.
d. Any defective joint bond discovered during SYSTEM TESTS AND INSPECTION shall be located, excavated, repaired, and backfilled.

4. Test Records: Records shall be made of each bonded pipeline during the test and submitted to the ENGINEER. These records shall include:
a. Description and location of the pipeline tested.
b. Starting location and direction of test.
c. Date of test.
d. Joint type.

e. Measured joint bond resistance

5. Report: Submit a QC report upon completion of joint bond resistance testing which includes the information listed above.

C. Insulated Joint Isolation Test:
1. Provide a Corrosion Expert to test each insulating joint after assembly with a insulator tester or equivalent instrument in accordance with the manufacturer's written instructions.
2. The Corrosion Expert shall conduct additional insulating joint testing as required to insure that insulating flanges are not electrically shorted by other equipment or incidental contact with concrete reinforcement.
3. Conduct test before burial and coating of buried insulating flanges.
4. Replace damaged or defective insulation parts identified during testing.
5. Electrical Isolation is defined as a condition of being electrically isolated from other metallic structures (including, but not limited to, other piping, concrete reinforcement, casings, and other structures not intended to be cathodically protected) and the environment as defined in NACE Recommended Practice RP0169-83.
6. Submit a report prepared by the Corrosion Expert certifying insulating joint testing isolation, test method(s), test data, and any corrective action required.

D. Casing Isolation Testing:
1. Test each casing and carrier pipe after assembly for electrical isolation before and after filling of casing with the specified fill material.
2. An electrical isolation test method and evaluation criterion to be utilized by Corrosion Expert is to be submitted in writing for approval by ENGINEER prior to beginning field testing.
3. Electrical Isolation is defined as a condition of being electrically isolated from other metallic structures (including, but not limited to, other piping, concrete reinforcement, casings, and other structures not intended to be cathodically protected) and the environment as defined in NACE Recommended Practice RP0169-83.
4. Conduct any and all remedial actions necessary to clear all electrical contacts between the carrier pipe and casing before filling of the casing shall be permitted.
5. Submit a written report prepared by the Corrosion Expert certifying casing isolation, testing method(s), test data, and any corrective action required.

3.14 SYSTEM TESTS AND INSPECTION

A. General
1. All testing specified in SYSTEM TESTS AND INSPECTION shall be performed by the Engineer and shall include:
a. Preliminary electrical continuity testing of the full pipeline.
b. Initial baseline testing and hookup of galvanic anode ground beds at test stations.
2. Correct all construction defects identified during testing.
3. Provide one week advance notice of completion of corrosion monitoring system work.

B. Electrical Continuity Testing:

1. Preliminary Continuity Test by Engineer

a. After the pipeline construction is completed and all test stations have been installed, the ENGINEER shall test all pipelines with joint bonds for electrical continuity using the four-wire lineal pipe resistance test method.

b. Test will be conducted with a minimum test current of 15 amperes using a portable rectifier or dc welder.

c. An electrically continuous pipeline will be defined as a pipe or section of pipe that has a linear electrical resistance equal to or less than the sum of the resistance of the pipe plus the maximum allowable joint bond resistance for each joint as specified in this section.

d. The CONTRACTOR shall locate electrically discontinuous joints at his sole expense as specified herein.

e. Each discontinuous section of pipe shall be retested by the Engineer after all continuity repairs are completed to demonstrate that the pipeline is electrically continuous. Engineer retesting costs shall be at the Contractor's expense.

f. Electrical continuity testing requires two electrically continuous wires connected to pipeline at each test station. Any pipe section with one or more broken test wire(s) cannot be tested for continuity and will be classified as electrically discontinuous.

2. Electrical Discontinuity Location:

a. CONTRACTOR shall be solely responsible for location and repair of all discontinuous or high resistance joints bonds using a test method determined by the CONTRACTOR. Regardless of test method used to locate discontinuous joints, final acceptance of discontinuous sections shall be determined by the lineal pipe resistance method.

b. After all discontinuous or high resistance joint bonds are repaired, the repaired section shall have a resistance less than or equal to the calculated allowable lineal pipe resistance as determined by the initial final continuity testing.

c. Existing joint bonds damaged during excavation of the pipe for repairs or temporary wire connections shall be repaired by the CONTRACTOR.

d. Existing test stations shall be protected from damage. When damage occurs CONTRACTOR shall complete repairs while the excavation is open. Undisclosed test station damage that requires repairs to be made after backfilling the excavation will be repaired at the CONTRACTOR sole expense.

e. Upon completion of continuity repairs, the ENGINEER shall retest the continuity of repaired sections at the CONTRACTOR's expense in accordance with the General Conditions.

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DIVISION 26
ELECTRICAL

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SECTION 26 05 00
ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall provide electrical and appurtenant Work necessary for a complete and operable electrical system, in accordance with the Contract Documents.

B. Make all field connections and terminations to all motors, switchgear, panels, control equipment and devices, instruments, and to all vendor-furnished packaged equipment. The requirements of this Section shall apply to all electrical items indicated in the various Sections of Division 26 unless otherwise indicated.

C. Provide all materials and incidentals required to complete the electrical work. Typical materials which may be incidentals are terminal lugs not furnished with vendor-supplied equipment, compression connectors for cables, splices, junction and terminal boxes, and all control wires required by vendor-furnished equipment to interconnect with other equipment all specifically indicated on the Contract Documents.

D. All concrete work required for encasement, installation, or construction of the Work specified in the various Sections of Division 26 shall be 4,000 psi concrete, and the following requirements shall apply:
   1. Consolidation of encasement concrete around duct banks shall be by hand puddling, and no mechanical vibration shall be permitted.
   2. A workability admixture shall be used in encasement concrete, which shall be a hydroxylated carboxylic acid type in liquid form. Admixtures containing calcium chloride shall not be used.
   3. Concrete used to encase conduits shall be made with gravel containing rocks ¾ inch in size or less. It shall be wet enough to flow easily into the spaces around the conduits, but not so fluid as to float the conduits.
   4. Concrete for encasement of conduit or duct banks shall contain an integral red-oxide coloring pigment in the proportion of 8 pounds per cubic yard of concrete.

1.2 INTERFACE TO EQUIPMENT, INSTRUMENTS, AND OTHER COMPONENTS:

A. The contract drawings, specifications, and overall design are based on non-certified information furnished by various equipment manufacturers. This “equipment” includes, but not limited to, instruments, control devices, electrical equipment, packaged mechanical systems, and control equipment provided with mechanical systems.

B. The electrical specifications, ladder logic diagrams, and installation details are based on non-certified vendor information and indicate minimum scope of supply from Manufacturers.

C. Include all labor, material, and others costs in the bid to add additional instrument, wiring, control system inputs/outputs, controls, conduit, interlocks, electrical hardware, etc., into the Work based on the Equipment Manufacturer’s final certified Drawings.

D. Revise or produce new loop diagrams to meet the Equipment Manufacturer's wiring requirements.

E. Incorporate such changes to Instrumentation and Electrical Work at no additional cost to the Owner in light of the Contractor's knowledge that non-certified vendor information has been used in the design, and due to the fact that the final selection of the vendor may have been by the Contractor.

F. Submit all such changes and additions to the Engineer for acceptance before starting field installation Work.

G. The Contractor is responsible for providing all material and labor needed to install the actual equipment furnished, as such the Contractor's bid includes all costs to add any additional conduit, wiring, terminals, or other electrical hardware to the design, which may be necessary to make a complete, functional installation based on the actual equipment furnished:
   1. Make all changes necessary to meet the Manufacturer's wiring requirements.
   2. Incorporate such changes to the electrical installation into the final "As-Built" Drawings.

H. Review the complete set of Drawings and Specifications in order to ensure that all items related to the electrical power and control systems are completely accounted for. Include any such items that appears on Drawings or Specifications from another discipline in the scope of Work and any costs for these items.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Codes and Standards

NEC National Electrical Code, latest edition

B. Government Standards

FS W-C 596E/GEN(1)	Connector, Plug, Receptacle and Cable Outlet, Electrical Power
FS W S 896E/GEN(1)	Switches, Toggle (Toggle and Lode), Flush Mounted (ac)
FS WW C 581D, E	Conduit, Metal, Rigid, And Intermediate; And Coupling, Elbow, and Nipple, Electrical Conduit: Steel, Zinc Coated
OSHA	Safety and Health Standards, 29 CFR 1910 and 29 CFR 1926 as applicable

C. Commercial Standards

ANSI C80.1	Zinc Coated, Rigid Steel Conduit, Specification for
ANSI C80.4	Fittings for Rigid Metal Conduit and Electrical Metallic Tubing, Specifications for
ANSI/UL 467	Grounding and Bonding Equipment, Safety Standard for

ASTM B 3	Soft or Annealed Copper Wire
ASTM B 8	Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, and Soft
ASTM B 33	Specification for Tinned Soft or Annealed Cooper Wire for Electrical Purposes
ICEA S 61 402	Thermoplastic Insulated Wire and Cable
ICEA S 68 516, NEMA WC8	Ethylene Propylene Rubber Insulated Wire and Cable
NEMA 250	Enclosures for Electrical Equipment (1,000 volts maximum)
NEMA PB 1	Panelboards
UL 6	Rigid Metal Electrical Conduit
UL 514	Electrical Outlet Boxes and Fittings

D. All equipment furnished by the Contractor shall be listed by and shall bear the label of Underwriters' Laboratories, Incorporated, (UL) or an independent testing laboratory acceptable to the local Code-enforcement agency having jurisdiction.

E. The construction and installation of all electrical equipment and materials shall comply with all applicable provisions of the OSHA Safety and Health Standards (29CFR1910 and 29CFR1926, as applicable), State Building Standards, and applicable local codes and regulations.

1.4 PUBLIC UTILITIES REQUIREMENTS

A. Contact the serving agency, Rocky Mountain Power Co., and verify compliance with their requirements before construction.

B. Electrical service shall be as indicated by the Contract Documents.

C. Verify, furnish, and install all service conduits, fittings, transformer pad, grounding devices, and all service wires not furnished by the serving utility.

D. Verify with the utility the exact location of each service point and type of service.

E. All charges levied by the serving utility for permanent service will be paid for by the Owner.

1.5 PERMITS AND INSPECTION

A. Permits shall be obtained, and inspection fees shall be paid for as required by local governmental jurisdictions.

1.6 CONTRACTOR SUBMITTALS

A. Shop Drawings and Catalog Data: Submit shop drawings and catalog data submittals in accordance with Section 01 33 20 – Submittal Procedures.

B. Submit complete material lists for the Work of this Section. Such lists shall state manufacturer and brand name of each item or class of material. Submit shop drawings for all grounding work not specifically indicated.

C. Shop drawings are required for materials and equipment listed in other sections. Shop drawings shall provide sufficient information to evaluate the suitability of the proposed material or equipment for the intended use, and for compliance with these Specifications. The following shall be included:
   1. Front, side, rear elevations and top views with dimensional data.
   2. Location of conduit entrances and access plates.
   3. Component data.
   4. Connection diagrams, terminal numbers, wire numbers, internal wiring diagrams, conductor size, and cable numbers.
   5. Method of anchoring, seismic requirement; weight.
   6. Types of materials and finish.
   7. Nameplates.
   8. Temperature limitations, as applicable.
   9. Voltage requirement, as applicable.
   10. Front and rear access requirements.

D. Catalog data shall be submitted to supplement all shop drawings. Catalog cuts, bulletins, brochures, or the like or photocopies of applicable pages thereof shall be submitted for mass produced, non-custom manufactured material. These catalog data sheets shall be stamped to indicate the project name, applicable Specification section and paragraph, model number, and options. This information shall be marked in spaces designated for such data in the stamp.

E. Materials and Equipment Schedules: Furnish within 30 days, a complete list of all materials, equipment, apparatus, and fixtures proposed for use. The list shall include type, sizes, names of manufacturers, catalog numbers, and such other information required to identify the items.

F. Conduit Layout: Provide drawings for underground and concealed conduits, including but not limited to ductbanks, under floor slabs, concealed in floor slabs, and concealed in walls. Provide plan and section showing arrangement and location of conduit and duct bank required for: 1) low and medium voltage feeder and branch circuits, instrumentation and control systems, communication systems, empty conduit for future use. Layouts shall be of a reproducible scale not greater than 1 inch equals 20 feet.

G. O&M Manuals: Furnish manuals as part of the shop drawing submittals under "Operation and Maintenance Manuals" in Section 01 33 20 – Submittal Procedures.

H. Record Drawings: In addition to the record drawings as a part of the record drawing requirements specified in Section 01 33 20 – Submittal Procedures, show depths and routing of all duct bank concealed below grade electrical installations. Said set of record drawings

shall be available to the Engineer during construction. After final inspection, transfer all record drawing information using a red pen to a set of drawings which shall then be delivered to the Engineer. In addition, the record drawings shall show all variations between the Work as actually constructed and as originally shown on the Drawings, based upon information supplied by the Contractor.

1.7 QUALITY ASSURANCE

A. Field Control of Location and Arrangement: The Drawings diagrammatically indicate the desired location and arrangement of outlets, conduit runs, equipment, and other items. Determine exact locations in the field based on the physical size and arrangement of equipment, finished elevations, and other obstructions. Locations shown on the Drawings, however, shall be adhered to as closely as possible.

B. All conduit and equipment shall be installed in such a manner as to avoid all obstructions and to preserve head room and keep openings and passageways clear. Lighting fixtures, switches, convenience outlets, and similar items shall be located within finished rooms, as shown. Where the Drawings do not indicate exact locations, such locations shall be obtained from the Engineer. Where equipment is installed without instruction and must be moved, it shall be moved without additional cost to the Owner.

C. Workmanship: All materials and equipment shall be installed in accordance with printed recommendations of the manufacturer which have been reviewed by the Engineer. The installation shall be accomplished by workmen skilled in this type of work and installation shall be coordinated in the field with other trades so that interferences are avoided.

D. All Work, including installation, connection, calibration, testing, adjustment, and paint touchup, shall be accomplished by qualified, experienced personnel working under continuous, competent supervision. The completed installation shall display competent work, reflecting adherence to prevailing industrial standards and methods.

E. Protection of Equipment and Materials: Furnish adequate means for and fully protect all finished parts of the materials and equipment against damage from any cause during the progress of the Work and until acceptable by the Engineer.

F. All materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. All moving parts shall be kept clean and dry.

G. Replace or have refinished by the manufacturer, all damaged materials or equipment, including face plates of panels and switchboard sections, at no expense to the Owner.

H. Tests: Perform all tests required by the Engineer or other authorities having jurisdictions. All such tests shall be performed in the presence of the Engineer. Furnish all necessary testing equipment and pay all costs of tests, including all replacement parts and labor necessary due to damage resulting from damaged equipment or from test and correction of faulty installation. The following testing shall be accomplished:
   1. Insulation resistance tests under "Wire and Cable," below.
   2. Operational testing of all equipment furnished and/or connected in other Sections of Division 26, including furnishing of support labor for testing.

I. Standard test reports for mass-produced equipment shall be submitted along with the shop drawing for such equipment. Test reports on testing specifically required for individual pieces of equipment shall be submitted for review prior to final acceptance of the project.

J. Any test failure shall be corrected in accordance with the industry practices and in a manner satisfactory to the Engineer.

K. Regulatory Requirements:
   1. Perform all Work to meet the requirements of all legally constituted authorities having jurisdiction.
   2. Perform all Electrical Work, whether needed for the power, control system, process, HVAC, telephone, security, etc. in accordance with all codes and standards required by Division 26.
   3. Perform all Work so as to comply with the accepted editions, amendments, practices, and rulings of the applicable codes and standards, except where the Drawings and Specifications are more stringent.

1.8 DELIVERY, STORAGE, AND PROTECTION

A. Acceptance of material and equipment Furnished By Others (F.B.O.):
   1. Where equipment or materials are to be F.B.O. to the Contractor for installation and connection, the Contractor must:
      a. Upon receiving such equipment or materials, make a complete check of all items and provide a transfer of materials document.
      b. Provide the transfer of materials document as a receipt detailing the products received and the condition of the products delivered to the Contractor.
      c. After Receiving and accepting the material, assume full responsibility for the safe keeping, handling, and the installation of the materials and equipment, until completed installation and final acceptance by the Engineer.
      2. Failure to issue said receipt assumes that all equipment and materials were then delivered to the Contractor in the proper quantities and in perfect condition.

B. Storage and Protection:
   1. Provide for the safe storage and delivery of materials, whether furnished by the Contractor or by others.
   2. Replace all equipment or material, damaged before final acceptance by the Engineer in a manner acceptable to the Engineer.
   3. Meet all storage requirements of the Manufacturer and provide for the safe storage of all materials and equipment as recommended by the Manufacturer.
   4. Protect electrical Work at all times from damage, defacement, or deterioration from any cause whatever:
      a. Provide proper storage facilities and conduct operations to this effect.
      b. Perform electrical Work in a manner as to protect the Work of other trades.

1.9 AREA DESIGNATIONS

A. General: For purposes of delineating electrical enclosure and electrical installation requirements of this project, certain areas have been classified in the Contract Documents as

defined below. Electrical installations within these areas shall conform to the referenced code requirements for the area involved.

B. General Purpose Indoor Locations: Electrical work installed in areas which are not otherwise specifically classified shall be "General Purpose." Workmanship and enclosures shall comply with the general requirements of these Specifications. Electrical enclosures shall be NEMA Type 12.

C. Outdoor and Damp Locations: In outdoor locations, raceway shall be rigid galvanized steel (GRS) conduit; entrances shall be threaded; and fittings shall have gasketed covers. Provisions shall be made to drain the fitting or conduit system. Threaded fastening hardware shall be stainless steel. Raceway supports such as hanger rods, clamps, and brackets shall be stainless steel. Attachments or welded assemblies shall be galvanized after fabrication. Instruments and control cabinets shall be NEMA Type 4X unless otherwise noted on the drawings. Switchboards, motor control centers, and panel enclosures shall be weatherproof NEMA Type 3R unless otherwise noted on the drawings. Locations which are indoors and below grade elevation or which are classified as damp locations on the Drawings shall have electrical installations which conform to the requirements for outdoor locations. "Damp locations" shall include pipe galleries, tunnels, vaults, and basements. All rooms housing liquid handling equipment are also classified as damp locations regardless of grade elevation.

D. Splash Locations: Areas shown as splashproof shall have electrical installations as described for "outdoor locations."

1.10 CLEANUP

A. In addition to the requirements of "Cleanup" in Section 01 77 00 Project Closeout, all parts of the materials and equipment shall be thoroughly cleaned. Exposed parts shall be thoroughly clean of cement, plaster, and other materials. All oil and grease spots shall be removed with a nonflammable cleaning solvent. Such surfaces shall be carefully wiped, and all cracks and corners scraped out. Paint touchup shall be applied to all scratches on panels and cabinets. Electrical cabinets or enclosures shall be vacuum cleaned before final acceptance.

B. During the progress of the Work, clean the premises and leave the premises and all portions of the site free of debris.

1.11 DEMOLITION AND RELATED WORK

A. The Contractor shall perform all electrical demolition work as indicated.
   1. Electrical equipment and components, terminal and relay cabinets, MCCs, shall be returned to the Owner in an orderly fashion to a designated location on the site.
   2. Wire, conduit, junction boxes, fittings, supports, and miscellaneous hardware removed a part of the demolition work shall not be reused and shall be returned to the Owner for their salvage use.
   3. Wires and/or conduits which need to be extended shall be terminated in a new terminal box with terminal strips. Terminal box shall be properly sized by the Contractor unless specified on drawings. Wires and terminals shall be properly identified before disconnection and after reconnection.

4. Wiring in conduits located in or under slabs shall be removed. The conduit shall be plugged level with the floor where practical. In other cases, the conduit shall be cut three inches below the finished floor and the area shall be resurfaced.
5. Openings in walls and platforms created by the removal of conduit or electrical equipment shall be patched with materials similar to those in surrounding work areas or as required to provide proper sealed conditions as reviewed and accepted by the Engineer.
6. Electrical demolition work shall be as shown on the Drawings or as required by the Specifications.
7. Exercise due care in the removal of the equipment made surplus by this project so as not to impair its resale value or reuse. The Owner has the right to salvage any wire or other electrical equipment removed from the project.
8. Contractor shall be responsible for properly disposing of all electrical demolition materials, except those items to be salvaged to the Owner as directed by the Engineer.

B. Installation of New Equipment in Existing Structures
1. Certain new equipment and devices' installation are required in existing structures. Under this phase of the Work the Contractor shall be required to remove existing equipment or devices, install new equipment as indicated, remove existing conductors from existing raceway, and pull new conductors in existing raceway, reconnect existing conductors or furnish and install new conduit and wires.
2. Visit the site before bidding and carefully examine existing installation so that its proposal will reflect all the Work necessary to provide a complete installation so that the resulting installation will function as required. Include in the bid price all costs of labor and materials necessary to complete installations.

C. Modifications to Existing Electrical Facilities
1. Provide all modifications or alterations to existing electrical facilities required to successfully install and integrate the new electrical equipment. All modifications to existing equipment, panels, or cabinets shall be made in a professional manner with all coatings repaired to match existing. The total costs for all modifications to existing electrical facilities required for a complete and operating system shall be included in the original bid amount and no additional payment for this Work shall be authorized. Extreme caution shall be exercised in digging trenches in order not to damage existing underground utilities. Cost of repairs of damages caused during construction shall be the Contractor's responsibility.
2. The Contractor shall be responsible for verifying all available existing circuit breakers in lighting panels for their intended use as required by the Drawings. It shall also be responsible for verifying the available space in substation switchboards to integrate new power circuit breakers. Expenses in time for all of this Work shall be included in the original bid amount.

1.12 PROJECT OR SITE CONDITIONS

A. Site Conditions:
1. Provide an electrical, instrumentation and control system, including all equipment, raceways and any other components required for a complete installation that meets the Environmental conditions for the Site as specified in the General Requirements and below.

2. Seismic Classification:
   a. Provide all electrical equipment and construction techniques suitable for the seismic requirements for the Site, as specified in 01 81 10.
3. Wind:
   a. Provide all electrical equipment and construction techniques suitable for the Site wind loading criteria, as specified in section 01 81 11.
4. Altitude:
   a. The site is located at approximately 4,440 feet above mean sea level. Provide all electrical components and equipment fully rated for continuous operation at this altitude, with no additional derating factors applied.
5. Humidity:
   a. The facility is located in an area where the relative humidity is 90 percent non-condensing. Furnish all components and equipment fully rated for continuous operation at this relative humidity level.
6. Temperature:
   a. The facility is located in an area where the temperature will vary from a minimum of -20 degrees Fahrenheit to a maximum of 100 degrees Fahrenheit.
   b. Provide additional temperature conditioning equipment to maintain all equipment in non-conditioned spaces subject to these ambient temperatures 10 degrees Fahrenheit above the minimum operating temperature and 10 degrees Fahrenheit below maximum operating temperature as determined by the equipment Manufacturer's guidelines.
7. Outdoor installations:
   a. Provide all electrical, instrumentation and control equipment installed outdoors that are suitable for operation in the ambient conditions where the equipment is located.
   b. Provide heating, cooling, and de-humidifying devices incorporated into and included with electrical equipment, instrumentation and control panels located outdoors in order to maintain the enclosures within the rated environmental operating ranges as specified in this Paragraph for the equipment:
      1) Provide all wiring necessary to power these devices.
8. Site Security:
   a. Abide by all security and safety rules concerning the Work on the Site.

1.13 WARRANTY

A. Warrant the performance and the hardware of the complete electrical systems including all lamps, lighting, switchgear, circuit breakers, transformers, MCCs, VFD, etc. for a period of 1 year following the date of substantial completion of the Work:
   1. To fulfill this obligation, provide technical service personnel designated by the Electrical Contractor and/ or Manufacturer.
   2. Perform services to correct any defect within 3 calendar days after notification by the Owner of a defect.

B. Warrant the satisfactory performance of the software, equipment, and materials under the specified operating conditions.
   1. In the event that operations, tests, or inspections disclose latent defects or failure to meet the specified requirements, upon notification by the Owner, promptly correct

or repair any such defects or non-conformance, or furnish such new equipment or parts as may be necessary for conformity to the specified requirements.

C. Replace or modify equipment, software, and materials that do not achieve design requirements after installation in order to attain compliance with the design requirements. Following replacement or modifications retest the system and perform additional testing to place the complete system in satisfactory operation and obtain compliance acceptance from the Engineer.

D. Provide all parts, material, labor, travel, subsistence, or other expenses incurred in providing services and service visits during the warranty period:
   1. Furnish spare parts and tools on site at inventory levels sufficient to meet the response and repair times specified.
      a. All spare parts and tools stored on-site become the property of the Owner upon completion of the warranty period.

1.14 MAINTENANCE

A. Provide similar items of same Manufacturer throughout the Electrical and Instrumentation portion of the project.

B. Furnish all spare parts as required by other sections of the Specifications.

PART 2 - PRODUCTS

2.1 GENERAL

A. All equipment and materials shall be new, shall be listed by UL, and shall bear the UL label, where UL requirements apply. All equipment and materials shall be the products of experienced and reputable manufacturers in the industry. Similar items in the project shall be products of the same manufacturer. All equipment and materials shall be of industrial grade and standard of construction; shall be of sturdy design and manufacture; and shall be capable of reliable, trouble-free service.

2.2 GROUNDING

A. General: All components of the grounding electrode system shall be manufactured in accordance with UL 467 and shall conform to the applicable requirements of National Electrical Code Article 250.

B. Grounding cable shall be copper. Bare copper wire shall be annealed, No. 8 AWG minimum, if not called out in the Drawings.

C. Ground rods shall conform to ANSI/UL 467 and shall be ¾-inch diameter copper-clad steel, sectional type, joined by threaded copper alloy couplings.
   1. Grounding connectors shall be high-strength copper alloy suitable for direct burial.
   2. Wire connections shall be exothermic weld by Cadweld of Erico Products.
      a. Manufacturers of grounding materials shall be Copperweld, Blackburn, Burndy, or equal.

2.3 UNDERGROUND DUCTS AND MANHOLES

A. General: Where an underground distribution system is required, it shall be comprised of multiple runs of single bore nonmetallic conduits, with underground manholes and pullboxes. When nonmetallic conduits are required, they shall be rigid Schedule 40 PVC.
   1. Manholes and pullboxes shall be of precast concrete. Concrete construction shall be designed for traffic loading.

B. Covers shall be traffic type, except as shown otherwise. Manholes and pullbox covers shall be labeled as shown on drawings.

C. Manholes and pullboxes shall be equipped with pulling-in irons opposite and below each ductway entrance.

D. Manholes shall have concrete covers with 30- inch diameters lids. All covers and lids shall be bolted to cast-in-place steel frames with corrosion resistant hardware. Frames shall be factory-primed; covers shall be cast-iron and shall have pick holes or lifting handles.
   1. Manholes and pullboxes shall have cable supports so that each cable is supported at 3-foot intervals within the manhole or pullbox. Cable supports and racks shall be fastened with galvanized bolts and shall be fabricated of fiberglass or galvanized steel. Porcelain insulators for cable racks shall be provided.
   2. Manholes and pullboxes shall be Brooks, Quikset, U.S. Precast, or equal.

E. The concrete shall have a compression strength of 3,000 psi in accordance with the requirements of Section 03 30 00 Cast In Place Concrete.

2.4 RACEWAYS

A. General: Raceway shall be manufactured in accordance with UL and ANSI standards and shall bear UL label as applicable.

B. Galvanized Rigid Steel (GRS) Conduit
   1. Rigid steel conduits and fittings shall be full weight, mild steel, hot-dip galvanized and zinc bichromate coated inside and outside after galvanizing.
   2. Rigid steel conduit shall be manufactured in accordance with UL Standard No. 6 and ANSI 80-1.
   3. Rigid steel conduit shall be manufactured by Triangle PWC, Republic Steel, or equal.

C. Rigid nonmetallic conduit shall be Schedule 40 PVC.
   1. Nonmetallic conduits and fittings shall be UL listed, sunlight-resistant, and rated for use with 90 degrees C conductors.
   2. Nonmetallic conduits and fittings shall be manufactured by Carlon, Condux, or equal.

D. Flexible metallic conduit shall be fabricated from galvanized interlocked steel strip. Liquid-tight flexible metallic conduit shall have an extruded PVC covering over the flexible steel conduit. For conduit sizes 3/4 inch through 1-1/4 inches, flexible conduits shall have continuous built in copper ground conductor. Flexible conduit shall be American Brass, Anaconda, Electroflex, or equal.

E. PVC-coated raceway system shall conform to Federal Specification WW C 581E, ANSI C80.1, and to Underwriter's Laboratories specifications.

1. The zinc surfaces of the conduits and fittings shall remain intact and undisturbed on both the inside and the outside of the conduit through the preparation and application processing.
2. A PVC coating shall be bonded to the galvanized outer surface of the conduit. The bond between the PVC coating and the conduit surface shall be greater than the tensile strength of the plastic.
3. The thickness of the PVC coating shall be a minimum of 40 mils.
4. A PVC jacketed coupling shall be furnished with each length of conduit. A PVC sleeve equal to the OD of the conduit shall extend 1-1/2 inches from each end of coupling.
5. PVC-coated conduits shall be as manufactured by Robroy, Occidental (OCCAL), or equal.

2.5 WIRE AND CABLE

A. General: All conductors, including ground conductors, shall be copper. Insulation shall bear UL label and the manufacturer's trademark, type, voltage and temperature rating, and conductor size. Wire and cable shall be products of American, BICC/General, Rome Cable, Okonite, or equal.

B. Control Cables: All control cables shall be rated for 600 volts and shall meet the following requirements:

1. Control wires shall consist of No. 14 gauge stranded copper conductors and shall be THWN/THWN-2 rated for 90 degrees C at dry locations and 75 degrees C at wet locations.
2. Control wires at panels and cabinets shall be machine tool grade type MTW, UL approved, rated for 90 degrees C at dry locations.

C. Instrumentation Cables: Shielded instrumentation cables shall be rated at 600 volts and shall comply with the following requirements:

1. Individual shielded cable shall consist of twisted 2 or 3 No. 18 gauge, stranded, color coded, tinned-coated copper in accordance with ASTM B 33 Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes and B8 Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, and Soft. Color coding shall be black-clear, or black-red-clear.
2. Insulation thickness shall be 32 mils of polyethylene, insulated with 2.3 mils 100 percent aluminum foil/polyester shield and No. 18 stranded tinned copper drain wire, all under a 32 mil PVC jacket. The shield shall be continuous and shall be grounded only at the receiving end, or as indicated.
3. Multi-individual shielded pair or triad instrumentation cable shall consist of individual shielded and twisted pair copper conductors with an ethylene-propylene insulation, and No. 18 AWG tinned stranded copper drain wire, an overall aluminum mylar shield and an overall chloro-sulfonated polyethylene compound jacket. The cables shall be suitable for cable tray installation and shall be flame retardant.

D. Building Wire and Cable: Building wires and cables shall be rated at 600 volts and shall meet the following requirements:

1. Building wire shall be single conductor copper cable listed by UL as Type THWN/THWN-2 rated 75 degrees C in wet locations and rated 90 degrees C in dry locations.
2. Building wire; **all conductors shall be stranded**.
3. No wire smaller than No. 12 AWG shall be used unless specifically indicated.

E. Cable Terminations: Cable terminations shall be in accordance with the following:
1. Compression connectors shall be Burndy "Hi Lug", Thomas & Betts "Shure Stake", or equal. Threaded connectors shall be split bolt type of high strength copper alloy.
2. Spring connectors (wire nuts) shall be 3M "Scotch Lok," "Ideal Wing Nuts", or equal.
3. Preinsulated fork tongue lugs shall be "Thomas & Betts" RC Series, Burndy, or equal.
4. General purpose insulating tape shall be Scotch No. 33, Plymouth "Slip knot", or equal. High temperature tape shall be polyvinyl by Plymouth, 3M, or equal.
5. Epoxy resin splicing kits shall be 3M Scotchcoat 82 Series, Burndy Hy Seal, or equal.
6. Motor load termination kits shall be 3M.

2.6 PULL AND JUNCTION BOXES

A. Outlet, switch, pull and junction boxes for flush-mounting in general purpose locations shall be one-piece, galvanized, pressed steel. Ceiling boxes for flush-mounting in concrete shall be galvanized, pressed steel.

B. Outlet, switch, pull and junction boxes where surface mounted in exposed locations shall be cast ferrous boxes with mounting lugs, zinc or cadmium plating, and enamel finish. Surface mounted boxes in concealed locations may be pressed steel.

C. Control station, pull and junction boxes, including covers, for installation in corrosive locations shall meet the NEMA 4X requirements and shall be stainless steel or fiber glass-reinforced polyester and shall be furnished with mounting lugs.

D. All cast boxes and pressed steel boxes for flush mounting in concrete shall be fitted with cast, malleable box covers and gaskets. Covers for pressed steel boxes shall be one-piece pressed steel, cadmium plated, except that boxes for installation in plastered areas and finished rooms shall be stainless steel over plaster rings. Stainless steel plates shall be Sierra S line, Hubbell, or equal. Cast boxes shall be as manufactured by Crouse-Hinds, Appleton, or equal.

2.7 CONDUIT FITTINGS

A. General: Fittings shall comply with the same requirements as the raceway with which they will be used. Fittings for use with rigid steel conduit, shall be cast or malleable ferrous metal. Such fittings larger than one inch shall be "mogul size." Fittings shall be of the gland ring compression type. Covers of fittings, unless in "dry" locations, shall be closed with gaskets. Surface-mounted cast fittings, housing wiring devices in outdoor and damp locations, shall have mounting lugs.

B. Insulated bushings shall be molded plastic or malleable iron with insulating ring, similar to O Z Type A and B, equivalent types by Thomas & Betts, Steel City, Appleton, O Z/Gedney, or equal.

C. Insulated grounding bushings shall be malleable iron with insulating ring and with ground lug, - by T & B, - no substitutions.

D. Crouse Hinds UNF or UNY unions shall be used at all points of union between ends of rigid steel conduits which cannot be coupled. Running threads and threadless couplings shall not be used.

E. Liquid-tight fittings shall be manufactured by T & B, no substitutions.

F. Hubs for threaded attachment of steel conduit to sheet metal enclosures shall be similar to Appleton Type HUB, equivalent types such as manufactured by T & B, Myers Scrutite, or equal.

G. Transition fittings to mate steel to PVC conduit, and PVC access fitting, shall be as furnished or recommended by the manufacturer of the PVC conduit.

H. Conduit sealant shall be Chico, or equal.

I. Expansion fittings shall be installed wherever a raceway crosses a structural expansion joint. Such fittings shall be expansion and deflection type and shall accommodate lateral and transverse movement. Fittings shall be O Z/Gedney Type "DX," Crouse Hinds "XD," or equal. These fittings are required in metallic and nonmetallic raceway installations. When the installation is in a nonmetallic run, a 3 foot length of rigid conduit shall be used to connect the nonmetallic conduit to the fitting.

2.8 WIRING DEVICES

A. All wiring devices shall be a product of a single manufacturer and shall conform to applicable NEMA Standards and be UL listed. Devices shall be as manufactured by Hubbell, Sierra, Pass & Seymour, or equal. General purpose duplex receptacles and toggle switch handles shall be white. Special purpose receptacles shall have a body color as shown. Receptacles and switches shall conform to Federal Specifications W C 596E and W S 896E, respectively.
   1. Receptacles
      a. General purpose duplex receptacles shall be grounding type, 125-volt, ac, 20-amperes, **backwired** NEMA Configuration 5-20R, such as Hubbell 5362, or equal.

B. Convenience receptacles for installation in outdoor and corrosive areas shall be NEMA 5-20R configured and shall have stainless steel or nickel plated parts and plastic parts of Melamine.
   1. Receptacles at outdoor locations shall be UL-approved for weatherproof locations with plug inserted. These shall be Crouse-Hinds, Hubbell, Pin and Sleeve Series, or equal.
   2. Receptacles at damp or dry locations shall be Crouse-Hinds DS 23G, Pyle National N 1, or equal.
   3. Receptacles at corrosive locations shall be Hubbell 52CM62 15 ampere, 53CM62 20 ampere, or equal.

C. Ground fault interrupter (GFI) receptacles shall be NEMA 5-20R configured and shall mount in a standard outlet box. Units shall trip at 5 milliamperes of ground current and shall comply with NEMA WD 1 1.10 and UL 943. GFI receptacles shall be capable of individual as well as "downstream" operation. GFI receptacles shall be Hubbell GF 5252, or equal.

D. Switches

a. Switches at outdoor locations shall be Crouse-Hinds DS 128, Mackworth Rees Style 3845, Joy Flexitite, or equal.

b. Switches at damp locations shall be Mackworth Rees Style 3496, Joy Flexitite, or equal.

c. Switches at dry locations shall be Crouse-Hinds DS 32G, Pyle National SCT 10k, or equal.

E. Toggle switches shall be suitable for backwiring and shall conform to the following table, or equal:

	Hubbell No.	**Bryant No.**	**Hubbell No.**	**Bryant No.**
Single Pole	1221 (white)	4901 (white)	1221W (white)	4901W (white)
Three Way	1223	4903	1223W	4903W
Momentary	1556	4821	1556W	4821W
Four Way	1224		1224W	

2.9 CABINETS AND ENCLOSURES

A. General: All electrical cabinets and enclosures housing control relays and terminal blocks shall be manufactured in accordance with NEMA Publications 250, UL Standards 50 and 508.

1. Relay or control, and terminal cabinets or outdoor cabinets shall be NEMA 4 enclosures. Sizes shown on the Drawings are minimum. Interiors of cabinets shall be finished white including internal back mounting plate.
2. Pull boxes and fan timer enclosure in vault shall be fiberglass, NEMA type 4X.

B. Wiring of terminal cabinets, control or relay cabinets shall be accomplished with stranded copper conductor rated for 600-volts and UL listed as Type MTW. Wires for annunciator and indication circuits shall be No. 16 AWG. All others shall be No. 14 AWG. Color coding shall be as specified elsewhere in this Section.

C. All terminal block requirements shall be as manufactured by Entrelec with cage clamp, Phoenix, or equal.

D. Engraving shall be as shown or as directed by the Engineer. Characters shall be uniform block style not smaller than 1/8-inch. Nameplates shall be secured using cadmium plated steel or other corrosion resistant screws. Adhesive alone is not acceptable.

E. Each relay or control and terminal cabinets shall be completed, assembled, wired, and tested at the factory. Test shall be in accordance with the latest UL and NEMA Standards. All cabinets shall bear UL label, as applicable.

2.10 DISCONNECT SWITCHES

A. Unfused and fused disconnect switches shall be externally operated with quick-make/quick-break mechanisms. The handle shall be interlocked with the switch cover by means of a defeatable interlock device. The switch shall be padlockable in the "off" position. Switches shall have nameplates stating manufacturer, rating, and catalog number. Heavy-duty

switches shall have arc suppressors, pin hinges, and shall be horsepower rated at 600-volts. All switches rated at 100 amperes or larger shall have auxiliary contact for remote status indication. Heavy-duty switches shall be provided for all motor circuits above 3 horsepower. In smaller motor circuits switches shall be general duty.

B. Switch rating shall match the horsepower requirements of the load at the particular voltage if not otherwise shown.

C. Switch enclosure shall be NEMA 1 and shall be as manufactured by Square D, Cutler-Hammer, or equal.

2.11 ELECTRICAL IDENTIFICATION

A. Nameplates: Nameplates shall be fabricated from white-letter, black-face laminated plastic engraving stock, Formica type ES-1, or equal. Each shall be fastened securely, using fasteners of brass, cadmium plated steel, or stainless steel, screwed into inserts or tapped holes, as required. Engraved characters shall be block style of adequate size to be read easily at a distance of 6 feet with no characters smaller than 1/8-inch high.

B. Conductor and Equipment Identification: Conductor and equipment identification devices shall be either imprinted plastic-coated cloth marking devices such as manufactured by Brady, Thomas & Betts, or equal, or shall be heat-shrink plastic tubing, imprinted split-sleeve markers cemented in place, or equal.

C. Identification Tape: Identification tape for protection of buried electrical installation shall be a 6-inch wide red polyethylene tape imprinted "CAUTION - ELECTRIC UTILITIES BELOW."

2.12 LIGHTING AND POWER PANELBOARDS

A. General: Panelboards shall be dead front factory assembled. Panelboards shall comply with NEMA PB-1 as well as the provisions of UL 50 and 67. Panelboards used for service equipment shall be UL labeled for such use. Lighting panelboards shall be rated for voltages as shown on drawings.
   1. Interiors shall have solderless, anti-turn connectors and shall be constructed so that branch circuit breaker can be replaced without disturbing adjacent units or resorting to field drilling and tapping. Bus bars and connecting drops shall be copper. Neutral bar shall be full-sized and shall have one terminal screw for each branch circuit; main bus bar shall be full-sized for entire length. Spaces shown shall have cross connections for the maximum sized device that can be fitted.
   2. Panelboard box shall be galvanized code grade steel with knockouts, and shall have removable end walls. All boxes or panelboard enclosures shall have gray baked enamel finish.
   3. All circuit breakers shall be bolt-in type.

B. Lighting Panelboards
   1. Cabinets for building panels shall be 20-inch wide minimum, with 4-inch minimum side gutters and 5-inch minimum top and bottom gutters. Panelboard trim shall be the same size as cabinet on surface-mounted panels and 3/4-inch larger all around than cabinet of flush-mounted panels. Bus bars shall be copper. Doors in trim shall have typed circuit directory and pocket with protective clear plastic sheet. All trim

and cabinets of surface-mounted panels in general purpose areas shall be phosphate treated, primed and finished with baked enamel, panels of flush mounted panels shall be finished to match surrounding wall color.

2. The number of circuit breakers and the ampere ratings shall be in accordance with panel schedules. Main circuit breaker or main lugs only shall be provided as indicated. The panelboard circuit breakers shall be group mounted and shall be molded case with 3- or 2-pole main breakers as required and branch circuit breakers with 10,000 AIC.
3. Provide control enclosures under common panel trim. All panelboard doors shall be keyed alike.

2.13 CONTROL STATIONS

A. Control stations shall comply with NEMA Standards ICS2-216. All control stations shall be industrial type, heavy duty, oil-tight, with legend plates.

B. Control stations shall be as follows:
1. Pushbutton Switch: Pushbutton switches shall be momentary type with round or square button plate. All emergency-stop pushbuttons shall have red button plates. Lock-out stop shall be momentary pushbutton with locking mechanism.
2. Selector Switches: Selector switches shall be rated 10 amperes at 600 volts and shall be rotary type with number of position and poles as indicated.
3. Indicating Lights: Pilot lights shall be LED type and with plastic color caps: green color for running, yellow for ready, white for power status, and red for failure status.
4. Control station enclosures shall be NEMA 4X in corrosive, below grade, or wet areas.

C. Manufacturers shall be Square D Class 9001, or equal.

PART 3 - EXECUTION

3.1 GROUNDING

A. General: Grounding cable shall be sized in accordance with code requirements when sizes are not indicated on the Drawings.

B. Equipment Ground: Ground continuity throughout the facility shall be maintained by installing a grounding conductor in all raceways.
1. Metallic raceway shall be installed with double lock nuts or hubs at enclosures. Nonmetallic raceway containing dc conductors operating at more than 50 volts to ground, or any ac conductors, shall contain a copper-grounding conductor insulated green. Such conductor shall be bonded to terminal and intermediate metallic enclosures.
2. Metal equipment platforms which support any electrical equipment shall be bonded to the nearest ground bus or to the nearest switchgear ground bus. This grounding requirement is in addition to the raceway grounding required in the preceding paragraph herein.

C. Grounding Electrode System: Install the grounding electrode system with all required components in accordance with National Electrical Code Article 250.

1. Connection to ground electrodes and ground conductors shall be exothermic welded where concealed and shall be bolted pressure type where exposed. Bolted connectors shall be assembled wrench-tight.
2. Insulated grounding bushings shall be employed for all grounding connections to steel conduits in switchboards, in motor control centers, in pullboxes, and elsewhere where conduits do not terminate at a hub or a sheet metal enclosure. Where insulated bushings are required, they shall be installed in addition to double lock-nuts.
3. Copper bonding jumpers shall be used to obtain a continuous metallic ground.

D. Shield Grounding
1. Shielded power cable shall have its shield grounded at each termination in a manner recommended by the cable manufacturer.
2. Shielded instrumentation cable shall be grounded at one end only; this shall be at the RTU or otherwise at the "receiving" end of the signal carried by the cable, unless shop drawings indicate that the shield shall be grounded at both ends.
3. Termination of each shield drain wire shall be on its own terminal screw. All of these terminal screws in one rack shall be jumpered with No. 16 solid tinned bare copper wire; connection to ground shall be accomplished with a No. 12 green insulated conductor to the main ground bus.

3.2 UNDERGROUND DUCTS AND MANHOLES

A. The underground duct bank shall be installed in accordance with the criteria below:
1. Duct shall be assembled using high impact nonmetallic spacers and saddles to provide conduits with vertical and horizontal separation. Plastic spacers shall be set every 5 feet.
2. The duct shall be laid on a grade line of at least 4 inches per 100 feet, sloping towards pullboxes or manholes. Duct shall be installed and pullbox and manhole depths adjusted so that the top of the duct is a minimum of 24 inches below grade.
3. Changes in direction of the duct envelope by more than 10 degrees horizontally or vertically shall be accomplished using bends with a minimum radius 24 times the duct diameter.
4. Couplings shall be staggered at least 6 inches vertically. Bottom of trench shall be of select backfill or sand. The duct array shall be anchored every 4 feet to prevent movement during placement of backfill.
5. Each bore of the completed duct bank shall be cleaned by drawing through it a standard flexible mandrel one foot long and 1/4-inch smaller than the nominal size of the duct through which the mandrel will be drawn. After passing of the mandrel, draw a wire brush and swab through.
6. A raceway, in the duct envelope, which does not require conductors, shall have a 1/8 inch polypropylene pull cord installed throughout the entire length of the raceway.

B. Duct entrances shall be grouted smooth; duct for primary and secondary cables shall be terminated with flush end bells. Sections of pre-fabricated manholes and pullboxes shall be assembled with waterproof mastic and shall be set on a 6-inch bed of gravel as recommended by the manufacturer or as required by field conditions.

C. Duct bank markers shall be installed every 200 feet along run of duct bank, at changes in horizontal direction of duct bank, and at ends of duct bank. Concrete markers, 6 by 6 inches

square and one-foot long, shall be set 2 inches above finish grade. The letter "D" and arrow set in the concrete shall be facing in the direction of the duct alignment.

D. Duct bank penetration through walls of manholes or pullboxes, and on building walls below grade shall be watertight.

E. Trenches containing duct banks shall be filled with select backfill with no large rocks which could damage the duct.

3.3 RACEWAYS

A. General: Raceways shall be installed as indicated, however, conduit routings shown are diagrammatic. Raceway systems shall be electrically and mechanically complete before conductors are installed. Bends and offsets shall be smooth and symmetrical and shall be accomplished with tools designed for the purpose intended. Bends in metallic conduit shall be accomplished by field bending or by the use of factory elbows. All installations shall be in accordance with the latest edition of the National Electrical Code.

B. Raceways shall be installed in accordance with the following schedule:
   1. Low Voltage Raceway (control and power):
      a. Rigid Schedule 40 PVC shall be used for burial in earth.
      b. Galvanized rigid steel (GRS) shall be used on exposed installations in general purpose areas.
      c. Galvanized rigid steel or PVC shall be used for conduits embedded in concrete slab on grade and above grade.
      d. Galvanized rigid steel shall be used in exposed installations in outdoor areas.
   2. Exposed Raceways
      a. Conduits shall be rigidly supported with clamps, hangers, and Unistrut channels.
      b. Intervals between supports shall be in accordance with the National Electrical Code.
   3. All underground elbows shall be GRS (PVC coated).

C. Conduit Terminations
   1. Empty conduit terminations not in manholes or pullboxes shall be plugged. Exposed raceway shall be installed perpendicular or parallel to buildings except where otherwise indicated. Conduit shall be terminated with flush couplings at exposed concrete surfaces. Conduit stubbed up for floor-standing equipment shall be placed in accordance with approved shop drawings. Metallic raceways installed below-grade or in outdoor locations and in concrete shall be made up with a conductive waterproof compound applied to threaded joints. Compound shall be Zinc Clads Primer Coatings No B69A45, HTL-4 by Crouse-Hinds, Kopr Shield by Thomas & Betts, or equal.
   2. Both rigid and flexible conduit shall be sealed against water at each entrance to enclosures. Unless indicated otherwise, rigid and flexible conduit shall enter panels through the top, shall continue down from the top to the bottom, and shall turn upward at the bottom.

D. Conduit Installations

1. Conduit may be cast integral with horizontal and vertical concrete slabs, providing one-inch clearance is maintained between conduit surface and concrete surface. If said clearance cannot be maintained, the conduit shall be installed exposed below elevated slabs; provided, that in the case of slabs on grade, conduit shall be installed below the slab and shall be encased with a minimum cover of 3 inches of concrete. Maximum size of conduit that can be cast in slab above grade shall be 3 inches, in slab on grade shall be 1-1/2 inches.
2. Nonmetallic conduit may be cast integral with horizontal slabs with placement criteria stated above. Non-metallic conduit may be run beneath structures or slabs on grade, without concrete encasement. In these instances, conduit shall be placed at least 12 inches below the bottom of the structure or slab. Nonmetallic conduit may be buried 24 inches minimum below grade, in open areas or where otherwise not protected by concrete slab or structures. Nonmetallic conduit shall be permitted only as required by the Specifications and in concealed locations as described above.
3. Where a run of concealed PVC conduit becomes exposed, a transition to rigid steel conduit is required. Such transition shall be accomplished by means of a factory elbow or a minimum 3-foot length of rigid steel conduit, either terminating at the exposed concrete surface with a flush coupling. Piercing of concrete walls by nonmetallic runs shall be accomplished by means of a short steel nipple terminating with flush couplings.
4. Flexible liquid-tight conduit shall be used for the connection of equipment such as motors, transformers, instruments, valves, or pressure switches subject to vibration or movement during normal operation or servicing. Flexible liquid-tightdisco conduit may be used in lengths required for the connection of recessed lighting fixtures; otherwise the maximum length of flexible conduit shall be 18 inches.
5. Equipment subject to vibration or movement which is normally provided with wiring leads, such as solenoid valves, shall be installed with a cast junction box for the make-up of connections. Flexible conduits shall be as manufactured by American Brass, Cablec, Electroflex, or equal.
6. Conduit penetrations on walls, concrete structures, pull boxes, and equipment cabinets shall be performed in accordance with the following:
    a. Seal all raceways entering structures at the first box or outlet with conduit sealant to prevent the entrance into the structure of gases, liquids, or rodents.
    b. Dry pack with nonshrink grout around raceways that penetrate concrete walls, floors, or ceilings aboveground, or use one of the methods indicated for underground penetrations.
    c. Where an underground conduit enters a structure through a concrete roof or a membrane waterproofed wall or floor, provide an acceptable, malleable iron, watertight, entrance sealing device. When there is no raceway concrete encasement, provide such device having a gland type sealing assembly at each end with pressure bushings which may be tightened at any time. When there is raceway concrete encasement indicated, provide such a device with a gland type sealing assembly on the accessible side. Securely anchor all such devices into the masonry construction with one or more integral flanges. Secure membrane waterproofing to such devices in a permanently watertight manner.
    d. Where an underground raceway without concrete encasement enters a structure through a nonwaterproofed wall or floor, install a sleeve made of Schedule 40 galvanized pipe. Fill the space between the conduit and sleeve

with a suitable plastic expandable compound on each side of the wall or floor in such a manner as to prevent entrance of moisture. A watertight entrance sealing device may be used in lieu of the sleeve.

7. All underground GRS conduit shall be PVC coated.
8. Minimum size of buried conduit: 1".
9. Minimum size of exposed conduit: ¾"

3.4 WIRES AND CABLES

A. General: Conductors shall not be pulled into raceway until:
   1. Raceway system has been inspected and accepted by the Engineer.
   2. Plastering and concrete have been completed in affected areas.
   3. Raceway system has been freed of moisture and debris.

B. Wire and Cables
   1. Conductors of No. 1 size and smaller shall be hand pulled. Larger conductors may be installed using power winches. Pulling tensions on the cables shall be within the limits recommended by the cable manufacturer. Wire pulling lubricant, where needed, shall be UL approved.
   2. Wire in panels, cabinets, and gutters shall be neatly grouped using nylon tie straps and shall be fanned out to terminals.

C. Splices and Terminations
   1. The Contractor shall provide, install, and terminate the conductors required for power and controls to electrical equipment instrumentation terminal cabinets, control and instrumentation equipment except where indicated elsewhere. There shall be no splices in underground manhole or pullboxes of conductors smaller than #10 AWG.
   2. Two- and three-conductor shielded cables installed in conduit runs which exceed 2,000 feet may be spliced in pullboxes. These cable runs shall have only one splice per conductor.
   3. Control conductors shall be spliced or terminated only at the locations indicated and only on terminal strips or terminal lugs of vendor furnished equipment. For the purposes of the various Sections of Division 26 of the Specifications, "control conductors" are defined as conductors operating at 120 volts or less in circuits that indicate equipment status or that control the electric energy delivered to a power consuming device.
   4. All 120/208-volt and 480-volt branch circuit conductors may be spliced in suitable fittings at locations determined by the Contractor.
   5. Stranded conductors shall be terminated directly on equipment box lugs making sure that all conductor strands are confined within lug. Use forked-tongue lugs where equipment box lugs have not been provided.
   6. Splices in 600-volt wire which are not pre-insulated shall be insulated with three layers of tape each half lapped except that splices in below grade pull boxes or in any box subject to flooding shall be made watertight using in-line copper compression splices with heat shrink insulation.
   7. Splices to motor leads in motor terminal boxes shall be wrapped with mastic material to form a mold and then shall be taped with a minimum of 2 layers of varnished

cambric tape overtaped with a minimum of 2 layers of high temperature tape. Provide 3M motor lead termination kits.

8. Shielded power cable shall be terminated with pre-assembled stress cones in a manner approved by the cable manufacturer. Submit the proposed termination procedure as described for shop drawings.
9. Control devices, such as solenoid operated valves that are normally supplied with conductor pigtails shall be terminated as described for control conductors.

D. Cable Assembly and Testing: Cable assembly and testing shall comply with applicable requirements ICEA Publication No. S-68-516 and other relevant ICEA publications. The following tests shall be the minimum requirements:

1. Insulation resistance shall be obtained and shall not be less than the value recommended by ICEA.
2. All cables rated at 600 volts shall be tested for insulation resistance between phases and from each Phase to a ground using a megohmeter.
3. All field testing mentioned above shall be done after cables are installed in the raceways.
4. Cables failing in the said tests shall be replaced with a new cable or repaired. Such kind of repair methods shall be as recommended by the cable manufacturer and shall be performed by persons certified by the industry.

E. Continuity Test: All control and instrumentation cables shall be tested for continuity, polarity, undesirable ground, and origination. Such tests shall be performed prior to placing all cables in service.

3.5 PULL AND JUNCTION BOXES

A. Pull and junction boxes shall be sized in accordance with the requirements of the National Electrical Code or as shown on drawings.

B. Outlet boxes shall be used as junction boxes wherever possible. Where separate pullboxes are required, they shall have screw covers.

C. Pullboxes shall be installed when conduit run contains more than three 90-degree bends and runs exceed 200 feet or as shown on drawings.

3.6 CABINETS AND ENCLOSURES

A. Cabinets shall be set plumb at an elevation that will cause the maximum circuit breaker height to be less than 5 ft 6 inches. Top edge of trim of adjacent panels shall be at the same height. Panels which are indicated as flush mounted shall be set so cabinet is flushed and serves as a "ground" for plaster application.

B. All factory wire connections shall be made at shipping splits, and all field wiring and grounding connections shall be made after the assemblies are anchored.

3.7 CONCRETE HOUSEKEEPING

A. Concrete housekeeping pads shall be provided for all floor standing electrical equipment. Housekeeping pads for all equipment, including future units, shall be 2 inches above

surrounding finished floor or grade and 2 inches larger in both dimensions than the supported equipment, unless otherwise indicated.

B. Concrete housekeeping curb shall be provided for all conduit stub-up in indoor and outdoor locations, not concealed by equipment enclosures. Such curb shall be 3 inches above finished floor or grade.

3.8 EQUIPMENT ANCHORING

A. Freestanding or wall-hung equipment shall be anchored in place by methods that will meet seismic requirement in the area where project is located. Wall-mounted panels that weigh more than 500 pounds or which are within 18 inches of the floor shall be provided with fabricated steel support pedestal(s). Pedestals shall be of welded steel angle sections. If the supported equipment is a panel or cabinet and enclosed with removable side plates, it shall match supported equipment in physical appearance and dimensions. Transformers hung from 4-inch stud walls and weighing more than 300 pounds, shall have auxiliary floor supports.

B. Leveling channels anchored to the concrete pad shall be provided for all switchgear and pad-mounted transformer installations. Area between the channels shall be grouted perfectly flat.

C. Anchoring methods and leveling criteria specified in the printed recommendations of the equipment manufacturers are a part of the Work of this Contract. Such recommendations shall be submitted as required for shop drawings in Section 01 33 20 – Submittal Procedures.

3.9 CABLE AND EQUIPMENT IDENTIFICATION

A. General: The completed electrical installation shall be provided with adequate identification to facilitate proper control of circuits and equipment and to reduce maintenance effort.

B. Cable: Assign each control and instrumentation wire and cable a unique identification number. Said numbers shall be assigned to all conductors having common terminals and shall be shown on all shop drawings. Identification numbers shall appear within 3 inches of conductor terminals. "Control" shall be defined as any conductor used for alarm, annunciator, or signal purposes:

1. Multiconductor cable shall be assigned a number which shall be attached to the cable at intermediate pull boxes and at stub-up locations beneath free-standing equipment. It is expected that the cable number shall form a part of the individual wire number. All individual control conductors and instrumentation cable shall be identified at pull points as described above. The instrumentation cable numbers shall incorporate the loop numbers indicated on the Drawings.
2. All 120/208-volt system feeder cables and branch circuit conductors shall be color coded as follows: Phase 1-black, Phase 2-red, Phase 3-blue, and Neutral-white. The 480/277-volt system conductors shall be color coded as follows: Phase A-brown, Phase B-orange, Phase C-yellow, and Neutral-gray. Color-coding tape shall be used where colored insulation is not available. Branch circuit switch shall be yellow. Insulated ground wire shall be green, and neutral shall be gray. Color coding and phasing shall be consistent throughout the site, but bars at panelboards,

switchboards, and motor control centers shall be connected Phase 1-2-3, top to bottom, or left to right, facing the front of the equipment.

3. General purpose ac control cables shall be pink. General purpose dc control cables shall be blue.
4. All spare cables shall be terminated on terminal screws and shall be identified with a unique number as well as with destination.
5. Terminal strips shall be identified by imprinted, varnished, marker strips attached under the terminal strip.

C. Equipment: Equipment and devices shall be identified as follows:

1. Nameplates shall be provided for all panelboards, panels, starters, switches, and pushbutton stations. In addition to the name plates shown, control devices shall be equipped with standard collar-type legend plates.
2. Control devices within enclosures shall be identified similar to the paragraph above.
3. Three-phase receptacles shall be consistent with respect to phase connection of receptacle terminals. Errors in phasing shall be corrected at the bus, not at the receptacle.
4. Toggle switches which control loads out of sight of switch, and all multiswitch locations of more than 2 switches, shall have suitable inscribed finish plates.
5. Empty conduits shall be tagged at both ends to indicate the destination at the far end. Where it is not possible to tag the conduit, destination shall be identified by marking an adjacent surface.
6. Provide typewritten circuit directories for panelboards; circuit directory shall accurately reflect the outlets connected to each circuit.
7. Install identification tape directly above buried unprotected raceway; install tape 8 inches below grade and parallel with raceway to be protected. Identification tape is required for all buried raceway not under buildings or equipment pads except identification tape is not required for protection of street lighting raceway.

3.10 EXAMINATION

A. Study all Drawings and Specifications and to report to the Engineer before bidding:

1. Any errors.
2. Any omissions
3. Any Electrical Code problems
4. Any Local Building Code problems.
5. Or any points of conflict with other trades.

B. Review the existing site conditions and examine all shop drawings for the various items of equipment in order to determine exact routing and final terminations for all wiring and cables.

C. The Contractor is responsible for the complete electrical and instrumentation Work:

1. Install extra conduits, cables, and interfaces as may be necessary to provide a complete and operating electrical, power, and Process Control and Instrumentation System.

3.11 GENERAL INSTALLATION

A. Equipment locations shown on Electrical Drawings may change due to variations in equipment size or minor changes made by others during construction:
   1. Verify all dimensions indicated on the Drawings:
      a. Actual field conditions govern all final installed locations, distances, and levels.
   2. Review all information shown on the Contract Drawings, including architectural, structural, mechanical, instrumentation, and the accepted electrical and mechanical shop drawings, and coordinate Work as necessary to adjust to all conditions that arise due to such changes.

B. Cutting and patching:
   1. Perform all cutting, patching, channeling, core drilling, and fitting required for the Electrical Work, except as otherwise directed:
      a. Actual field conditions govern all final installed locations, distances, and levels.
         1) Before cutting, channeling, or core drilling any surface, ensure that no penetration of any other systems will be made.
            a) Verify that area is clear and free of conduits, cables, piping, ductwork, post-tensioning cables etc.
            b) Use tone-locate system or X-ray to ensure that area is clear of obstructions.
         2) Review the complete Drawing set to ensure that there are not conflicts or coordination problems before cutting, channeling, or core drilling any surface.
   2. Perform all patching to the same quality and appearance as the original Work. Employ the proper tradesmen to secure the desired results. Seal around all conduits, wires, and cables penetrating walls, ceilings, and floors in all locations with a fire stop material, typically:

a.	3M	CP25	Caulk
b.	3M	303	Putty
c.	T&B	S-100	Caulk
d.	T&B	FS-500	Putty
e.	T&B	FST-60l	Putty

   3. Seal around conduit penetrations of below grade walls with a waterproof, non-shrink, nonmetallic grout. Use Fox Industries FX-225 or equal. Install in accordance with manufacturer's recommendations.

C. Earthwork and Concrete:
   1. Install all trenching, shoring, concrete, backfilling, grading, and resurfacing associated with the electrical work.
   2. Notify the Engineer before encasing or backfilling any electrical work and arrange for inspection.

D. Terminations:
   1. Terminate all conductors required to interconnect power, controls, instruments, panels and other equipment otherwise specifically identified.

E. Miscellaneous Installation Requirements:
   1. In case of interference between electrical equipment shown on the Drawings and the other equipment, notify the Engineer in writing of the proposed change:
      a. Obtain Engineer's acceptance of the proposed changes before they are made.
   2. Location of manholes and pullboxes shown on Drawings are approximate. Coordinate exact location of manholes and pullboxes with mechanical and civil Work.
   3. Provide additional manholes or pullboxes to those shown where they are required to make a Workable installation.
   4. Circuits of different service voltage:
      a. Install in separate raceways, hand holes, pullboxes, and junction boxes.
      b. In manholes, install all cables operating at less than 50 VDC PVC coated flexible metallic conduit.
      c. The voltage and service levels are:
         1) Medium voltage: 12:47 KV
         2) Low voltage: 120V, 208V, 480V
         3) Control: less than 50VDC

F. Labeling:
   1. Provide all nameplates and labels as required on equipment.

G. Equipment Tie-Downs:
   1. Anchor all instruments, control panels, and equipment by methods that comply with seismic and wind bracing requirements, which apply to the site.
   2. All control panels, VCPs, LCPs, RTUs, PCMs, etc., must be permanently mounted and tied down to structures.

3.12 FIELD QUALITY CONTROL

A. Inspection:
   1. Conduct inspection of electrical, instrumentation and control system installation.
   2. Allow Owner, Engineer, or Owner's Representative access to site for inspection of materials, equipment, or installation at any time.
   3. Provide any technical data or other assistance necessary to support inspection activities.
   4. Electrical inspections include, but not limited to, the following:
      a. Inspect equipment and materials for physical damage.
      b. Inspect installation of compliance with plans and specifications
      c. Inspect installation for obstructions and adequate clearances around equipment.
      d. Inspect equipment installation for proper leveling, alignment, anchorage and assembly.
      e. Inspect equipment nameplate data to verify compliance with design requirements.
      f. Inspect raceway installation quality Workmanship and adequate support.
      g. Inspect cable terminations.
      h. Schedule Structural Engineer to inspect all mounting of electrical devices and all penetrations and connections to structures.
   5. Inspection activities conducted during construction do not satisfy inspection requirements outlined in each section of the Division 26 specifications.

B. Testing:
   1. When the electrical Work is substantially completed, notify the Engineer that the project is ready for Field Acceptance Testing.
   2. Perform the acceptance test in conformance with each section of the Division 26 specifications.
   3. Record results of the required tests along with the date of test:
      a. Use conduit schedule identification numbers to indicate portion of circuit tested.

C. Workmanship:
   1. Use only competent and skilled personnel experiences in their trade, Working under continuous competent supervision, to perform all Work, including installation, connection, calibration, testing, and adjustment.
      a. Perform all Work, including aesthetic as well as electrical and mechanical aspects, to standards consistent with the best practices of the trade.
   2. All Work is subject to review by the Engineer or Owner at any time.
   3. Provide all Work to the complete satisfaction of the Engineer or Owner.
   4. Repair or replace any Work, which, in the sole opinion of the Engineer, does not conform to these Specifications, or trade practices.
   5. Make all changes of any installed items to meet the intent of the Drawings and Specifications.
   6. Install all materials and equipment in accordance with the Manufacturer's printed installation instructions.
      a. Where Contractor asks to deviate from the Manufacturer's recommendations, such changes shall be reviewed by the Engineer and Manufacturer before installation.

3.13 CLEANING

A. General Requirements:
   1. Maintain all surfaces to be painted in a clean and smooth condition.
   2. Remove all foreign material and restore all damaged finishes to the satisfaction of the Engineer and Owner.
   3. Remove all debris, rubbish, and scraps, etc. each night.
   4. Leave all areas swept clean each night.
   5. Wipe clean all exposed threads of conduit of the KOPR-SHIELD compound after installation.

B. Vacuum clean all electrical enclosures of any debris before any wire or cable is installed.

C. Clean and re-lamp all new and luminaries that were used in the area affected by the construction and return all used lamps to Owner.

D. As specified in other Sections of the Specifications.

E. Leave wiring in panels, manholes, boxes, and other locations neat, clean, and organized:
   1. Neatly coil and label spare wiring lengths.
   2. Shorten re-terminate, and re-label excessive spare wire and cable lengths, as determined by the Engineer.

END OF SECTION

SECTION 26 05 83
WIRING CONNECTIONS

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 REFERENCES

A. ASTM International.

B. Code of Federal Regulations.

C. International Electrical Testing Association, NETA.

D. National Electrical Manufactures Association.

E. NFPA 70, National Electrical Code.

F. Underwriters Laboratories Inc.

1.3 SUMMARY

A. Section Includes:
   1. Wiring connecting devices.
   2. Terminations.
   3. Splices.

B. Related Sections:
   1. Contract Documents are a single integrated document, and as such all divisions and sections apply. It is the responsibility of the CONTRACTOR and its Sub-contractors to review all sections to ensure a complete and coordinated project.

1.4 DEFINITIONS

A. Definitions of terms are specified in Section 26 00 00.

1.5 SYSTEM DESCRIPTION

A. Provide a complete system of wiring connectors, terminators, fittings, etc. for a complete wiring system suitable for the cables and conductors used.

1.6 SUBMITTALS

A. Furnish complete submittals in accordance with Sections 01 33 20 and 26 05 00.

B. Product Data:
   1. Catalog cut sheets.

C. Shop drawings:
   1. Drawings showing the installation of junction modules, splices and terminators.

D. Instruction and Operating Manuals:
   1. Include drawings and data for medium voltage cable connectors, splices and junction modules in the operating manuals.

1.7 QUALITY ASSURANCE

A. As specified in Section 26 05 00.

B. All materials shall be UL listed.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Control Connections:
   1. Use insulated ring type wire terminators for connections to all screw terminals:
      a. With chamfered/funneled terminal barrel entry.
      b. Deep internal serrations.
      c. Long barrel design to reduce electrical resistance and increased insulator- barrel surface area to ensure that the insulator remains in contact with the barrel.
      d. Electroplated-tin copper conductor.
      e. Manufactured by the following or equal:
         1) Thomas and Betts, Stakon.
   2. For process equipment connections work from manufacturer's drawings.

B. Joints, Splices, Taps, and Connections:
   1. For 600-volt conductors use solderless connectors.
   2. Use only plated copper alloy connectors or lugs:
      a. Aluminum connectors or lugs are not acceptable for copper conductors.
   3. For wire Number 10 AWG and smaller use compression splice caps, with insulating caps.
      a. Manufactured by the following or equal:
         1) Buchanan 2006S or 2011S with 2007 or 2014 insulating caps.
   4. For wire Number 8 AWG and larger, use heavy duty copper compression connectors:
      a. Manufactured by one of the following or equal:
         1) Burndy.
         2) Thomas and Betts.
   5. Where waterproof splices are required:
      a. Suitable for indoor, outdoor, weather exposed, direct buried or submersed applications.
      b. Utilizing an epoxy, polyurethane, and re-enterable compounds.

c. For use with shielded or unshielded plastic- and rubber-jacketed, signal, control, and power cables rated up to 1 kV.
d. Two-part mold body with tongue and groove seams and built in spacer webbing.
e. Manufactured by the following or equal:
1) 3M – Scotchcast 72-N

C. Insulating Tape:
1. General purpose insulating tape:
a. Minimum 7 mil vinyl tape.
b. Suitable for application in an ambient of -18°C
c. (0°F).
d. Operating range up to 105°C (220°F).
e. Flame retardant, hot- and cold- weather resistant, UV resistant.
f. For use as a primary insulation for wire cable splices up to 600 VAC.
g. Meeting and complying with:
1) ASTM D-3005 Type I
2) UL 510
3) CSA C22.2
h. Manufactured by the following or equal:
1) 3M – Scotch Number Super 33+.
2. General-purpose color-coding tape:
a. Minimum 7 mil vinyl tape.
b. Suitable for application on PVC and polyethylene jacketed cables.
c. For use indoors and outdoors in weather protected enclosures.
d. Available with the following colors;
1) Red.
2) Yellow.
3) Blue.
4) Brown.
5) Gray.
6) White.
7) Green.
8) Orange.
9) Violet.
e. For use as phase identification, marking, insulating, and harnessing.
f. Meeting and complying with:
1) UL 510.
2) CSA C22.2
g. Manufactured by the following or equal:
1) 3M – Scotch Number 35.
3. Fire and Electric Arc Proofing tape:
a. Minimum 30-mil, flexible, elastomer tape that expands in fire to form an insulating firewall between flame and cable.
b. Bind in place with glass cloth electrical tape.
c. Manufactured by the following or equal:
1) 3M – Scotch Number 77.
4. Glass cloth electrical tape:

a. 7.4-mil thermosetting silicone adhesive that performs at Class H temperatures 180°C (356°F).
b. Use for the following applications:
1) To secure no-PSA insulations such as glass in high-temperature areas.
2) Splice wire rated at 180°C (356°F).
3) For binding Fire and Electric Arc Proofing Tape.
c. Meeting and complying with:
1) MIL-I-1966C.
2) UL Recognized Component listing for 200°C (392°F) (Guide OANZ2, File E17385).
3) CSA Accepted Component 180°C (356°F) File LR93411.
d. Manufactured by the following or equal.
1) 3M – Scotch Number 69.

5. Self-fusing Silicone Rubber Tape:
a. 12-mil, high-temperature, track resistant, insulating tape.
b. Composed of fully cured inorganic silicone rubber.
c. Use as a protective overwrap for terminating medium voltage cables.
d. Manufactured by the following or equal:
1) 3M – Scotch Number 70.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Load connections:
1. Connect loads to the circuits as indicated. Color-code all branch circuits as per Section 26 05 00.

B. Zero to 600-volt systems:
1. Make all connections with the proper tool and die as specified by the device manufacturer.
2. Use only tooling and dies manufactured by the device manufacturer.
3. Insulate all connections and splices with Scotch 33+ tape and Scotchfill, or pre-molded plastic covers, or heat shrink tubing and caps.
4. Number all power and control wires before termination.

C. Motor connections (600 Volts and below):
1. Terminate wires with compression type ring lugs at motors.
2. Connection at both the motor leads and the machine wires are to have ring type compression lugs.
3. Cover bolted connectors with a heat shrinkable, cross-linked polyolefin material formed as a single opening boot:
a. In damp and wet locations use a complete kit containing mastic that shall seal out moisture and contamination.
b. Shrink cap with low heat as recommended by manufacturer.
4. Wire markers shall be readable after boot installation.
5. Manufactured by one of the following or equal:
a. Raychem MCK.

END OF SECTION

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SECTION 26 28 16
LOW-VOLTAGE CIRCUIT BREAKERS

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. Section Includes:
   1. Requirements for Circuit Breakers.

B. Related Sections:
   1. Division 26 Section "Electrical General Provisions".
   2. Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the Contractor and its Sub-Contractors to review all sections to insure a complete and coordinated project.

1.3 DEFINITIONS

A. Definitions of terms and other electrical considerations as set forth in the:
   1. NEC: National Electrical Code.
   2. IEEE: Institute of Electrical and Electronic Engineers.
   3. NFPA: National Fire Protection Association.

1.4 SYSTEM DESCRIPTION

A. Furnish molded case, insulated case, power type, or motor circuit protector circuit breakers as indicated on the drawings and connect to form a completed system.

B. Circuit breakers must be of the current and voltage ratings indicated and be capable of interrupting the available fault current.

C. Where circuit breakers are used as disconnects for miscellaneous over-current protection, provide automatic type enclosed units with the indicated ratings and complying with applicable requirements (including manufacturer) for circuit breakers as specified.

1.5 SUBMITTALS

A. Furnish complete submittals in accordance with Sections 01 33 20 and 26 05 00.

B. Product Data:
   1. Catalog Cut Sheets
   2. Complete data sheets indicating:
      a. Manufacturer.
      b. Voltage rating.

c. Current rating.
d. Amperage rating.
e. Complete dimensional and weight information.

C. Operating Manuals
1. Furnish complete operating and maintenance instructions presenting full details for care and maintenance of equipment of every nature furnished and/or installed under this section.
a. Complete electrical ratings.
b. Complete renewal parts list.

1.6 WARRANTY

A. All circuit breakers shall be 100% warranted for a period of not less than two years from the date of final acceptance by the ENGINEER.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
1. Eaton.
2. Square D.
3. GE.
4. Siemens.
5. ABB.
6. Cutler-Hammer.

2.2 EQUIPMENT

A. Breakers General
1. All breakers shall have temperature insensitive trips.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive safety switches for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Arrange all breakers to correspond exactly with the schedules.

B. In damp or wet areas, mount the enclosures on Unistrut type mounting channels that run vertically so that water and moisture may flow freely behind enclosure.

END OF SECTION

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SECTION 26 50 00
LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   1. The general requirements for luminaries and light poles.

B. Related Sections
   1. Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the Contractor and its Sub-Contractors to review all sections to insure a complete and coordinated project.

1.2 DEFINITIONS

A. Definitions of terms and other electrical considerations as set forth in the:
   1. National Electrical Code.
   2. Institute of Electrical and Electronic Engineers.
   3. National Fire Protection Association.
   4. Illuminating Engineering Society.

1.3 SYSTEM DESCRIPTION

A. The Contractor shall furnish and install luminaries, and accessories for all lighting systems, complete and operable, all in accordance with the requirements of the Contract Documents.

B. Individual luminaire types etc. are identified in the plans and on the luminaire schedule.

1.4 SUBMITTALS

A. Furnish complete submittals in accordance with Section 26 05 00.

B. Product Data
   1. Catalog literature for each luminaire specified cross referenced to the luminaire type found on the Luminaire Schedule in the plans.
      a. Each such submittal shall clearly describe:
         1) Materials.
         2) Type of diffuser.
         3) Hardware.
         4) Gasketing.
         5) Reflector.
         6) Chassis.
         7) Finish.
   2. Complete literature for each luminaire substitutions.
      a. Submittals for luminaries shall be sufficient for competent comparison of the proposed luminaire to the originally specified luminaire.

1) Photometric data shall include coefficients of utilization, average brightness, candle power distribution curves, color, and lumen output chart.

b. Substitutions for specified luminaires shall be based upon quality of construction, light distribution, appearance, and maintenance.

3. Support method shall be submitted for interior fixtures weighing more than 50 pounds.

4. Fixture catalog data indicating input watts and power factor.

C. Calculations

1. Provide mounting details for indoor lights with calculations showing that the installation meets the seismic requirements of the site.

2. Calculations and design must be made by and stamped by a registered professional engineer registered in the state where the project is being constructed. In light of the fact that this design is being provided by a professional engineer the submittal will be reviewed for form and content but not reviewed for technical completeness, methods, or calculations.

D. Record Drawings

1. The luminaire schedule in the plans must be updated to reflect the acceptable substitutions, after the substitution has been reviewed and accepted by the Engineer.

1.5 QUALITY ASSURANCE

A. Without limiting the generality of other requirements of these specifications, all work hereunder shall conform to the applicable requirements of the referenced portions of the following documents, to the extent that the requirements therein are not in conflict with the provisions of this Section.

1. National Electric Code.
2. Underwriters Laboratories.
3. Illuminating Engineering Society (IES).

1.6 DELIVERY, STORAGE, AND HANDLING

A. Luminaries shall be stored in their original cartons from the manufacturers until the time of installation.

B. Luminaire poles shall be stored on blocks above grade until the time of installation.

1.7 WARRANTY

A. The Contractor shall warrant all fixtures for a minimum period of one (1) year from Substantial Completion unless otherwise specified by the General Conditions.

1. Furnish, and replace any defective equipment during that period at no charge to the Owner.

2. Said warranty shall be independent of any manufacturer infant mortality or normal failure statistics.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Pre-approved manufacturers are indicated on the Luminaire Schedule, and in notes on the drawings.
   1. This selection of manufacturer's is not intended to be overly restrictive and the Contractor may make substitutions from the manufacturers listed in the Luminaire Schedule in order to offer a more advantageous luminaire package.
   2. The lighting design and luminaire selection has been based upon the photometrics of the identified luminaries. It is the Contractor's responsibility to insure and prove to the Engineer at time of submittal that any substitutions meet the quality and photometric requirements of the original design.
   3. The Engineer shall make final determination if proposed substitutes are acceptable.
      a. The Contractor shall furnish the identified luminaries at no additional cost to the Owner for any luminaire substitutions that in the sole opinion of the Engineer, are not acceptable.

2.2 EQUIPMENT

A. Luminaries – General
   1. All luminaries shall be pre-wired with leads of 18-AWG, minimum, for connection to building circuits.
   2. In general the luminaries furnished shall be as per the Luminaire Schedule. The specifications apply to those luminaries not described or as an addition or supplement to the luminaire schedule.

B. Interior Luminaries
   1. Interior fluorescent luminaries without diffusers shall be furnished with end plates.
   2. Where diffusers are required, they shall be of high molecular strength acrylic.
      a. Minimum thickness of the acrylic shall be 0.125 inches for all diffusers, except that those on 4-foot square fixtures shall be 0.187 inches thick.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Special Techniques
   1. Luminaries shall be installed plumb and square with building and wall intersections.
      a. Pendant-mounted luminaries which are mounted from sloping ceilings shall be suspended by ball hangers, unless otherwise indicated on the Drawings.
      b. Luminaries installed in machinery rooms shall be located after machines have been installed.
   2. In all cases, luminaire locations shall be coordinated with work of other trades to prevent obstruction of light from the fixtures.
   3. Unless otherwise indicated, luminaries shall be centered on ceiling tiles.
   4. Luminaries weighing more than 25 pounds shall be supported independently of the outlet box.

3.2 CLEANING

A. Lenses, diffusers, and reflectors shall be cleaned just prior to the time specified for the system demonstrations.

B. Luminaire trim, support brackets, where finish has been damaged, shall be refinished.

3.3 DEMONSTRATION

A. Interior lighting system operation shall be observed to indicate that fixtures are properly focused and that switching functions as intended in accordance with the drawings.

B. Through demonstration, the Contractor shall also verify that panel schedules properly indicate the lighting outlets connected to each circuit.

3.4 SCHEDULES

A. Refer to the Luminaire Schedules as found in the plans.

END OF SECTION

DIVISION 31
EARTHWORK

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SECTION 31 10 00
SITE PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section includes all those measures required during the Contractor's initial move onto the site to protect existing fences, structures and associated improvements, streets, and utilities downslope of construction areas from damage due to boulders, trees or other objects dislodged during the construction process: clearing, grubbing and stripping; and regrading of areas to receive embankment fill.

B. The Contractor is required to protect and preserve all things designated to remain. Where Contractor's operation causes damage or injury to trees and plants designated to remain, an arborist or other qualified professional shall be employed by the Contractor, at no additional cost to the Owner, to repair the damage or provide adequate replacement to the Owner's satisfaction where damage is beyond repair.

C. Submit Tree Protection Plan in accordance with Herriman City requirements.

1.2 SITE INSPECTION

A. Prior to moving onto the Project site, the Contractor shall inspect the site conditions and review maps of the Owner's property and right-of-way lines.

B. Contractor shall submit photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site preparation.

C. The Contractor shall identify and accurately locate utilities and other subsurface structural, electrical, and mechanical conditions. Existing conditions shall be incorporated into the record drawings for the project.

1.3 DEFINITIONS

A. The following definitions apply to the Work of this Section:
   1. Clearing is defined as cutting trees, removing fences and posts, removing curbs and other improvements to prepare the site for grubbing and stripping.
   2. Grubbing is defined as the below grade part of clearing to remove roots, small piping, irrigation systems, etc., to prepare the site for stripping.
   3. Stripping is defined as removing a surface layer of soil and organic material, sod, topsoil, and other unsuitable material as defined in Section 31 23 00 – Earthwork, to a depth that earthwork can proceed.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Locate and clearly flag trees and vegetation to remain or to be relocated.

D. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TREE PROTECTION

A. Erect and maintain a temporary fence around drip line of individual trees or around perimeter drip line of groups of trees to remain. Remove fence when construction is complete.
   1. Do not store construction materials, debris, or excavated material within drip line of remaining trees.
   2. Do not permit vehicles, equipment, or foot traffic within drip line of remaining trees.

B. Do not excavate within drip line of trees, unless otherwise indicated.

C. Where excavation for new construction is required within drip line of trees, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
   1. Cover exposed roots with burlap and water regularly.
   2. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.
   3. Coat cut faces of roots more than 1-1/2 inches in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
   4. Cover exposed roots with wet burlap to prevent roots from drying out. Backfill with soil as soon as possible.

D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Engineer.
   1. Employ a qualified arborist, licensed in jurisdiction where project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
   2. Replace trees that cannot be repaired and restored to full-growth status, as determined by the qualified arborist.

3.3 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
   1. Owner will arrange to shut off indicated utilities when requested by Contractor.

2. Arrange to shut off indicated utilities with utility companies.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Engineer not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Engineer's written permission.

C. Excavate for and remove underground utilities indicated to be removed.

3.4 SITE ACCESS

A. Develop any necessary access to the site, including barrier facilities to be installed at the beginning of construction in order to prohibit entry of unauthorized persons.

B. Utility Interference: Where existing utilities interfere with the Work of this Section, notify the Engineer and work around the interferences until a directive is issued.

3.5 CLEARING, GRUBBING, AND STRIPPING

A. All construction areas shall be cleared of grass and weeds to at least a depth of six inches and cleared of structures, concrete or masonry debris, trees, logs, upturned stumps, loose boulders, and any other objectionable material of any kind which would interfere with the performance or completion of the Work, create a hazard to safety, or impair the Work's subsequent usefulness or obstruct its operation. Loose boulders within 10 feet of the top of cut lines shall be incorporated in landscaping or removed from the site. Trees and other natural vegetation outside the actual lines of construction shall be protected from damage during construction, as directed by the Engineer.

B. Within the limits of clearing, the areas below the natural ground surface shall be grubbed to a depth necessary to remove all stumps, roots, buried logs, and all other objectionable material. Debris or waste shall be totally removed if they are found on the site. All objectionable material from the clearing and grubbing process shall be removed from the site and wasted in approved safe locations in compliance with state and federal regulations.

C. The areas to be affected by construction that have not been pre-excavated to the subgrade elevation, topsoil shall be removed and placed in the designated stockpile areas, and/or incorporated into landscaped areas or other nonstructural embankments.

D. For all areas that have not been previously disturbed, including staging areas and temporary construction easements, topsoil-salvaging operation shall immediately follow clearing operations. The area shall be stripped of topsoil to a depth of 8 inches. Unsuitable materials, specified in Section 31 23 00, shall not be considered topsoil. The Contractor shall strip to the depth indicated regardless of the material encountered. All stripped topsoil shall be stockpiled within stripped areas in stockpiles not to exceed 15 feet in height. Vegetation shall be ground or chipped to a mulching consistency and mixed with the stripped soil. Stockpiles shall be placed away from high construction traffic areas and shall be fenced and signed to prevent accidental use as fill prior to topsoil replacement.

E. Upon completion of Work within the construction areas stripped of topsoil, the stored topsoil shall be respread over the disturbed areas. Topsoil shall be spread in about a 6-inch layer.

Respread topsoil shall match the existing terrain as much as possible. Interfaces between restored disturbed areas and undisturbed areas shall be chain dragged to eliminate obvious edges. All tracks and equipment marks shall be chain dragged or hand raked away. Replaced topsoil shall be thoroughly watered for dust control upon completion of the respreading operations. Once topsoil replacement has been completed, no vehicles or other motorized equipment shall be allowed to travel on the finished surface.

F. Unless otherwise indicated, native trees larger than three inches in diameter at the base shall not be removed without the Engineer's approval. The removal of any trees, shrubs, fences, or other improvements outside of rights-of-way, if not necessary for the Contractor's choice of means and methods, shall be arranged with the property owner and be removed and replaced at no increased cost to the Owner.

G. Except in areas to be excavated, holes and other holes resulting from Work of this section shall be backfilled with suitable material in accordance with Section 31 23 00 – Earthwork.

3.6 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
   1. Unless existing full-depth joints coincides with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

3.7 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 31 23 00
EARTHWORK

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall perform all earthwork indicated and required for construction of the Work, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

29 CFR 1926	OSHA Safety and Health Regulations for Construction
ASTM C 595	Standard Specification for Blended Hydraulic Cements
ASTM D 422	Method for Particle-Size Analysis of Soils
ASTM D 1556	Test Method for Density of Soil in Place by the Sand-Cone Method
ASTM D 1557	Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3) (2,700 kN-m/m^3)
ASTM D 1633	Test Method for Compressive Strength of Molded Soil-Cement Cylinders
ASTM D 2419	Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D 2487	Classification of Soils for Engineering Purposes
ASTM D 2901	Test Method for Cement Content of Freshly Mixed Soil Cement
ASTM D 2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods
ASTM D 4253	Test Methods for Maximum Index Density of Soils using a Vibratory Table
ASTM D4254	Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D 4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4832	Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders

ASTM D 5971	Practice for Sampling Freshly Mixed Controlled Low Strength Material (CLSM)
ASTM D 6023	Test Method for Unit Weight, Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low Strength Material (CLSM)
ASTM D 6024	Test Method for Ball Drop on Controlled Low Strength Material (CLSM) to Determine Suitability for Load Application
ASTM D 6103	Test Method for Flow Consistency of Controlled Low Strength Material (CLSM)

1.3 CONTRACTOR SUBMITTALS

A. The Contractor's attention is directed to the provisions of Subpart P, 29 CFR 1926 of the OSHA Safety and Health Standards for Construction, which relate to protection of employees in excavations. The Contractor shall submit, for information to the Engineer, the project excavation plan and the name of the Contractor's competent person, prior to commencing any excavation.

B. Submit samples of all materials proposed to be used in the work in accordance with the requirements in Section 01 33 20 – Submittal Procedures. Sample sizes shall be as determined by the testing laboratory.

C. Submit dewatering and water removal plan prior to performing any dewatering or water removal.

PART 2 - PRODUCTS

2.1 SUITABLE FILL AND BACKFILL MATERIAL REQUIREMENTS

A. General: Fill, backfill, and embankment materials shall be suitable material.

B. Suitable Materials: Suitable material is defined as selected or processed clean, well graded earth material, sands and gravels free of excessive fines. Suitable materials to have less than 20 percent rock and boulders larger than 4 inches, and be free of all grass, roots, brush, vegetation, or other deleterious materials.

C. Fill and backfill materials within 6 inches of any structure or pipe shall be smaller than 1 inch in any dimension.
   1. Suitable materials may be obtained from onsite excavations, may be processed onsite materials, or may be imported. If imported materials are required by this Section or to meet the quantity requirements of the Project, provide the imported materials at no additional expense to the Owner, unless a unit price item is included for imported materials in the bidding schedule. Onsite materials shall be stockpiled and segregated prior to use.
   2. The following types of suitable materials are defined:

Type A (Granular Backfill): Crushed rock or gravel, and sand well graded and readily compacted, non-plastic, meeting the following gradation requirements:

Sieve Size	Percentage Passing
1-inch	100
No. 40	15 - 60
No. 200	0 - 15

Type B (Crushed Rock): Manufactured angular, crushed rock, non-plastic, meeting the following gradation requirements:

Sieve Size	Percentage Passing
3/8-inch	100
No. 4	30 - 50
No. 200	0 - 5

Type C (Sand Backfill): Sand, non-plastic, meeting the following gradation requirements:

Sieve Size	Percentage Passing
3/4-inch	100
No. 4	80 - 100
No. 10	30-50
No. 40	10-30
No. 200	7 - 15

Pea Gravel or Squeegee is not acceptable as sand backfill.

Type D (Select Backfill): Suitable material that can be readily compacted and meets the requirements of AASHTO M 145 classification A-1-a, non-plastic, well graded with a maximum particle size of 2 inches.

Sieve Size	Percentage Passing
2-inch	100
No. 10	30-50
No. 40	15-30
No. 200	0 - 15

Type E (Pea Gravel Backfill): Crushed rock or gravel with 100 percent passing a 1/2-inch sieve and not more than 10 percent passing a No. 4 sieve.

Type F (Drainrock): Crushed rock or gravel conforming to one of the following gradation requirements, as shown on the Drawings or approved by the Engineer:

	Percentage Passing		
Sieve Size	3-inch Max.	2-inch Max.	3/4-inch Max.
3-inch	100	-	-
2-inch	90 – 100	100	-
1-1/2 inch	70 – 100	90 – 100	-
3/4 inch	0 - 50	0 – 15	100
1/2-inch	-	-	95 - 100
3/8-inch	0 - 10	0 - 5	70 - 100
No. 4	0 - 25	-	-
No. 8	0 - 5	-	-
No. 200	0 - 3	-	0 - 3

Type G (Type II Aggregate Base): Well-graded, clean, hard, tough, durable, and sound mineral aggregates consisting of crushed stone, or crushed gravel, free of organic matter and contamination from chemical or petroleum products meeting State specification requirements and conforming to the following Table and gradations:

Aggregate Properties			
	Aggregate Class		**Standard/Ref**
	A	**B**	
Dry Rodded Unit Weight	Not less than 75 lb/ft^3		AASHTO T 19
Liquid Limit/Plastic Index	Non-plastic	PI ≤ 6	AASHTO T 89 AASHTO 90
Aggregate Wear	Not to exceed 50 percent		AASHTO T 96
Gradation	Table 2		AASHTO T 11 AASHTO T 27
CBR with a 10 lb surcharge measured at 0.20 inch penetration	70% Minimum	N/A	AASHTO T 193
Two Fractured Faces	50% Min	N/A	AASHTO T 335

Sieve Size	Percentage Passing
1 ½ -inch	100
1-inch	90 - 100
3/4-inch	70 - 85
1/2-inch	65 - 80
3/8-inch	55 - 75
No. 4	40 - 60
No. 16	25 - 40
No. 200	7 - 11

Type H (Graded Drainrock): Graded drainrock shall be crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting and drying. The material shall be uniformly graded and shall meet the following gradation requirements:

Sieve Size	Percentage Passing
1-inch	100
3/4 inch	90 - 100
3/8-inch	40 - 100
No. 4	25 - 40
No. 8	18 - 33
No. 30	5 - 15
No. 50	0 - 7
No. 200	0 - 3

Type J (Cement-Treated Backfill): Material which consists of Type F material, or any mixture of Types B, C, G, and H materials which has been cement-treated so that the cement content of the material is not less than 5 percent by weight when tested in accordance with ASTM D 2901. The ultimate compressive strength at 28 days shall be not less than 400 psi when tested in accordance with ASTM D 1633.

Type K (Topsoil): Stockpile topsoil material which has been obtained at the site by removing soil to a depth as defined in Section 31 10 00 – Site Preparation. Removal of the topsoil shall be done after the area has been stripped of vegetation and debris.

Type M (Aggregate Subbase): Crushed rock aggregate subbase material non-plastic that can be compacted readily by watering and rolling to form a stable base. The sand equivalent value shall not be less than 18 and shall meet one of the following gradation requirements, as shown on the Drawings or approved by the Engineer:

	Percentage Passing	
Sieve Size	3-inch Max.	2-inch Max.
3-inch	100 -	
2-inch	90 - 100	100
1-1/2 inch	-	95 - 100
1-inch	70 - 90	-
No. 4	30 - 65	30 - 65
No. 16	15 - 40	15 - 40
No. 200	2 - 12	2 - 12

Type N (trench plug): Low permeable fill material, a nondispersable clay material having a minimum plasticity index of 10.

Type O (Controlled Low Strength Material (CLSM), Flowable Fill): CLSM shall consist of a mixture of portland cement, pozzolan, coarse and fine aggregate, water, and approved admixtures, meeting the following requirements:

1. Blended Hydraulic Cement: Comply with ASTM C 595, Type IL (10) (MS), grey color.
2. Pozzolan: Provide fly ash conforming to ASTM C618, Type C or Type F.
3. Water: Potable, clean and free from objectionable quantities of silt, organic matter, alkali, salt and other impurities..
4. Aggregate:
   a. Free from organic matter, clean imported sand and gravel, or selected material from the excavation, imported material, or a combination thereof as approved by the Engineer. Containing no more alkali, sulfates, or salts than the native materials at the site. The soluble sulfate content of aggregate in the mixture shall not exceed 0.3 percent by dry weight.
   b. Well-graded mixture of crushed rock, soil or sand, with a nominal maximum size of 3/8 inch and conforming to the following sieve limits:

Sieve Size	Percentage Passing
1/2-inch	100
3/8-inch	> 70
No. 200	<12[1]

[1] If more than 5 percent of the aggregate passes the No. 200 sieve, the plasticity index must be less than 0.73 (liquid limit – 20) when tested in accordance with ASTM D-4318.

5. Proportion the CLSM to be a flowable, nonsegregating, self-consolidating low shrink slurry. The Contractor shall determine the materials and proportions used to meet the requirements of these Specifications.
6. Admixtures:
   a. Air entraining admixture per ASTM C260
   b. Water reducing admixture per ASTM C494
7. The unconfined compressive strength at 7 days shall be a minimum of 80 psi and a maximum of 200 psi. Contractor shall form a minimum of six test cylinders with proposed materials to confirm design strength and mix design. Four of the cylinders shall be broken at 7 days in conformance with applicable concrete cylinder

specifications and results provided to Engineer. The remaining two cylinders shall be broken by Contractor at discretion of Engineer. Initial mix design and cylinder breaks shall be completed at least 28 days prior to use of the material on the jobsite. Final mix approval and use of the material shall not occur prior to confirmation of strength by the cylinder breaks.

8. The temperature of the CLSM discharged into the trench shall be below 90 degrees F but above 50 degrees F. Air temperature is to be 40 degrees F and rising. Do not place against frozen subgrade or other materials having temperature less than 32 degrees F. Protect flowable fill from temperatures below 40 degrees F for 72 hours.
9. Finish flowable fill smooth and to the grade indicated, finish free from fins, bulges, ridges, offsets and honeycombing. Wood float, steel trowel or similar is not required.
10. CLSM backfill under concrete structures shall be protected during curing as specified Section 03 30 00 - Cast-in-Place Concrete.
11. CLSM shall be tested in accordance with ASTM D 4832, ASTM D 5971, ASTM D 6023, and ASTM D6103

Type P: (Suitable Trench Backfill): Suitable material that can be readily compacted, with less than 35 percent passing the No. 200 sieve and a plasticity index of 10 or less.

2.2 UNSUITABLE MATERIAL

A. Unsuitable materials include but are not limited to the materials listed below.
   1. Soils which, when classified under ASTM D 2487 - Classification of Soils for Engineering Purposes, fall in the classifications of Pt, OH, CH, MH, or OL.
   2. Soils which cannot be compacted sufficiently to achieve the density indicated for the intended use.
   3. Materials that contain hazardous or designated waste materials including petroleum hydrocarbons, pesticides, heavy metals, slag, and any material which may be classified as hazardous or toxic according to applicable regulations.
   4. Soils that contain greater concentrations of chloride or sulfate ions or have a soil resistivity or pH less than the existing onsite soils.
   5. Topsoil, except as allowed below.

B. All unsuitable excavated material shall be disposed off site.

2.3 USE OF FILL, BACKFILL, AND EMBANKMENT MATERIAL TYPES

A. Use the types of materials as designated herein for all required fill, backfill, and embankment construction hereunder.

B. Where these Specifications conflict with the requirements of any local agency having jurisdiction or with the requirements of a pipe material manufacturer, notify the Engineer immediately. In case of conflict between types of pipe embedment backfills, use the agency-specified backfill material if that material provides a greater degree of support to the pipe, as determined by the Engineer. In case of conflict between types of trench or final backfill types, use the agency-specified backfill material if that material provides the greater in-place density after compaction.

C. Fill and backfill types shall be used in accordance with the following provisions:
   1. Embankment fills shall be constructed of Type P material, as defined herein, or any mixture of Type P and Type A through Type F materials.

2. Pipe zone backfill, as defined under "Pipe and Utility Trench Backfill" below, shall consist of the following materials for each pipe material listed below.
    a. Mortar coated pipe, concrete pipe, and uncoated ductile iron pipe shall be provided with Type A or C material in the pipe zone.
    b. Coal tar enamel coated pipe, polyethylene encased pipe, tape wrapped pipe, and other non-mortar coated pipe shall be backfilled with Type C material in the pipe zone.
    c. Plastic pipe and vitrified clay pipe shall be backfilled with Type C material in the pipe zone.
    d. Where pipelines are installed on grades exceeding 4 percent, and where backfill materials are graded such that there is less than 10 percent passing a No. 4 sieve, trench plugs of Type J or N material shall be provided at maximum intervals of 200 feet unless indicated otherwise.
    e. Type O material shall be used in the pipe zone where shown on plans, specified, or required by the Engineer for special crossings or other locations, or where otherwise approved.
    f. Type E material will not be allowed for backfill within the pipe zone.
3. Trench zone backfill for pipelines as defined under "Pipe and Utility Trench Backfill" shall be Type D backfill material.
4. Final backfill material for pipelines under paved areas, as defined under "Pipe and Utility Trench Backfill" shall be Type G backfill material. Final backfill under areas not paved shall be the same material as that used for trench backfill.
5. Trench backfill and final backfill for pipelines under structures shall be Type A or B, except where concrete encasement is required by the Contract Documents.
6. Aggregate base materials under pavements shall be Type G material constructed to the thicknesses indicated. Aggregate subbase shall be Type M material.
7. Backfill around structures shall be Type P material, or Types A through Type F materials, or any mixture thereof, except as shown.
8. Backfill materials beneath structures shall be as follows:
    a. Drainrock materials under hydraulic structures or other water retaining structures with underdrain systems shall be Type H material.
    b. Under concrete hydraulic structures or other water retaining structures without underdrain systems, Types F, G or H materials shall be used.
    c. Under structures where groundwater must be removed to allow placement of concrete, Type F material shall be used. Before the Type F material is placed, filter type geotextile fabric shall be placed over the exposed foundation.
    d. Under all other structures, Type F, G or H material shall be used.
9. Backfill used to replace pipeline trench overexcavation shall be a layer of Type F material encased in non-woven geotextile fabric to prevent migration of fines for wet trench conditions or the same material as used for the pipe zone backfill if the trench conditions are not wet.

2.4 PIPELINE MARKING TAPE

A. Metallic Tape: Tape shall be minimum 5.5 mils thick aluminum foil imprinted on one side, encased in high visibility inert polyethylene jacket. Tape shall be a minimum of 6 inches wide. Imprinted lettering shall be 1 inch tall, permanent black, as indicated. Joining clips shall be manufacturer's standard tin or nickel coated. Tape shall be as manufactured by Reef Industries (Terra "D"), Allen (Detectatape), or equal.

B. Plastic Tape: Tape shall be minimum 4-mil thick polyethylene which is impervious to alkalais acids, and chemicals and solvents which are likely in the soil. Tape shall be a minimum of 6 inches wide and lettering shall be 1-inch tall permanent black on a colored background. Tape shall be manufactured by Reef Industries (Terra Tape), Allen (Markline), or equal.

C. Warning Tape: Warning tape manufactured for marking and identifying underground utilities continuously inscribed with a description of utility, colored as follows:
1. Red; Electric.
2. Yellow; Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water Systems.
5. Green: Sewer Systems.

2.5 MATERIALS TESTING

A. Schedule A: All soils testing of samples submitted by the Contractor will be done by a testing laboratory of the Owner's choice and at the Owner's expense. At its discretion, the Engineer may request that the Contractor supply samples for testing of any material used in the work.

B. Schedule B: Contractor shall employ and pay for the services of a qualified independent testing consultant, approved by the City, to perform quality assurance for the testing: soil compaction control/material aggregate control. Contractor will be responsible for all construction quality control, testing including soils, backfill concrete, waterline, etc.

C. Particle size analysis of soils and aggregates will be performed using ASTM D 422 - Method for Particle-Size Analysis of Soils.

D. Determination of sand equivalent value will be performed using ASTM D 2419 - Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

E. Unified Soil Classification System: References in this Section to soil classification types and standards shall have the meanings and definitions indicated in ASTM D 2487. The Contractor shall be bound by all applicable provisions of said ASTM D 2487 in the interpretation of soil classifications.

F. The testing for chloride, sulfate, resistivity, and pH will be done by a testing laboratory of the Owner's choice and at the Owner's expense.

PART 3 - EXECUTION

3.1 EXCAVATION – GENERAL

A. General: Except when specifically provided to the contrary, excavation shall include the removal of all materials of whatever nature encountered, including rock and all obstructions of any nature that would interfere with the proper execution and completion of the Work. The removal of said materials shall conform to the lines and grades indicated or ordered. Unless otherwise indicated, the entire construction site shall be stripped of all vegetation and debris, and such material shall be removed from the site prior to performing any excavation or placing any fill. Furnish, place, and maintain all supports and shoring that may be required for the sides of the excavations. Excavations shall be sloped or otherwise supported in a safe

manner in accordance with safety requirements of the requirements of OSHA Safety and Health Standards for Construction (29CFR1926).

B. Maximum Length of Open Trench: The maximum length of open trench in roadways shall not exceed 200-feet day or night. The maximum length of open trenches in urban and rural areas shall not exceed 500-feet at each pipe installation heading beyond the end of the installed pipeline, or the requirements of the agency with jurisdiction, whichever is lesser.

C. Construction Delays: In the case of any construction delay in excess of five calendar days, whether Contractor or Owner caused, the Contractor shall backfill the excavation, install temporary paving including temporary traffic markings, and restore traffic to pre-construction condition to minimize disruption to traffic and the community at no additional cost to the Owner.

D. Removal and Exclusion of Water: Remove and exclude water, including storm water, groundwater, irrigation water, and wastewater, from all excavations. Dewatering wells, well points, sump pumps, or other means shall be used to remove water and continuously maintain groundwater at a level at least 2 feet below the bottom of excavations before the excavation work begins at each location. Water shall be removed and excluded until backfilling is complete and all field soils testing has been completed. Dewatering to include filtering to prevent migration of the soil materials and fines from the subgrade.

3.2 STRUCTURE, ROADWAY, AND EMBANKMENT EXCAVATION

A. Excavation Beneath Structures and Embankments: Except where otherwise indicated for a particular structure or ordered by the Engineer, excavation shall be carried to the grade of the bottom of the footing or slab. Where indicated or ordered, areas beneath structures or fills shall be overexcavated. The subgrade areas beneath embankments shall be excavated to remove not less than the top 6 inches of native material and where such subgrade is sloped, the native material shall be benched. When such overexcavation is indicated, both overexcavation and subsequent backfill to the required grade shall be performed. When such overexcavation is not indicated but is ordered by the Engineer, such overexcavation and any resulting backfill will be paid for under a separate unit price bid item if such bid item has been established; otherwise payment will be made in accordance with a negotiated price. After the required excavation or overexcavation has been completed, the exposed surface shall be excavated with a smooth-edged bucket to minimize disturbance, and rolled with heavy compaction equipment to obtain 95 percent of maximum density.

B. Excavation Beneath Paved Areas: Excavation under areas to be paved shall extend to the bottom of the aggregate base or subbase, if such base is called for; otherwise it shall extend to the bottom of the paving thickness. After the required excavation has been completed, the top 12 inches of exposed surface shall be scarified, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 95 percent of maximum density. The finished subgrade shall be even, self-draining, and in conformance with the slope of the finished pavement. Areas that could accumulate standing water shall be regraded to provide a self-draining subgrade.

C. Notification of Engineer: Notify the Engineer at least 3 days in advance of completion of any structure excavation and allow the Engineer a review period of at least 1 day before the exposed foundation is compacted or is covered with backfill or with any construction materials.

3.3 PIPELINE AND UTILITY TRENCH EXCAVATION

A. General: Unless otherwise indicated or ordered, excavation for pipelines and utilities shall be open-cut trenches with widths as indicated.

B. Trench Bottom: Except when pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe zone. Excavations for pipe bells and welding shall be made as required.

C. Open Trench: The maximum amount of open trench permitted in any one location shall be 500 feet or 200 feet in roadways. or the length necessary to accommodate the amount of pipe installed in a single day, whichever is greater. All trenches shall be fully backfilled at the end of each day or, in lieu thereof, shall be protected in accordance with Section 01 71 50 – Protection and Restoration of Existing Facilities. The Contractor shall provide temporary 6-foot chain link fencing panels for protection of all open excavations and trenches within public streets, residential areas, and all other locations with the exception of unimproved open areas where excavations and/or pipeline trenches that can be safely sloped in accordance with current OSHA standards to provide safe access without the use of shoring devices. Temporary fencing panels shall fully enclose open excavations and trenches and shall remain in place during all non-working hours.

D. Trench Overexcavation: Where trenches are indicated to be overexcavated, excavation shall be to the depth indicated and backfill shall be installed to the grade of the bottom of the pipe bedding.

E. Overexcavation: When ordered by the Engineer, whether indicated on the Drawings or not, trenches shall be overexcavated beyond the depth and/or width shown. Such overexcavation shall be to the dimensions ordered. The trench shall then be backfilled to the grade of the bottom of the pipe bedding. Overexcavation less than 6 inches below the limits on the Drawings shall be done at no increase in cost to the Owner. When the overexcavation ordered by the Engineer is 6 inches or greater below the limits shown, or wider, additional payment will be made. Said additional payment will be made under separate unit price bid items for overexcavation if such bid items have been established; otherwise payment will be made in accordance with a negotiated price.

F. Where pipelines are to be installed in embankments, fills, or structure backfills, the fill shall be constructed to a level at least one foot above the top of the pipe before the trench is excavated.

G. If a moveable trench shield is used during excavation operations, the trench width shall be wider than the shield so that the shield is free to be lifted and then moved horizontally without binding against the trench sidewalls. If the trench walls cave in or slough, the trench shall be excavated as an open excavation with sloped sidewalls or with trench shoring, as indicated and as required by the pipe structural design.

3.4 OVEREXCAVATION NOT ORDERED OR INDICATED

A. Any overexcavation carried below the grade ordered or indicated, shall be backfilled to the required grade with the indicated material and compaction. Such work shall be performed at no additional cost to the Owner.

3.5 EXCAVATION IN LAWN AREAS

A. Where excavation occurs in lawn areas, the sod shall be carefully removed, dampened, and stockpiled to preserve it for replacement. Excavated material may be placed on the lawn; provided, that a drop cloth or other suitable method is employed to protect the lawn from damage. The lawn shall not remain covered for more than 72 hours. Immediately after completion of backfilling and testing of the pipeline, the sod shall be replaced and lightly rolled in a manner so as to restore the lawn as near as possible to its original condition. Provide new sod if stockpiled sod has not been replaced within 72 hours.

3.6 EXCAVATION IN VICINITY OF TREES

A. Except where trees are indicated to be removed, trees shall be protected from injury during construction operations. No tree roots over 2 inches in diameter shall be cut without express permission of the Engineer. Trees shall be supported during excavation by any means previously reviewed by the Engineer.

3.7 BACKFILL – GENERAL

A. Backfill shall not be dropped directly upon any structure or pipe. Backfill shall not be placed around or upon any structure until the concrete has attained sufficient strength to withstand the loads imposed. Backfill around water retaining structures shall not be placed until the structures have been tested, and the structures shall be full of water while backfill is being placed. Structures shall not be constructed on CLSM backfill until the CLSM has obtained a 7-day minimum cure.

B. Except for drainrock materials being placed in overexcavated areas or trenches, backfill shall be placed after all water is removed from the excavation, and the trench sidewalls and bottom have been dried to a moisture content suitable for compaction.

C. If a moveable trench shield is used during excavation, pipe installation, and backfill operations, the shield shall be moved by lifting the shield free of the trench bottom or backfill and then moving the shield horizontally. Do not drag trench shields along the trench causing damage or displacement to the trench sidewalls, the pipe, or the bedding and backfill.

D. Immediately prior to placement of backfill materials, the bottoms and sidewalls of trenches and structure excavations shall have all loose sloughing, or caving soil and rock materials removed. All materials disturbed from their intact condition that are 4 inches or larger in least dimension or aggregates of soil material thicker than 4 inches shall be removed from the excavation walls and base prior to placing pipe or any backfill material. Trench sidewalls shall consist of excavated surfaces that are in a relatively undisturbed condition before placement of backfill materials.

3.8 PLACING AND SPREADING OF BACKFILL MATERIALS

A. Backfill materials shall be placed and spread evenly in layers. When compaction is achieved using mechanical equipment, the layers shall be evenly spread so that the depth of each uncompacted layer shall not exceed 8 inches of compacted thickness.

B. During spreading, each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer. Pipe zone backfill materials shall be manually spread around the

pipe so that when compacted the pipe zone backfill will provide uniform bearing and side support.

C. Where the backfill material moisture content is below the optimum moisture content, water shall be added before or during spreading until the proper moisture content is achieved.

D. Where the backfill material moisture content is too high to permit the indicated degree of compaction the material shall be dried or mixed with drier material until the moisture content is satisfactory.

3.9 COMPACTION OF EARTH FILL, BACKFILL, AND EMBANKMENT MATERIALS

A. Each layer of Types A, B, C, G, H, and K backfill materials as defined herein, where the material is graded such that at least 10 percent passes a No. 4 sieve, shall be mechanically compacted to the indicated percentage of density. Equipment that is consistently capable of achieving the required degree of compaction shall be used and each layer shall be compacted over its entire area while the material is at the required moisture content.

B. Each layer of Type E and J backfill materials shall be compacted by means of at least 2 passes from a flat plate vibratory compactor. When such materials are used for pipe zone backfill, vibratory compaction shall be used at the top of the pipe zone or at vertical intervals of 24 inches, whichever is the least distance from the subgrade.

C. Fill on reservoir and structure roofs shall be deposited at least 30 days after the concrete roof slab has been placed. Equipment weighing more than 10,000 pounds when loaded shall not be used on a roof. A roller weighing not more than 8,000 pounds shall be used to compact fill on a roof.

D. Pipe zone backfill materials that are granular shall be compacted by using vibratory compactors.

E. Equipment weighing more than 10,000 pounds shall not be used closer to structure walls than a horizontal distance equal to the depth of the fill at that time. Hand operated power compaction equipment shall be used where use of heavier equipment is impractical or restricted due to weight limitations. Reduce the lift thickness as necessary to achieve the required compaction.

F. Backfill around and over pipelines that is mechanically compacted shall be compacted using light, hand operated, vibratory compactors and rollers. Reduce the lift thickness as necessary to achieve the required compaction. After completion of at least 2 feet of compacted backfill over the top of pipeline, compaction equipment weighing no more than 8,000 pounds may be used to complete the trench backfill.

G. Compaction Requirements: The following compaction test requirements shall be in accordance with ASTM D 1557, method C. Compaction shall be obtained with the moisture content within plus or minus 2 percent of the optimum moisture content. Where agency or utility company requirements govern, the highest compaction standards shall apply.

Location or Use of Fill	Percentage of Maximum Density
Pipe embedment backfill for flexible pipe	90
Pipe bedding and overexcavated zones under bedding for flexible pipe, including trench plugs	90
Pipe embedment backfill for steel yard piping	---
Pipe embedment backfill for rigid pipe	90
Pipe zone backfill portion above embedment for rigid pipe	90
Pipe bedding and overexcavated zones under bedding for rigid pipe	90
Final backfill, beneath paved areas or structures	95
Final backfill, not beneath paved areas or structures	90
Trench zone backfill, beneath paved areas and structures, including trench plugs	95
Trench zone backfill, not beneath paved areas or structures, including trench plugs	90
Embankments and fills	90
Embankments and fills beneath paved areas or structures	95
Backfill beneath structures and hydraulic structures	95
Backfill and fill around structures on reservoir or structure roof	90
Topsoil (Type K material)	80 (uncompacted placement) 90 for earthwork under topsoil – topsoil not to be compacted
Aggregate base or subbase (Type G or M material)	95

3.10 PLACEMENT OF CLSM

A. Following placement and anchoring of the pipe, remove all loose soil from trench walls and floor. Remove any unstable soil at the top of the trench, which might fall into the trench during placement of the CLSM.

B. Prior to placement of CLSM, the pipeline steel temperature shall be controlled as specified in Section 33 11 11 – Steel Pipe.

C. Deliver the CLSM to the trench in ready mix trucks and utilize pump or chutes to place the CLSM in the trench. Direct CLSM to one side of the pipe, taking care not to displace the pipe at any time. Continue placing CLSM on one side of the pipe until CLSM has gone under the pipe and up the other side to a depth of 1.5 feet above the pipe bottom. Use at least two hand-held vibrators to continuously liquefy and move CLSM into all voids. Adjust water in mixture to maintain fluid consistency but maintain strength requirements. Continue placing CLSM on both sides of the pipe continuously using two vibrators for every 30 feet of pipe run.

D. Maintain stability of pipe throughout CLSM placement. CLSM will likely require placement in lifts to prevent pipe flotation. No movement of the pipe caused by flotation will be allowed. If any movement occurs, the CLSM material shall be removed and the pipe placed back on line and grade. Any damage to the pipeline system caused by movement of the pipe shall be removed and/or repaired in full conformance with these Contract Documents at no additional cost to the Owner. Remove all sloughed material or other debris from top of previously placed CLSM.

3.11 PIPE AND UTILITY TRENCH BACKFILL

A. Pipe Zone
   1. The pipe zone is defined as that portion of the vertical trench cross-section lying between a plane 6 inches below the bottom surface of the pipe and a plane at a point 12 inches above the top surface of the pipe. The bedding is defined as that portion of pipe zone backfill material between the bottom of the trench and the bottom of the pipe. The embedment is defined as that portion of the pipe zone material between the bedding and a plane at a point 6 inches above the top surface of the pipe.
   2. After compacting the bedding, perform a final trim using a string line for establishing grade, such that each pipe section when first laid will be continually in contact with the bedding along the extreme bottom of the pipe. Excavation for pipe bells and welding shall be made as required.
   3. The pipe zone shall be backfilled with the indicated backfill material. Exercise care to prevent damage to the pipeline coating, cathodic bonds, and the pipe itself during the installation and backfill operations.
   4. If a moveable trench shield is used during backfill operations the shield shall be lifted to a location above each layer of backfill material prior to compaction of the layer. Do not displace the pipe or backfill while the shield is being moved.

B. Trench Zone: After the pipe zone backfills have been placed, backfilling of the trench zone may proceed. The trench zone is defined as that portion of the vertical trench cross-section lying between a plane 12 inches above the top surface of the pipe and a plane at a point 18 inches below the finished surface grade, or if the trench is under pavement, 18 inches below the roadway subgrade.

C. Marking Tape Installation:
   1. Continuously install metallic marking tape along the pipe at a depth of 3 feet below finish grade.
   2. Continuously install plastic marking tape along the pipe at the elevation indicated on the Drawings.

D. Final Backfill: Final backfill is all backfill in the trench cross-sectional area within 18 inches of finished grade, or if the trench is under pavement, all backfill within 18 inches of the roadway subgrade.

3.12 FIELD TESTING

A. General: All field soils testing will be done by a testing laboratory of the Owner's choice at the Owner's expense except as indicated below.

B. Where soil material is required to be compacted to a percentage of maximum density, the maximum density at optimum moisture content will be determined in accordance with Method C of ASTM D 1557. Field density in-place tests will be performed in accordance with ASTM D 1556 or by such other means acceptable to the Engineer.

C. In case the test of the fill or backfill show noncompliance with the required density, perform remedies as may be required to ensure compliance. Subsequent testing to show compliance shall be by a testing laboratory selected by the Owner, paid by the Contractor, at no additional cost to the Owner.

D. Provide test trenches and excavations including excavation, trench support, and groundwater removal for the Owner's field soils testing operations. The trenches and excavations shall be provided at the locations and to the depths required by the Owner. All Work for test trenches and excavations shall be provided at no additional cost to the Owner.

E. Frequency of Testing
   1. Backfill around structures and in embankments shall be tested every 300 square ft of each lift of placement.
   2. CLSM shall be tested each batch being placed or every 300 cubic yards that is placed.
   3. Pipe backfill shall have one test every 80 feet (2 joints) of backfill placed, per lift at Engineer’s discretion.

END OF SECTION

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SECTION 31 32 19
GEOTEXTILES

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install geotextiles, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCES

A. ASTM International (ASTM) standards, most recent editions:

ASTM D 4355	Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon-Arc Type Apparatus.
ASTM D 4491	Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
ASTM D 4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
ASTM D 4595	Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
ASTM D 4751	Standard Test Method for Determining Apparent Opening Size of a Geotextile.
ASTM D 4833	Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
ASTM D 4884	Standard Test Method for Strength of Sewn or Thermally Bonded Seams of Sewn Geotextiles.
ASTM D 4886	Standard Test Method for Abrasion Resistance of Geotextiles (Sand Paper/Sliding Block Method).

1.3 DEFINITIONS.

A. Fabric: Geotextile, a permeable geosynthetic comprised solely of textiles.

B. Minimum Average Roll Value (MinARV): Minimum of series of average roll values representative of geotextile provided.

C. Maximum Average Roll Value (MaxARV): Maximum of series of average roll values representative of geotextile provided.

D. Nondestructive Sample: Sample representative of finished geotextile, prepared for testing without destruction of geotextile.

E. Overlap: Distance measured perpendicular from overlapping edge of one sheet to underlying edge of adjacent sheet.

F. Seam Efficiency: Ratio of tensile strength across seam to strength of intact geotextile, when tested according to ASTM D 4884.

G. Woven geotextile: A geotextile fabric composed of polymeric yarn interlaced to form a planar structure with uniform weave pattern.

H. Nonwoven geotextile: A geotextile fabric composed of a pervious sheet of polymeric fibers interlaced to form a planar structure with uniform random fiber pattern.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 20 – Submittal Procedures.

B. Product Data.
1. Manufacturer's material specifications and product literature.
2. Installation drawings showing geotextile sheet layout, location of seams, direction of overlap, and sewn seams.
3. Description of proposed method of geotextile deployment, sewing equipment, sewing methods, and provisions for holding geotextile temporarily in place until permanently secured.

C. Samples.
1. Geotextile: One-piece, minimum 18-inches long, taken across full width of roll of each type and weight of geotextile. Label each with brand name and furnish documentation of lot and roll number from which each sample was obtained.
2. Field Sewn Seam: 5-foot length of seam, 12-inches wide with seam along center, for each type and weight of geotextile.
3. Securing Pin and Washer: 1 each.

D. Certificates.
1. Certification from geotextile manufacturer that products satisfy the indicated requirements.
2. Field seam efficiency test results.

1.5 DELIVERY, STORAGE AND HANDLING

A. Comply with Section 01 25 10 - Products, Materials, Equipment and Substitutions.

B. Deliver each roll with sufficient information attached to identify manufacturer and product name or number.

C. Handle products in manner that maintains undamaged condition.

D. Do not store products directly on ground. Ship and store geotextile with suitable wrapping for protection against moisture and ultraviolet exposure. Store geotextile in a way that protects it from elements. If stored outdoors, elevate and protect geotextile with waterproof cover.

PART 2 - PRODUCTS

2.1 WOVEN GEOTEXTILE

A. Woven geotextile shall be composed of polymeric yarn interlaced to form a planar structure with uniform weave pattern. Products shall be calendared or finished so that yarns will retain their relative position with respect to each other.

B. Polymeric yarn shall be long-chain synthetic polymers (polyester or polypropylene) with stabilizers or inhibitors added to make filaments resistant to deterioration due to heat and ultraviolet light exposure.

C. Sheet Edges: Selvaged and finished to prevent outer material from separating from sheet.

D. Unseamed Sheet Width: Minimum 12 feet.

E. Nominal Weight per Square Yard: 6 ounces.

F. Physical Properties: Conform to physical property requirements below:

Property	Requirement	Test Method
Apparent Opening Size (AOS)	No. 10 to No. 100 U.S. Standard Sieve Size	ASTM D4751
Water Permittivity	0.02 to 3.34 $Sec.^{-1}$, MinARV	ASTM D4491 (Falling Head)
Vertical Water Flow Rate	10 to 150 gpm/sq ft, MinARV	
Wide Width Strip Tensile Strength	60 to 1,500 MinARV	ASTM D4595
Wide Width Strip Elongation	14 to 60 percent, MaxARV	ASTM D4595
Trapezoidal Tear Strength	30 to 200 lb, MinARV	ASTM D4533
Puncture Strength	50 to 250 lb, MinARV	ASTM D4833
Abrasion Resistance	5 to 25 percent loss, 250 cycles, MaxARV	ASTM D4886
Ultraviolet Radiation Resistance	70 to 90 percent strength retention, MinARV after 500 hours	ASTM D4355

2.2 NONWOVEN GEOTEXTILE

A. Nonwoven geotextile shall be composed of a pervious sheet of polymeric fibers interlaced to form a planar structure with uniform random fiber pattern. Products shall be calendared or finished so that yarns will retain their relative position with respect to each other.

B. Polymeric yarn shall be long-chain synthetic polymers (polyester, polypropylene, or polyethylene) with stabilizers or inhibitors added to make filaments resistant to deterioration due to heat and ultraviolet light exposure.

C. Geotextile Edges: Selvaged or finished to prevent outer material from separating from sheet.

D. Unseamed Sheet Width: Minimum 6 feet.

E. Nominal Weight Per Square Yard: 8 ounces.

F. Physical Properties: Conform to physical property requirements below:

Property	Requirement	Test Method
Apparent Opening Size (AOS)	Max No. 80 U.S. Standard Sieve Size	ASTM D4751
Water Permittivity	1.4 $sec.^{-1}$, MinARV	ASTM D4491 (Falling Head)
Vertical Water Flow Rate	95 gpm/sq ft, MinARV	
Grab Tensile Strength	205 MinARV	ASTM D4632
Grab Tensile Elongation	50 percent, MaxARV	ASTM D4632
Trapezoidal Tear Strength	80 lb, MinARV	ASTM D4533
CBR Puncture Strength	500 lb, MinARV	ASTM D6241
Ultraviolet Radiation Resistance	70 percent strength retention, MinARV after 500 hours	ASTM D4355

1. Minimum average roll value (weakest principal direction)

2.3 SEWING THREAD

A. Sewing thread shall be polypropylene, polyester, or Kevlar thread with durability equal to or greater than durability of geotextile sewn.

2.4 SECURING PINS

A. Securing pins shall be steel rods or bars conforming to the following:
1. 3/16-inch diameter.
2. Pointed at one end; head on other end, sufficiently large to retain washer.
3. Minimum Length: 12-inches.

B. Steel Washers for Securing Pins:
1. Outside Diameter: Not less than 1-1/2 inches.
2. Inside Diameter: 1/4-inch.
3. Thickness: 1/8-inch.

C. Steel Wire Staples:
1. U-shaped.
2. 10-gauge.
3. Minimum 6-inches long.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Laying Geotextile
1. Notify the Engineer whenever geotextiles are to be placed. Do not place geotextile prior to obtaining Engineer's approval of underlying materials.
2. Lay and maintain geotextile smooth and free of tension, folds, wrinkles, or creases.

B. Orientation on Slopes
1. Orient geotextile with long dimension of each sheet parallel to direction of slope.
2. Geotextile may be oriented with long dimension of sheet transverse to direction of slope only if sheet width, without unsewn seams, is sufficient to cover entire slope and anchor trench and extend at least 18-inches beyond toe of slope.

C. Joints.
1. Unseamed Joints.
   a. Overlap unseamed joints to the following dimensions unless otherwise indicated:
   b. Foundation/Subgrade Stabilization: Minimum 18-inches.
   c. Riprap: Minimum 18-inches.
   d. Drain Trenches: Minimum 18-inches, except overlap shall equal trench width if trench width is less than 18-inches.
   e. Other Applications: Minimum 12-inches.
2. Sewn Seams.
   a. Use sewn seams wherever stress transfer from one geotextile sheet to another is necessary. Sewn seams, as approved by Engineer, also may be used instead of overlap at joints for applications that do not require stress transfer.
   b. Seam efficiency shall be minimum 70 percent.
   c. Type: "J" type seams are preferred, but flat or butterfly seams are acceptable.
   d. Stitch Count: Minimum 3 to maximum 7 stitches per inch.
   e. Stitch Type: Double-thread chain stitch, Type 401, Federal Standard No. 751a.
   f. Stitch Location: 2-inches from geotextile sheet edges, or more if necessary to develop required seam strength.
   g. Sewing Machines: Capable of penetrating 4 layers of geotextile.

D. Securing Geotextile.
1. Secure geotextile during installation as necessary with sand bags or other means approved by Engineer.
2. Securing Pins
   a. Insert securing pins with washers through geotextile, midway between edges of overlaps and 6-inches from free edges.
   b. Spacing:

Slope	Maximum Pin Spacing (Feet)
Steeper than 3:1	2
3:1 to 4:1	3
Flatter than 4:1	5

c. Install additional pins across each geotextile sheet as necessary to prevent slippage of geotextile or to prevent wind from blowing geotextile out of position.

d. Push each securing pin through geotextile until washer bears against geotextile and secures it firmly to subgrade.

E. Placing Products over Geotextile.

1. Notify Engineer before placing material over geotextile. Do not cover installed geotextile prior to receiving authorization from the Engineer to proceed.
2. If tears, punctures, or other geotextile damage occurs during placement of overlying products, remove overlying products as necessary to expose damaged geotextile. Repair damage as indicated below.

F. Installing Geotextile in Trenches.

1. Place geotextile in a way that will completely envelope granular drain material to be placed in trench and with indicated overlap at joints. Overlap geotextile in direction of flow. Place geotextile in a way and with sufficient slack for geotextile to contact trench bottom and sides fully when trench is backfilled.
2. After granular drain material is placed to grade, fold geotextile over top of granular drain material, unless otherwise indicated. Maintain overlap until overlying fill or backfill is placed.

G. Riprap Applications.

1. Overlap geotextile at each joint with upstream sheet of geotextile overlapping downstream sheet. Sew joints where wave run-up may occur.

H. Geotextile-Reinforced Earth Wall Applications.

1. Sew exposed joints; extend sewn seams minimum 3-feet behind face of wall.
2. Protect exposed geotextile from damage and deterioration until permanent facing is applied.

I. Silt Fence Applications.

1. Install geotextile in one piece or continuously sewn to make one piece, for full length and height of fence, including portion of geotextile buried in toe trench.
2. Install bottom edge of sheet in toe trench and backfill in a way that securely anchors geotextile in trench.
3. Securely fasten geotextile to a wire mesh backing and each support post in a way that will not result in tearing of geotextile when fence is subjected to service loads.
4. Promptly repair or replace silt fence that becomes damaged.

3.2 REPAIRING GEOTEXTILE

A. Repair or replace torn, punctured, flawed, deteriorated, or otherwise damaged geotextile. Repair damaged geotextile by placing patch of undamaged geotextile over damaged area plus at least 18-inches in all directions beyond damaged area. Remove interfering material as necessary to expose damaged geotextile for repair. Sew patches or secure them with pins and washers, as indicated above for securing geotextile, or by other means approved by Engineer.

3.3 REPLACING CONTAMINATED GEOTEXTILE

A. Protect geotextile from contamination that would interfere, in Engineer's opinion, with its intended function. Remove and replace contaminated geotextile with clean geotextile.

3.4 FIELD QUALITY CONTROL

A. Testing: Test seam efficiency by preparing and testing minimum of one set of nondestructive samples per acre of each type and weight of geotextile provided for the Work. Test according to ASTM D4884 and submit written results to Engineer.

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DIVISION 32
EXTERIOR IMPROVEMENTS

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SECTION 32 90 00
LANDSCAPE PLANTING

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall provide landscaping and appurtenant work, complete and in place, in accordance with the Contract Documents.

B. Landscaping as referred to herein shall include supplying and placing topsoil, soil preparation, installation of headers, weed control, finish grading, furnishing and installing plant materials, seeding, erosion control, cleanup, and maintenance guarantee.

1.2 DEFINITIONS

A. The terms "plant material" or "plants" refer to all vegetation, including but not limited to seed and seeded areas, etc.

B. "Quality" refers to general development without consideration of size or condition. "Standard quality" indicates the least acceptable quality. "Standard quality" seeded and germinated plants shall be typical of the species and variety of good average uniform growth, shall be well formed.

C. "Condition" is the factor controlled by vitality and ability to survive and thrive and be comparable with normal plants of the same species and variety in the vicinity at the same season of the year. Plants shall be free from physical damage or adverse conditions that would prevent thriving. "Condition" also sometimes refers to state of growth, i.e., whether "dormant condition" or "growing condition" and this state shall be comparable to plants of similar species in the vicinity for leaves, formation of buds, and the like.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

ASTM D 422	Method for Particle-Size Analysis of Soils
ANSI Z60.1	Nursery Stock

American Association of Rules and Grading Provisions Nurserymen, Inc.

1.4 CONTRACTOR SUBMITTALS

A. General: Submittals shall be furnished in accordance with Section 01 33 20 - Contractor Submittals.

B. Product Information
1. Manufacturer's product information on slow release fertilizer, fertilizer tablets, seed, and erosion control materials.

2. **Topsoil Analysis Report:** A report certified by an analytical laboratory which shows results of analyzing representative samples of topsoil proposed for use. Approval of the report does not constitute final acceptance of the topsoil.
3. Supplier's information and testing information on compost for soil amendment.

C. Certificate
1. Certificates shall accompany each product delivery stating source, quantity, and type of material. All certificates shall be submitted to the Landscape Architect at the time of delivery.
2. Certificates of inspection of plant material, as may be required by Federal, State, or other authorities having jurisdiction, which accompany the shipment, shall be submitted to the Landscape Architect at the time of delivery.
3. Landscaping Subcontractor guarantee to perform seed maintenance and weeding services during the one-year correction of defects period.

1.5 QUALITY ASSURANCE

A. General: All plants shall be true to type or name as indicated in the Contract Documents and shall be tagged in accordance with the standard practice recommended by the Agricultural Code of the State of Utah however, determination of plant species or variety will be made by the Landscape Architect.

B. All plants shall comply with Federal and Utah State laws requiring inspection for plant diseases and infestations.

C. The Contractor shall obtain clearance from the County Agricultural Commissioner, as required by law, before planting plants delivered from outside the County in which they are to be planted. Evidence that such clearance has been obtained shall be filed with the Engineer or Landscape Architect.

D. Inspections will be made by the Engineer or Landscape Architect. The Contractor shall request inspection at least 24 hours in advance of the time inspection is required. Inspection is required on the following stages of the Work:
1. During preliminary grading, soil preparation, and initial weeding.
2. When approved, amended topsoil is placed.
3. When finish grading has been completed.
4. When seed is to be applied.
5. Once seed application has been complete and erosion control is in place.
6. When all Work except the maintenance period has been completed.
7. Final inspection before acceptance of the project.
8. At the one-year project warranty inspection.

1.6 CLEANUP

A. Upon completion of all planting operations, the portion of the Site used for a work or storage area by the Contractor shall be cleaned of all debris, superfluous materials, and equipment. All such materials and equipment shall be entirely removed from the Site in accordance with Section 01 70 10 – Project Closeout.

B. All walks or pavement shall be swept or washed clean upon completion of the Work of this Section.

C. During the entire Contract period, plant containers that have been cut or removed from plant materials shall be removed from the site daily.

D. All fertilizer packaging shall be cleared from the site at the end of every day.

1.7 MAINTENANCE OF LANDSCAPING PLANTING PRIOR TO ACCEPTANCE OF PROJECT

A. General: The Contractor shall be responsible for protecting and maintaining all seeded areas until final acceptance of all Work under the Contract.

B. Protection: The Contractor shall provide adequate protection to all newly seeded areas including the installation of approved temporary fences to prevent trespassing and damage, as well as erosion control, until the end of the correction of defects period.

C. The Contractor shall replace any materials or equipment that its employees or Subcontractors have damaged.

D. Partial utilization of the project shall not relieve the Contractor of any of the requirements contained in the Contract Documents.

E. Plants shall be maintained in a vigorous, thriving condition by watering, cultivating, weeding, pruning, fertilizing, spraying, and other operations necessary.

F. Maintenance shall include, in addition to the foregoing, cleaning, the repair of erosion, reseed bare areas, and all other necessary maintenance work. Sidewalks, retaining walls and paved areas shall be kept clean while seeding and maintenance are in progress.

1.8 FINAL INSPECTION AND GUARANTEE

A. Inspection of all planted areas will be part of final inspection under the Contract.

B. Written notice requesting inspection shall be submitted to the Landscape Architect at least 10 days prior to the anticipated inspection date.

C. Final acceptance prior to start of the guarantee period of the Contract will be on written approval by the Engineer or Landscape Architect, on the satisfactory completion of all Work, including maintenance, but exclusive of the replacement of plant material or reseed areas that have less than 60% coverage.

D. Any delay in the completion of any item of work in the planting operation which extends the seeding into more than one season shall extend the correction period in accordance with the date of completion given above.

E. The Contractor shall reseed, as soon as weather conditions permit, all bare areas or areas that show less than 60% seed germination which are noted at the end of the one-year correction period.

F. All Work under this Section shall be left in good order to the satisfaction of the Owner and the Landscape Architect, and the Contractor shall, without additional expense to the Owner.

1.9 MAINTENANCE AND GUARANTEE FOLLOWING ACCEPTANCE OF PROJECT

A. General: The Contractor shall be responsible for a period of one year after date of acceptance of the Work of this Section, for maintaining all seeded areas, including fertilizing, controlling insects and diseases and weeding. The Contractor shall obtain a written guarantee from the landscaping Subcontractor embodying the provisions of this paragraph.

B. The Work covered by the maintenance and guarantee portions of this paragraph includes providing all reseeding of seeding areas for the one year maintenance period or for 2 full growing seasons if the maintenance periods starts in the fall or winter, labor, materials, chemicals, equipment, and supplies and in performing all operations in connection with maintenance and guarantees.

C. The Contractor shall clean-up and remove unused or waste materials from the Site and leave the area in a neat condition satisfactory to the Owner whenever it performs work during the maintenance period.

D. Final Inspection: The Owner and Contractor shall make a final inspection at the end of the one-year maintenance and correction period. Any bare seed areas or less than 60% coverage at time of final inspection shall be reseeded within a time agreed upon by both parties. If it is outside of the seeding window for seeding, seeding shall take place within the next seeding window even though reseeding may run beyond the maintenance and correction period.

PART 2 - PRODUCTS

2.1 GENERAL

A. All landscaping materials including but not limited to, soil amendments, fertilizer, herbicides, pesticides, seed mixtures and erosion control materials shall be first-grade, commercial quality and shall have certificates indicating the source of material, analysis, quantity, or weight attached to each sack or container or furnished with each delivery. Delivery certificates shall be given to the Landscape Architect as each shipment of material is delivered. A list of the materials used, together with typical certificates of each material, shall be submitted to the Landscape Architect prior to final acceptance.

2.2 TOPSOIL

A. Imported topsoil shall be obtained from naturally drained areas and shall be fertile, friable loam suitable for plant growth. Topsoil shall be subject to inspection and approval by the Landscape Architect at the source of supply and upon delivery to the site. All laboratory soil testing shall be ordered and paid by the Contractor.

B. Eighteen inches of topsoil shall be placed around the mature canopy of all tree and shrub areas for all tree, shrub and ornamental grass species. This area shall have 4-inches of rock mulch (see plans for exact depths) and well as bark mulch and placed on top of weed barrier fabric (Dewitt Pro 5 weed barrier fabric).

C. Onsite or imported topsoil shall be of uniform quality, free from toxic substances, subsoil, stiff or lumpy clay, hard clods, hardpan, rocks, disintegrated debris, plants, roots, seeds, and any other materials that would be toxic or harmful to plant growth. **Topsoil shall contain no noxious weeds or noxious weed seeds.**

D. Topsoil used for this Work shall meet the following requirements.
1. Soluable salts (EJe) Less than 4 dS/m or mmho/cm
2. ph Between 5.0 and 7.5
3. Sand, silt, clay content Less than 30% clay
   a. Less than 70% sand and
   b. Less than 70% silt.
4. Soil texture Sand clay loam (SLC)
   a. sandy loam (SL)
   b. clay loam (CL)
5. Organic matter content (by weight) Minimum 0.5 Percent
6. SAR (sodium absorption ratio)Less than 7
7. Percent coarse fragments (rocks>2mm) Less than 5 percent
8. Nitrate Nitrogen (ppm) Greater than 20
9. Phosphorus (ppm) Greater than 15
10. Potassium (ppm) Greater than 150
11. Iron (ppm) Greater than 10

2.3 FERTILIZER AND AMENDMENTS

A. Fertilizer shall be furnished in bags or other standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon.

B. Chemical fertilizers shall be a mixed commercial fertilizer with percentages of nitrogen, phosphoric acid, and potash at 16-16-8 slow release formula. Fertilizers shall be uniform in composition, dry, and free flowing.

C. Fertilizer tablets shall be 12 grams each 20-10-5 "Agriform," "Lesslie", or equal.

D. Compost: Onsite topsoil shall be amended with one part compost to 5 parts topsoil. Compost shall consist of composed leaves and yard grass. Compost shall meet the following requirements:
1. Compost shall be dark brown to black in color,
2. Compost shall have no objectionable odor,
3. Compost shall have a particle size of ½ inch or less,
4. Compost shall have a pH of 5.0 to 7.8,
5. Compost shall have a soluble salt concentration (mmhos/cm or dS/m) of less than 5 and
6. Compost shall have a carbon-to-nitrogen ration of less than 25:1.

2.4 MULCH & COMPOST

A. Dark bark mulch shall be provided at a depth of 4-inches in areas around tree wells. Bark mulch shall be purchased through Wolf Mountain.

B. Shredded stringy bark mulch in planting beds shall be clean, pine bark free of sticks and pieces over 2 inches in size produced by "chipping and shredding" tree branches or similar means.

C. Organic Compost material as outlined in “Compost Quality Guidelines for Landscaping” by Isaman, Koening, Cerny, USU Extension, 3 March 2003.

2.5 PLANT MATERIALS

A. Plants shall meet requirements of the Contract Documents and shall be in accordance with the botanical names and applicable standards of quality, size, condition, and type. They shall be true to name, genera, species, and variety in accordance with reference publications.

B. Plant names are defined in "Standardized Plant Names" and "Bailey's Encyclopedia of Horticulture." When a name is not found in either reference, the accepted name used in the nursery trade shall apply.

C. Plants shall be marked for identification. Each bundle of plants and at least 25 percent of each species and variety of separate plants in any one shipment shall have legible labels securely attached before delivery to the site.

D. All trees and shrubs shall be measured while their branches are in their normal position. Height and spread dimensions specified refer to the main body of the plant and not from branch or root tip to tip. No trees will be accepted with their leaders cut, or so damaged that cutting is necessary.

E. All plants shall be symmetrical and shall conform to the size, age, and condition as specified on the plant list shown in the Contract Documents. Exceptions are as follows:
   1. Plants larger than specified in the plant list may be used if approved by the L.A., but use of such plants shall not increase the contract price. If the use of larger plants is approved, the spread of roots or ball earth shall be increased in proportion to the size of the plant. Bare root plants furnished in size greater than specified shall be balled and burlaped when required by the L.A.
   2. Where caliper or other dimensions of any plant materials are omitted from the Plant List, it shall be understood that such plant materials shall be normal stock for type.

F. Plants shall be of sound health, vigorous, and free from plant disease and shall be well-branched, shall have full foliage when in leaf, and shall have a healthy well-developed normal root system. Cold storage plants will not be accepted. Plants that are sensitive to shock from elevation change shall be grown at elevations close enough to site to alleviate any plant damage due to such change for at least 2 years.

G. Roots or balls of all plants shall be adequately protected at all times from sun and drying winds.

H. Plants (indicated to be in marked cans, pots, or other containers on the plant list) shall have been grown in the containers for a minimum of 6 months and a maximum of 2 years. Roots shall fill the containers but show no evidence of being or having been root bound.

I. Trees shall have straight trunks and all old abrasions and cuts shall be completely callused over. In no case shall trees be topped before delivery.

J. Plants shall have been transplanted or root-pruned at least once in the 2 years. Plants shall not be pruned prior to delivery except as authorized by the L.A.

2.6 STAKING MATERIALS

A. Stakes for supporting trees to be metal "T" fence posts.

B. Guying kits for trees will be "Cable Guy" (Alpine Nursery 1-800-356-6633) #CG-4000 and CG-6800-T. Add extra hose where guy cable comes in contact with tree.

C. Hose for covering wire shall be new or used black or green 2-ply fiber-bearing garden hose, not less than ½-inch inside diameter.

D. Wire for tree bracing and guying shall be double strand pliable No. 10-gage galvanized steel wire or vinyl-coated steel wire.

2.7 NATIVE SEED

A. Seed shall conform with applicable City, County, State, Federal regulations and meet Utah Seed Law. Seed shall be mixed by dealer. The Contractor shall furnish dealer's guaranteed germination figure for each variety. Grass seed shall not be delivered until samples have been approved in writing by the Engineer, Landscape Architect or its authorized landscape representative. Approval of samples, however, shall not affect the right of the Engineer, Landscape Architect or the authorized landscape representative to reject seed upon or after delivery. Seed that has become wet, moldy, or otherwise damaged prior to use will not be accepted.

B. Grass seed shall be fresh, clean, new-crop seed, composed of the following varieties mixed in the proportions by weight. Purity and germination percentage shall be the results of testing.

C. Weather Conditions: Fertilizing, seeding, or mulching operations will not be permitted when wind velocities exceed 5 miles per hour or when the ground is frozen, unduly wet, or otherwise not in tillable conditions. Seeding shall not be conducted when temperatures exceed 80°F.

D. Topsoil: Four inches of approved, onsite or imported, amended topsoil shall be placed in all areas delineated to be seeded. Imported, amended topsoil shall be placed and raked smooth prior to seeding or sodding

E. Soil Preparation: The ground to be seeded shall be graded in conformance with the Drawings and shall be loose and reasonably free of large rocks, roots, and other material which will interfere with the work.

F. Supply seed on a pure live seed (PLS) basis.

G. Obtain seed from lots that have been tested by a state certified seed testing laboratory. (Association of Seed Analyst (AOSA) or Society of Commercial Seed Technologists (SCST). Seed germination tests older than 18 months for grass seed, and 9 months for shrub or tree seed are not acceptable.

H. Do not use wet, moldy or otherwise damaged seed.

I. Seed mix for project below. Seed mix shall be applied at a rate of 26 PLS per acre.

SEED SCHEDULE FORUPLAND SEED MIX BC&A						
SEED NO.	SPECIES NAME		Number of Seeds per Pound (LBS)	SEED		
	BOTANICAL NAME	COMMON NAME		Pounds (LBS) of Pure Live Seed (PLS)/Acre	Percentage of Seed mixture	Number of Seeds (PLS/Sq. Foot)
	GRASSES					
1	*Achnatherum hymenoides*	Indian ricegrass	141,000	4.00	8.73%	13
2	*Elytrigia repens x Pseudoroegneria spicata* 'Newhy'	Newhy Hybrid wheatgrass	122,000	3.50	6.61%	10
3	*Elymus lanceolatus ssp. lanceolatus*	Thickspike wheatgrass	154,000	3.50	8.35%	12
4	*Elymus trachycaulus ssp. Trachycaulus* 'Pryor'	Pryor Slender wheatgrass	159,000	4.00	9.85%	15
5	*Festuca ovina 'Covar'*	Covar Sheep fescue	680,000	1.50	15.80%	23
6	*Poa secunda* ssp. *Sandbergii*	Sandberg bluegrass	1,047,000	1.00	16.21%	24
	FORBS/SHRUBS/COVER CROP					
7	*Artemisia fridiga*	Fringed sagebrush	4,536,000	0.25	17.56%	26
8	*Chrysothamnus viscidiflorus*	Douglas rabbitbrush	782,000	0.75	9.08%	13
9	*Linum lewisii*	Lewis flax	170,000	1.00	2.63%	4
10	*Oenothera pallida*	White Evening primrose	512,000	0.50	3.96%	6
11	*Triticum aestivum x Secale cereale*	Triticale	13,000	6.00	1.21%	2
			TOTALS =	**26.00**	**100.00%**	**148**

J. Include Granite Seed Low Growing Wildflower Mix at a rate of 8 lbs/acre in addition to the seed mix shown above.

K. In disturbed areas, complete all weed removal, final grading, trench settling, surface preparation and irrigation work (if applicable) before seeding begins.

L. Roughen soil receiving seed.

M. Do not install when seed or soil is saturated or frozen.

N. Seeding shall be done by either drill seeding of hydromulch method. Broadcast seeding is not permitted.

O. MAINTENANCE

1. During the maintenance period the contractor shall be responsible for removing weeds and maintaining the site to provide as good of conditions as possible for seed to grow.
2. Contractor shall plan on one re-seeding if the native stand has not established at the end of the warranty period.

2.8 DRILL SEEDING

A. Drill seeding of the native seed may occur either in the spring or fall. Seeding in the spring may occur between February 15 to April 15 or before temperatures exceed 75°F. Seeding in the fall may occur between September 15 to November 15 or until the ground is frozen. The

actual seeding period must be approved by the Engineer or Landscape Architect because weather conditions vary from year to year. No seed shall be conducted until approved.

B. All areas that are designated for seeding with the native seed mixture in the Contract Documents shall be seeded by drilling unless otherwise approved in writing by the Engineer or Landscape Architect. Only those areas that are too steep to drill may be hydroseeded.

C. Seeding: Seed shall be uniformly drilled to an average depth of 1/4 to 1/2 inch at the rate specified using equipment having drills not more than 6-1/2 inches apart. Row markers shall be used with the drill seeder. Drill seeding shall take place 3 days after application of herbicide.

D. Rolling: Immediately after seeding, the entire area shall be firmed with a roller not exceeding 90 pounds for each foot of roller width. Areas seeded with drills equipped with rollers shall not be rolled.

E. Hydromulch: Apply hydromulch over the entire seeded area at a rate of 2000 pounds per acre. Hydromulching operation shall be conducted as described in Section 3.13 Hydroseeding.

2.9 HYDROSEEDING

A. Hydroseeding shall only be used in areas that are too steep for drill seeding.

B. Hydroseeding of the native seed mix may occur either in the spring or fall. Seeding in the spring may occur between February 15 to April 15 or before temperatures exceed 75°F. Seeding in the fall may occur between September 15 to November 15 or until the ground is frozen. The actual seeding period must be approved by the Engineer or Landscape Architect because weather conditions vary from year to year. No seed shall be conducted until approved.

C. Hydromulch or slurry shall conform to the following:
   1. Echofiber or Conwed or approved equal wood fiber mulch, applied at a rate of 2000 pounds per acre.
   2. M-binder or Plantego tackifier, applied at a rate of 100 pounds per acre.
   3. 16-16-8 slow release fertilizer, applied at a rate of 150 pounds per acre
   4. Water at a rate of 4000 gallons per acre.

D. Hydromulch shall be applied using a hydro-seeding equipment manufactured by Finn or Bowie or approved equal. Machines shall be equipped with heavy duty cast iron pumps and agitators capable of thoroughly mixing the slurry.

E. Spray of hydromulch shall begin immediately after the tank is full and the slurry components are mixed.

F. Apply hydromulch in a downward drilling motion using a fam stream nozzle. It is important to ensure that all of the components enter and mix eith the topsoil.

G. Only qualified and trained personnel shall perform hydroseeding to insure the uniformity of the hyroseeding application.

2.10 EROSION CONTROL BLANKET

A. Erosion Control Blanket shall be AEC Premier Coconut or approved equivalent and placed on slopes 3:1 or greater.

B. Erosion control blanket shall be keyed in at the top of the slope as per manufacturer specifications.

C. Anchorage devices shall be 9-inch, two-legged staples furnished by the manufacturer, or staples of the proper length as recommended by the manufacturer for specific soil conditions.

PART 3 - EXECUTION

3.1 GENERAL

A. The landscape work shall not be performed at any time when it may be subject to damage by climatic conditions.

B. The Contractor shall carefully scale or otherwise verify all dimensions in the Contract Documents. Dimensions and plant locations shall be coordinated with Engineer or Landscape Architect and final location shall be Site-oriented by the planter and Engineer or Landscape Architect. Any discrepancies or inconsistencies shall be brought to the attention of the Engineer.

C. In case of conflict between the Plant List totals and total plant count of the Contract Documents, the Contractor shall provide the higher number of plants.

D. Delivery of materials may begin only after samples and tests have been approved by the Engineer or Landscape Architect. Materials provided shall be not less quality than the approved sample.

E. Substitutions for the indicated plant materials may be considered pursuant to the Contract Documents.

F. The Contractor shall provide temporary fencing, barricades, covering, or other protections to preserve existing landscaping items indicated to remain and to protect the adjacent properties and other structures when they may be damaged by the landscape work.

G. Waste materials shall be removed and disposed of off the Site, unless otherwise indicated.

H. It shall be the responsibility of the Contractor to obtain information regarding utilities in the area of work and to prevent damage to the same. The Contractor shall protect the utilities as necessary.

I. Burning of combustible materials on the Site shall not be permitted.

J. The Contractor shall protect structures, sidewalks, pavements, existing irrigation system, and other facilities that are subject to damage during landscape work. Open excavations shall be provided with barricades and warning lights which conform to the requirements of

governing authorities and the State's OSHA safety requirements from dusk to dawn each day and when needed for safety.

K. Planting areas include all areas to be landscaped unless indicated otherwise.

3.2 SOIL PREPARATION

A. The landscape work shall not begin until all other trades have repaired all areas of settlement, erosion, rutting, etc., and the soils have been re-established, recompacted, and refinished to finish grades. The Engineer or Landscape Architect shall be notified of all areas that prevent the landscape work from being executed.

B. Areas requiring grading by the landscaper including adjacent transition areas shall be uniformly level or sloping between finish elevations to within 0.10-ft above or below required finish elevations.

C. The landscape work shall not proceed until after walks, roads, vaults, trenching, and reservoir construction is in place. Work under the Contract shall be completed to a point where the landscape areas will not be disturbed. The subgrade shall be free of waste materials of all kinds.

D. During grading, waste materials in the planting areas such as weeds, rocks 3-inches and larger, building materials, concrete rubble, wires, cans, glass, lumber, masonry, sticks, etc., shall be removed from the Site. All weeds shall be dug out by the roots.

E. Fertilizers, soil additives, seed, etc. subject to moisture damage shall be kept dry in a weatherproof storage place.

F. After removal of waste materials, the planting and sod area subgrade shall be scarified and pulverized to a depth of not less than 6 inches, and all surface irregularities below the cover of topsoil shall be removed.

G. Finish grading shall consist of:
1. Final contouring of the planting areas.
2. Removal of 6 inches of hardpan material and placement of four inches of imported, amended topsoil over all areas to be planted, deeded or sodded unless indicated otherwise.
3. Placing all soil additives and fertilizers.
4. Tilling of planting areas.
5. After tilling, bringing areas to uniform grades by floating and/or hand raking.
6. Making minor adjustment of finish grades as directed by the Engineer or Landscape Architect.
7. Removing waste materials such as stones, roots, weeds or other undesirable foreign material and raking, disking, dragging, and smoothing soil ready for planting.
8. Finished grades shall be one inch below the top of curbs, sills and walkways in all areas for seed, one and a half inches for sod and three inches for areas with mulch or groundcover.
9. Finished grades shall be smoothed to eliminate puddling or standing water.

H. Any unusual subsoil condition that will require special treatment shall be reported to the Engineer or Landscape Architect.

I. Unless otherwise specified, seeding areas shall receive a minimum of 4 inches of topsoil.

J. Surface drainage shall be provided as indicated by shaping the surfaces to facilitate the natural run-off of water. Low spots and pockets shall be filled with topsoil and graded to drain properly.

K. Finish grade of all planting areas shall be 1-1/2 inches below finish grade of adjacent pavement of any kind.

3.3 DELIVERY, STORAGE, AND HANDLING OF PLANT MATERIALS

A. No plants other than the required samples shall be dug or delivered to the site until the required inspections have been made and the plant samples are approved

B. Plants shall not be pruned prior to delivery except upon approval by the L.A.

C. Plant material shall be planted on the day of delivery if possible. The CONTRACTOR shall protect the stock in a temporary nursery at the project site where it shall be protected from sun and drying winds and shall be shaded, kept moist, and protected with damp soil, moss, or other acceptable material. Plants shall be planted within 2 days after delivery.

D. All balled and burlapped plants which cannot be planted immediately in delivery shall be set on the ground and shall be well protected with soil, wet moss, or other acceptable material. Bare rooted plants, which cannot be planted immediately, shall be planted on heeled-in trenches immediately upon delivery. No material heeled-in more than one week may be used. Bundles of plants shall be opened and the plants separated before the roots are covered. Care shall be taken to prevent air pockets among the roots.

E. During planting operations, bare roots shall be covered with canvas, wet straw, or other suitable materials. No plants shall be bound with wire or rope at any time so as to damage the bark or break branches.

F. Plants shall not be picked up or moved by stem or branches, but shall be lifted the ball or container.

C. Plants shall be lifted and handled from the bottom of the ball or container. Plants with balls cracked or broken before or during planting operations will not be accepted and shall be immediately removed from the site.

3.4 TREE AND PLANT LOCATIONS

A. The CONTRACTOR shall locate and stake all tree and shrub locations and have the locations approved by the L.A. before starting excavation for same. The plant locations shall be observed, and their locations shall be adjusted as directed by L.A. before final approval.

B. No trees shall be located closer than 72 inches to structures unless otherwise shown. Ground covers and shrubs may be planted up to structures or curbs.

3.5 PLANT PITS

A. Plant pits, centered on location stakes, shall be excavated circular pits with vertical sides and flat or saucer shape bottom in accordance with the following sizes unless shown

1. Tree pits shall be at least 3 feet greater in diameter than the specific diameter of ball or spread of roots, and at depth of ball or roots.

2. Shrubs shall be planted in pits or holes of soil the depth of ball below finished grade, or as much deeper as necessary to properly set the plant at finished grade. Shrubs with balls shall be planted in pits that are at least 12 inches greater in diameter than the bottom of ball.

3.6 PREPARED BACKFILL

A. Tree and shrub pit backfilling soil shall consist of ½ existing soil from plant pit and ½ topsoil mixed.

B. Tree and shrub pits shall be provided with fertilizer tablets as follows:
1 per one-gallon can plant
2 per 5-gallon can plant
3 per 1.5" cal. tree

3.7 ROCKS OR UNDERGROUND OBSTRUCTIONS

A. In the event that rock or underground obstructions are encountered in the excavation of plant pits, alternative locations shall be selected by the L.A. Moving of trees to alternative locations shall not entail additional costs to the OWNER.

3.8 SETTING PLANT MATERIALS

A. The soil shall not be worked when the moisture content is so great that excessive compaction will occur, nor when it is so dry that a dust will form in the air or that clods will not break readily. Water shall be applied if necessary to provide ideal moisture for filling and for planting as herein specified.

B. Plants shall be set in center of pits as shown in the Contract Documents. They shall be set plumb and straight, and at such a level that after settlement that the crown of the plant will be 2 inches above the finished grade.

C. Balled and burlapped trees shall have planting soil placed and compacted around base of ball to fill all voids. All burlap ropes or wires shall be removed from the sides and tops of balls.

D. All ground cover plants shall be evenly spaced, staggered in rows, and set at intervals specified, so as to produce a uniform effect. Plants shall be watered immediately after Planting operations have been completed.

E. All shrubs and vines shall be pruned to remove damaged branches. All bare root shrubs shall be pruned and shaped to compensate for transplant root loss.

F. Planting soil around roots or balls shall be thoroughly compacted and watered. After planting, the soil in the shrub beds shall be cultivated between shrubs, raked smooth, and neatly outlined. Muddy soil shall not be used for backfilling. All broken or frayed roots shall be properly cut off.

G. Trees and shrubs on slopes steeper than 6 to 1 shall be provided with watering dams or berms at least 6 inches high and 8 inches wider than planting pit (hole) unless specified or shown otherwise.

H. All trees shall be thoroughly watered immediately after planting.

I. Remove all tags and labels when directed by L.A.

3.9 STAKING AND TREE WRAPPING

A. Staking of trees shall be done immediately after they are planted. Plants shall stand plumb after staking. Staking shall be as specified unless shown or indicated otherwise.

B. Trees 2-inch caliper and less shall be supported by 2 stakes placed diametrically opposite at perimeter line of ball and to sufficient depth to hold tree rigid. Stakes shall be driven vertically and not twisted or pulled. Trees shall be wired to each stake as indicated on staking details. Trees shall be protected with rubber hose over wires at points of contact.

C. Trees (deciduous) 3-inch caliper and evergreen trees over 6 feet tall to be guyed at points of branching with 3 wire guys spaced equally around and outside the perimeter of the ball with “Cable Guy” product model #CG-4000. Trees over 3-inch caliper to be guyed with “Cable Guy” product CG-6800-T. Each guy shall be positioned below crotches. Provide extra hose cushion where cable comes in contact with tree.

D. Tree wrap all trees that may be susceptible to winter sun damage as follows:

1. Starting as low as possible, wrap Treesaver in a smooth spiral to assure overlapping each previous wrap by 1/4 inch.
2. Continue wrapping up the trunk to just below the second scaffold branches.
3. Tie of Treesaver with a half hitch knot.
4. Cover the base of tree and the first wrap of Treesaver with soil.

3.10 PRUNING AND MULCHING

A. Each tree and shrub shall be pruned in accordance with standard horticultural practice to preserve the natural character of the plant in the manner fitting its use in the landscape design, as approved by the L.A.

B. All dead wood or suckers and all broken or badly bruised branches shall be removed by thinning out and shortening branches. Deciduous bare-rooted plants shall have

not less than 1/3 of their respective leaf surfaces removed. All cuts shall be made just above a healthy bud. Pruning shall be done with clean, sharp tools.

C. Plants shall be mulched after planting and cultivating have been completed. A layer of mulch materials, as hereinbefore specified, shall be spread on finished landscaping grade within all planting areas to a depth of 4 inches. The mulch around isolated trees shall follow the tree planting details shown on plans. All shrub and ground cover beds shall be completely covered with the mulch.

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DIVISION 33
UTILITIES

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SECTION 33 05 07
POLYVINYL CHLORIDE (PVC) PIPE (AWWA C900, MODIFIED)

PART 1 - GENERAL

1.1 SUMMARY

A. Provide polyvinyl chloride (PVC) pressure pipe, complete in place, in accordance with the Contract Documents.

B. Polyvinyl chloride pipe and fittings shall be new without any defects when delivered to the job site.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

ANSI/AWWA C104/A24.22	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
ANSI/AWWA C105/A21.5-18	Polyethylene Encasement for Ductile Iron Pipe Systems
ANSI/AWWA C110/A21.10-82	American National Standard for Ductile-Iron and Gray-Iron Fittings 3-in Through 48-in for Water and Other Liquids
ANSI/AWWA C111/A21.11-17	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C153-11	Ductile-Iron Compact Fittings
ANSI/AWWA C600-17	Installation of Ductile-Iron Water Mains and Their Appurtenances
ANSI/AWWA C900-07	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. Through 60 in.
ASTM D 2584 -18	Standard Test Method for Ignition Loss of Cured Reinforced Resins
ASTM D3139-98	Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM F477-14	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
PPI Technical Report TR 4 2024	PPI Listing of Hydrostatic Design Basis (HDB), Strength Design Basis (SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe

1.3 SUBMITTALS

A. Shop Drawings: Submit shop drawings of pipe, fittings, and appurtenances in accordance with the requirements in Section 01 33 20 – Submittal Procedures. Manufacturer's literature for metallic locating tape.
   1. Dimensions and details of pipe joint fittings, fitting specials, valves and appurtenances.
   2. Detailed layout, spool, or fabrication drawings showing pipe spools, spacers, adapters, connectors, fittings, and pipe supports not indicated in the Contract Documents.
   3. Manufacturer's product data and samples of all materials proposed for use on the work.

B. Certifications: Produce a certified affidavit of compliance for pipe and other products or materials under this Section.

C. Test Reports:
   1. Hydrostatic proof test reports.
   2. Sustained pressure test reports.
   3. Burst strength test reports.

D. Performing and pay for sampling and testing as necessary for the certifications.

E. Owner's Manual:
   1. Manufacturer's technical data and installation instructions.
   2. Manufacturer's certificates of compliance indicating that all materials provided under this Section meet the requirements of the Contract Documents.

1.4 QUALITY ASSURANCE

A. Inspection: Ensure that inspection of the pipe occurs at the place of manufacture.

B. During manufacture of the pipe, give the Engineer access to all areas where manufacturing is in process and permit the Engineer to make all inspections necessary to confirm compliance with the Specifications.

C. Tests: Test materials used in manufacture of the pipe in accordance with the requirements of this Section and the referenced standards, as applicable.

D. Perform said material tests. Permit the Engineer to witness testing, provided that the testing schedule is not delayed for the convenience of the Engineer.

E. In addition to those tests specifically required, the Engineer may request additional samples of any material for testing by the Owner. Furnish the additional samples as a part of the Work.

1.5 INSPECTION

A. All pipe may be subject to inspection at the place of manufacture in accordance with the provisions of the referenced standards as supplemented by the requirements herein. Notify

the District in writing of the manufacturing starting date not less than 14 calendar days prior to the start of any phase of the pipe manufacture.

B. During the manufacture of the pipe, give the District access to all areas where manufacturing is in process and permit the District to make all inspections necessary to confirm compliance with the Specifications.

1.6 SOURCE QUALITY CONTROL

A. Except as modified herein, test pipe in accordance with the requirements of this Section and AWWA C900 as applicable.
   1. Perform said material tests in accordance with the requirements of the Contract Documents. Permit the Owner to witness all testing conducted by the Contractor, provided that the Contractor's schedule will not be delayed for the convenience of the Owner.
   2. Bear all expenses incurred in obtaining samples for testing at no increased cost to the Owner.
   3. In addition to those tests specifically required, the Owner may request additional samples of any material for testing by the Owner. Furnish the additional samples at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

A. Ensure that PVC pressure pipe (4-inch through 60-inch) conforms to the applicable requirements of ANSI/AWWA C900 subject to additional requirements herein.

B. Clearly label each piece of pipe and fitting to identify its size, pressure class, and manufacture date.

2.2 PIPE DESIGN CRITERIA

A. General: Design PVC pressure pipe in accordance with the requirements of ANSI/AWWA C900.

B. Ensure that PVC pipe has outside diameter dimensions conforming to cast iron pipe and matches the diameter and class indicated on the plans. Ensure that the pipe meets the pressure class requirements indicated on the drawings and meets the requirements of Table 2 of AWWA C900.

C. Provide PVC pipe in standard 20-foot lengths, unless otherwise specified, detailed, or required on the approved plans. The Engineer may authorize shorter lengths, up to 10 feet. Field cut lengths of pipe used as closures may not be shorter than 2 feet in length and must be approved by the Engineer.

2.3 PIPE

A. Ensure that pipe is of the diameter and pressure class specified or shown, is furnished complete with rubber gaskets, and all specials and fittings are provided as required in the

Contract Documents. Unless otherwise noted, diameters shown in the Contract Documents shall refer to Cast-Iron Pipe Equivalent Outside Diameters (CIOD), conforming to the requirements of AWWA C900, as appropriate.

B. Additives and Fillers: Unless otherwise allowed in alternate qualification procedures of PPI-TR 4, compounds which have a Hydrostatic Design Basis (HDB) of 4000 psi at 73.4 degrees F and for water shall not contain additives and fillers that exceed the recommended values in Section E.5. of PPI-TR3 (e.g., allowable content range for calcium carbonate is 0.0-5.0 parts per hundred of resin). If requested by the Engineer, the additive and filler content shall be determined using the pyrolysis method as specified in ASTM D2584.

C. Color: Ensure that pipe for use in potable or culinary water systems, or directly attached to potable or culinary water systems, is white or blue. Ensure that pipe used in irrigation, reuse, utility water or any other non-potable use is purple.

D. Joints: Except where specifically noted or where designated as "fusible PVC", joints for buried PVC pipe shall be either an integral bell manufactured on the pipe or a separate coupling, both employing a rubber ring joint. Ensure that the bell and coupling is the same thickness as of the pipe barrel, or greater thickness. Ensure that the sealing ring groove in the coupling is of the same design as the groove in cast iron fittings and valves available from local water works supply distributors. Do not allow restrained joint PVC pipe. When the spigot end of pipe is to be inserted into a mechanical joint fitting, remove the beveled end of the pipe prior to insertion. Solvent weld joints are not permitted.

E. Seal the joint with an elastomeric gasket meeting the requirements of ASTM F477 and ASTM D3139. Ensure that gaskets and lubricants are made from materials that are compatible with the plastic material and with each other when used together. Ensure that they do not support the growth of bacteria and will not adversely affect the potable qualities of the water that is to be transported. Furnish one elastomeric gasket with each length of bell-end pipe.

F. Joint Deflection: Ensure that deflection at the joint does not exceed 1.5 degrees or the maximum deflection recommended by the manufacturer. Do not allow deflection of the joint for joints which are over-belled or not belled to the stop mark.

2.4 FITTINGS

A. Fittings shall be ductile iron fittings meeting the requirements of Section 33 05 19 – Ductile Iron Pipe and of AWWA C110 and/or AWWA C153. Coat fitting hardware with a wax tape coating system meeting the requirements of Sections 09 90 00 and 09 90 10 and wrap in polyethylene encasement per Section 33 05 19.

B. Where fabricated PVC fittings are specifically required:
   1. Fittings (4-inch through 60-inch) shall conform to the applicable requirements of ANSI/AWWA C900 subject to additional requirements herein.
   2. All fabricated PVC fittings 14-inch and larger shall include fiberglass reinforcement permanently bonded to the outside surfaces of the fitting.

C. Line all ductile iron fittings in accordance with Section 33 41 05 – Ductile Iron Pipe. Fittings shall be cement-mortar lined ductile iron pipe coated with a bituminous material. Ensure that they conform to the requirements of AWWA Standard C110 and C111 with a minimum rated

working pressure of 250 psi. Ensure that the cement lining conforms to the requirements of AWWA Standard C104.

D. Clearly label each fitting to identify its size and pressure class.

E. Restrain all fittings and valves against thrust forces by furnishing and installing concrete thrust blocks as indicated in the Drawings.

2.5 TRACER WIRE

A. Use N0. 12 AWG copper wire, THWN-2 jacketed for underground services, as tracer wire.

2.6 SERVICE SADDLES

A. Use bronze-bodied saddles with double bronze straps or full circle body clamp double bolted to each side of the saddle on pipe sizes 4 inch through 12 inch. Manufacture the saddle body from cast bronze in accordance with ASTM B62 or B584 and AWWA C800. Ensure that the single strap has double bolts on each end of the strap to connect it to the bronze saddle. Ensure that the ears of the strap are turned inward and rest against the inside of the strap. Use a Buna N gasket. Thread the saddle with 1-inch or 2-inch iron pipe threads.

PART 3 - EXECUTION

3.1 GENERAL

A. Perform laying, jointing, and testing for defects and for leakage in the presence of the Engineer. These activities are subject to Engineer approval before acceptance. Material found to have defects will be rejected. Promptly remove such defective materials from the Site.

B. Ensure that installation conforms to the requirements of AWWA M23 PVC Pipe – Design and Installation, instructions furnished by the pipe manufacturer, and to the supplementary requirements herein. Wherever the provisions of this Section and the aforementioned requirements are in conflict, apply the more stringent provision.

C. Install all the pipe closure sections, fittings, valves, and appurtenances shown on the approved plans, including bolts, nuts, gaskets, and joining materials.

D. Excavate sufficiently in advance of pipe laying operations to enable the alignment and profile to be revised to clear existing utilities and to align with existing connection points.

E. Do not use gouged PVC pipe. PVC pipe which has received minor scratches during handling may be used solely at the discretion of the Engineer.

F. Maintain the interior of the pipe clean, sanitary, and free from foreign materials. At all times when the work of installing pipe is not in progress, keep all openings into the pipe and the ends of the pipe in the trenches tightly closed to prevent the entrance of animals and foreign materials. To prevent unwanted water intrusion, temporarily close open ends of pipe with a watertight bulkhead.

G. Do not install any pipe contaminated with a petroleum product (inside or outside).

H. Do not install any pipe that shows evidence of exposure to sunlight, age, surface deterioration, or other physical damage. The decision of the Engineer shall be final as to the acceptability of the pipe to be installed.

3.2 HANDLING AND STORAGE

A. Handling: Carefully inspect pipe, fittings, and accessories before and after installation and reject those found defective. Ensure that pipe and fittings are free from fins and burrs. Before being placed in position, clean pipe, fittings, and accessories, and maintain them in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Do not drop or dump pipe, fittings or any other material into trenches under any conditions. Hoist the pipe with mechanical equipment using a cloth belt sling or a continuous fiber rope which avoids scratching the pipe. A chain is not permitted. Pipes up to 6 inches in diameter can be lifted by hand.

B. Storage: Store pipe, if possible, at the Site in unit packages provided by the manufacturer. Exercise caution to avoid compression damage or deformation to bell ends of the pipe. Uniformly support pipe while being stored in such a way as to prevent sagging or bending and protect pipe from exposure to direct sunlight by covering with an opaque material while permitting adequate air circulation above and around the pipe. Store gaskets in a cool, dark place out of the direct rays of the sun, preferably in original cartons.

3.3 TRENCHING AND BACKFILL

A. Ensure that trench excavation and backfill conforms to the requirements of Section 31 23 00 – Earthwork. Take care to ensure that pipe zone material is compacted and in full contact with the haunches of the pipe and that the pipe is fully supported.

3.4 INSTALLATION

A. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade pipe in straight lines, taking care to avoid the formation of any dips or low points. Do not lay pipe when the conditions of trench or weather are unsuitable. At the end of each day’s work, close the open ends of pipe temporarily with wood blocks or bulkheads.

B. Support pipe at its proper elevation and grade, taking care to secure firm and uniform support. Wood support blocking will not be permitted. Ensure that the full length of each section of pipe and fittings rests solidly on the pipe bed, with recessed excavation to accommodate bells, joints, and couplings. Provide anchors and supports where indicated and where necessary for fastening work into place. Ensure that fittings are independently supported.

C. Use short lengths of pipe in and out of each rigid joint or rigid structure. Replace piping that does not allow sufficient space for proper installation of jointing material by one of proper dimensions. Blocking or wedging between bells and spigots will not be permitted.

D. Install joints according to manufacturer's recommendations. Keep trenches free of water until joints have been properly made. Ensure that the maximum combined deflection at any coupling is in accordance with the manufacturer's recommendations.

E. Cut pipe by means of saws, power driven abrasive wheels, or pipe cutters, which will produce a square cut. No wedge-type roller cutters will be permitted. After cutting, bevel the end of the pipe using a beveling tool, portable type sander, or abrasive disc.

F. Secure pipe ends at all times and take care to prevent any foreign object, dirt, rocks, debris, rubbish, tools, etc. from entering the pipe. Cap the pipe end at the end of each day's laying operations, provided required minimum separation from adjacent utilities are satisfied.

G. Install PVC pipe such that the indelible identification strip markings on each pipe section are continuously aligned for the total length of the pipeline being installed. Orient the strip marking upward to the 12 o'clock position (top) of the trench opening.

H. Assemble the pipe joint using the lubricant supplied by the manufacturer. Ensure lubricant is NSF-certified for use in potable water systems. Insert the spigot end into the bell or coupling to the proper insertion mark. Check that the elastomeric ring has not left the groove during assembly by passing a feeler gauge around the completed joint.

I. Install tapping saddles a minimum of 5 feet from the edge of the saddle to any pipe joint or other saddle. Do not make multiple taps of 6 inches or larger in the same length of pipe without the approval of the Engineer.

3.5 INSTALLATION OF METALLIC LOCATING TAPE

A. Provide polyvinyl chloride pipelines with a metallic locating tape laid along the centerline of the pipe trench at a depth of 18 inches below finished grade or above top of pipe. Furnish manufacturer's literature, completely describing the tape proposed to be furnished. No tape shall be used prior to receipt of written approval of the Engineer.

3.6 INSTALLATION OF LOCATOR WIRE

A. Provide polyvinyl chloride pipelines with locator wire secured to the pipe with surface connections provided at all valve boxes and hydrants and as required to maintain a maximum distance between connections of no greater than 500 feet. Lay tracer wire along the top of the pipe and hold wire in place with ties or hitches. Do not space the ties or hitches more than 10 feet apart. Use the copper wire in the future as a means of locating the pipe with an electronic-type pipe locator.

3.7 FIELD TESTING AND DISINFECTION

A. Ensure that field testing conforms to the requirements of Section 33 13 00 – Water Pipeline Testing and Disinfection as applicable.

END OF SECTION

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SECTION 33 05 19
DUCTILE IRON PIPE (AWWA C151, MODIFIED)

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install ductile iron pipe and appurtenant work, complete in place, in accordance with Contract Drawings and these Specifications.

1.2 RELATED SECTIONS

A. Section 09 90 00 – Protective Coatings and Linings

B. Section 31 23 00 – Earthwork

C. Section 33 13 00 – Water Pipeline Testing and Disinfection

1.3 DEFINITIONS

A. Gland or Follower Gland: Non-restrained, mechanical joint fitting.

B. Retainer Gland: Mechanically restrained mechanical joint fitting.

1.4 REFERENCE STANDARDS

A. ASTM International (ASTM) standards, most recent editions:

ASTM C150	Specification for Portland Cement
ASTM C283	Standard Test Methods for Resistance of Porcelain Enameled Utensils to Boiling Acid
ASTM D792	Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D882	Standard Test Method for Tensile Properties of Thin Plastic Sheeting
ASTM D1330	Standard Specification for Rubber Sheet Gaskets
ASTM D1922	Standard Test Method for Propagation Tear Resistance of Plastic Film and Thin Sheeting by Pendulum Method
ASTM D4976	Standard Specification for Polyethylene Plastics Molding and Extrusion Materials

B. American Water Works Association (AWWA) standards, most recent editions:

ANSI/AWWA C104/A21.4	Cement-Mortar Lining for Ductile Iron Pipe and Fittings

ANSI/AWWA C105/A21.5	Polyethylene Encasement for Ductile Iron Pipe Systems
ANSI/AWWA C110/A21.10	Ductile-Iron and Gray Iron Fittings
ANSI/AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
ANSI/AWWA C115/A21.15	Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
ANSI/AWWA C150/A21.50	Thickness Design of Ductile Iron Pipe
ANSI/AWWA C151/A21.51	Ductile-Iron Pipe, Centrifugally Cast
ANSI/AWWA C153/A21.53	Ductile-Iron Compact Fittings
ANSI/AWWA C104/A21.4	Cement-Mortar Lining for Ductile-Iron Pipe
ANSI/AWWA C209	Tape Coatings for Steel Water Pipe and Fittings
ANSI/AWWA C214	Tape Coatings for Steel Water Pipe
ANSI/AWWA C600	Installation of Ductile-Iron Mains and Their Appurtenances
ANSI/AWWA C606	Grooved and Shouldered Joints
AWWA M41	Ductile-Iron Pipe and Fittings

C. National Sanitation Foundation (NSF) standards, most recent edition:

NSF 61	Drinking Water System Components, Health Effects

1.5 SUBMITTALS

A. Submit in accordance with Section 01 33 20 – Submittal Procedures.

B. Product Data:
1. Manufacturer's installation instructions.
2. Manufacturer's data on coatings and linings.
3. Manufacturer's data on metallic locating tape.

C. Shop Drawings
1. Submit shop drawings of pipe and fittings in accordance with the requirements of the referenced standards and the following supplemental requirements, as applicable and as specified herein.
    a. Provide a marking plan with details showing standard pipe section, dimensions, pipe joints, fittings and special fittings, pressure rating, thickness, size, coating, and lining data.
    b. Pipeline layout drawings showing the location of each pipe section, each special length, closure sections, location and angle of bends, outlets, location of valves, and other special fittings.

D. Certificates
1. Furnish an affidavit of compliance for all Ductile-Iron pipe and other products or materials furnished under this Section, as specified in the referenced standards, and the following supplemental requirements:
a. Physical and chemical properties.
b. Hydrostatic Test Reports.

E. Quality Control Tests
1. Submit certified inspection reports from the independent agency for witnessed tests within 10 days of the inspection.
2. Test results must show restrained joints in the sizes specified have been successfully tested to at least twice the specified pressure rating of the joint without leakage or failure.

1.6 QUALITY ASSURANCE

A. Qualifications
1. Manufacturers
a. Finished pipe and fittings shall be the products of a single manufacturer.
1) Change orders, specials, and field changes may be provided by a different manufacturer upon Engineer's approval.
b. Pipe manufacturing operations (pipe, lining, and coatings) shall be performed under the control of the manufacturer.
c. Manufacture ductile-iron pipe in accordance with ANSI/AWWA C151/A21.51
1) Perform quality control tests and maintain results as outlined within standard and as specified herein to assure compliance.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with Section 01 25 10 - Products, Materials, Equipment and Substitutions.

B. Storage And Handling Requirements
1. Handle and store ductile-iron pipe materials in accordance with the guidelines in AWWA Manual M41 - Ductile-Iron Pipe and Fittings.
2. Handle the pipe with devices acceptable to Engineer, designed and constructed to prevent damage to the pipe coating/exterior.
3. Securely attach metal, hardboard, or wood protectors over entire gasket surface of pipe flanges.
4. Provide plastic plugs or caps for threaded or socket welding pipe ends.
5. In cold weather, locate products to prevent coating from freezing to the ground.
6. Suitably support and secure stockpiled pipe to prevent accidental rolling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
1. Restrained Joint Connectors:
a. American Cast Iron Pipe Company: Flex-Ring, Field Flex-Ring, and Lok-Ring

b. McWane Cast Iron Pipe Company: Thrust-Lock.
c. U.S. Pipe Company: TR Flex and HP Lok.
d. EBAA Iron: 1100 Megalug.
e. Engineer-approved equal.

2. Grooved Joint Connectors:
   a. Victaulic Company of America: QuickVic.
   b. Engineer-approved equal.
3. Ball Joint Connectors:
   a. American Cast Iron Pipe Company: Flex-Lock.
   b. U.S. Pipe Company: M-Flex.
   c. Engineer-approved equal.
4. Glass Lining:
   a. Fast Fabricators/Waterworks Manufacturing: MEH-32.
   b. Vitco Corporation: SG-14.
   c. Engineer-approved equal.
5. Pipe Gaskets for Pipe 54-inch Diameter and Larger:
   a. American Cast Iron Pipe Company: Toruseal.
   b. U. S. Pipe Company: Flange-Tyte.
   c. Engineer-approved equal.
6. Polyethylene Pipe Encasement
   a. U.S. Pipe Company: V-Bio Enhanced Polyethylene Encasement.
   b. AA Thread Seal Tape, Inc.: VB3 Enhanced Polyethylene Encasement.
   c. Engineer-approved equal.

2.2 EQUIPMENT, PRODUCT TYPES, AND MATERIALS

A. Pipe

1. Fabricate mortar-lined and polyethylene-wrapped ductile-iron pipe in accordance with ANSI/AWWA C104/A21.4, ANSI/AWWA C105/A21.5, AWWA/ANSI C111/A21.11, AWWA/ANSI 15 C150/A21.15, and AWWA/ANSI C151/A21.51.
2. Pipe must meet the requirements of NSF 61.
3. All pipe must be new and recently manufactured. Refurbished pipe will not be accepted.
4. Provide pipe with lay length of 18 feet or 20 feet, except for special fittings or closure pieces and as necessary to comply with the Contract Drawings.
   a. Provide closures and correction pieces as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing shown on the Contract Drawings.
   b. Locations of correction pieces and closure assemblies are shown on the Contract Drawings. Any change in location or number of these items must be approved by Engineer.
5. Finish: Smooth and dense interior surfaces, free from fractures, excessive interior surface crazing, and roughness.
6. As a minimum, the following pressure classes apply. The Contract Drawings may specify a higher pressure class, but in no case shall it be less than the following:

Diameter (inches)	Minimum Pressure Class (psi)
3 through 12	350

Diameter (inches)	Minimum Pressure Class (psi)
14 through 20	250
24	200
30 through 64	150

7. As a minimum, the following thickness classes apply. The Contract Drawings may specify a heavier thickness class, but in no case shall it be less than the following:

Diameter (inches)	Minimum Thickness Class
3 through 12	51
14 through 64	50

8. Mark each pipe per the requirements of ANSI/AWWA C151/A21.51. Minimum markings are as follows:
   a. "DI" or "Ductile" clearly labeled on each pipe section.
   b. Weight, pressure class, and nominal thickness of each pipe section.
   c. Year and country where each pipe section was cast.
   d. Manufacturer's mark.
9. Pipe Design
   a. Base pipe design on trench conditions and design pressure shown on the Contract Drawings.
   b. Design pipe according to methods indicated in ANSI/AWWA C150/A21.50, ANSI/AWWA C151/A21.51, and AWWA M41 as modified by this Section.
   c. Pipe Wall Thickness for Internal Pressure:
      1) Design the pipe wall net thickness for internal design pressure in accordance with the hoop stress formula.
   d. Pipe Wall Thickness for External Load:
      1) Also design the pipe net thickness to withstand external loads using ANSI/AWWA C150/A21.50, Design Equation 2, and the appropriate bending moment and deflection coefficients for Laying Condition Types 4 and 5 as applicable.
   e. Pipe Deflection:
      1) Check pipe deflection using ANSI/AWWA C150/A21.50, Design Equation 3 and the coefficients stated above.
      2) Deflection limit: 0.0225 times the nominal pipe diameter. If this value is exceeded, increase the pipe wall thickness.
   f. Earth Loads:
      1) In lieu of ANSI/AWWA C150/A21.50 Design Equation 4, compute the earth loads using the following two equations for trench or embankment loading, as applicable:
         a) Trench Condition:
            $W_d = C_d\, w\, B_d^2$, Where
            W_d = Earth load in pounds per linear foot
            C_d = Calculation Coefficient
            $K\,\mu' = 0.13$
            w = soil unit weight = 120 lb/ft^3
            B_d = trench width at top of pipe, feet
         b) Positive Projecting Embankment Condition:

$W_c = C_c\ w\ B_c^2$, Where

W_c = Earth load in pounds per linear foot

C_c = Calculation Coefficient based on r_{sd} p of 0.3

K μ = 0.13

w = soil unit weight = 120 lb/ft^3

B_c = trench width at top of pipe, feet

2) The above two formulas are based on a depth of cover of 10 feet or greater, which neglects any live load or impact on the pipe. For depths of cover less than 10 feet, include AASHTO HL-93 live load (truck only). For depths of cover of three feet or less, include HL-93 live load (truck only) plus impact. Determine live load and impact factors as recommended by AASHTO in "AASHTO LRFD Bridge Design Specifications".

g. Minimum Pipe Wall thickness: In addition to the requirements of this Section, the minimum thickness shall be in accordance with Table 5 of ANSI/AWWA C150/A21.5.

10. Pipe Design

a. General: Furnish ductile iron pipe, mortar lined, and polyethylene wrapped with rubber gasketed joints as shown on the Contract Drawings.

b. Manufacturing Requirements: Design, manufacture, test, inspect, and mark the pipe according to applicable requirements previously stated and, except as modified herein, conform to ANSI/AWWA C151/A21.51.

c. Pipe Dimensions: Provide pipe with diameter and class shown on the Contract Drawings. Provide pipe wall thickness for each pipe size as specified herein or shown on the Contract Drawings.

d. Fitting Dimensions: Provide fittings for each pipe size of the diameter and class shown on the Contract Drawings.

11. Joint Design

a. Provide mechanical and push-on joints conforming to ANSI/AWWA C111/A21.11

b. Push-On Joint: Provide joint rated at minimum working pressure equal to pipe material design.

c. Restrained Joint:

1) Manufactured proprietary joint that mechanically restrains pipe to adjoining pipe without setscrews or shoes or wedges activated by setscrews or bolts.

2) Permanent (primary) restraint for all buried pipe fittings must be accomplished using concrete thrust blocks. Temporary (secondary) fitting restraint for testing of pipelines can be accomplished using mechanical thrust restraint. Temporary fitting restraint shall be in addition to permanent restraint.

d. Mechanical Wedge Action Type Joint:

1) Devices utilizing multiple gripping wedges incorporated into a follower gland meeting the requirements of ANSI/AWWA C111/A21.11 or ANSI AWWA C153/A21.53.

2) Use only in areas adjoining fixed points where laying length is determined in the field.

3) Use only where prior to purchase and installation, the type and application of this joint has been approved by Engineer.

e. Setscrew Type Joint:

1) The use of setscrews for restraint or field-lock gaskets will not be allowed unless specifically shown on the Contract Drawings or approved by Engineer on a per-application basis.

f. Grooved Joint:
   1) Flexible type radius cut grooved, conforming to AWWA C606.
   2) Use minimum special thickness Class 53 for grooved joints.

g. Ball Joint:
   1) Conform to requirements of ANSI/AWWA C151/A21.51.
   2) Minimum working Pressure:
      a) 4-inch through 12-inch diameter: 350 psi.
      b) Larger than 12-inch diameter: 250 psi.

h. Proprietary locking system type joints (e.g., TR Flex, Field Lok, or HDSS, etc.) shall not be used in the following situations.
   1) When above ground (bridge crossings on piers, etc.)
   2) When used in poor soil conditions (swamps, marshes, etc.)
   3) When long lengths of pipe are required for restraint due to high operating pressures and/or unfavorable soil parameters.
   4) Where pipes are used inside of casing pipe.
   5) Where pipe and fittings are in vertical alignment.

i. Flanged joints shall conform to ANSI/AWWA C115/A21.15.

B. Joint Clearances: For bell-and-spigot ends with rubber gaskets, set the clearance between the bells and spigots such that when combined with the gasket groove configuration and the gasket itself, it will provide watertight joints under all operating conditions when properly installed. Submit details complete with significant dimensions and tolerances and submit performance data indicating that the proposed joint has performed satisfactorily under similar conditions. In the absence of a history of field performance, submit results of the test program.

C. Coating and Linings Held Back: Hold back shop-applied interior linings and exterior coatings from the ends of the pipe as shown on the Contract Drawings, or as otherwise acceptable to Engineer.

D. Fittings
1. Provide new and recently manufactured fittings. Refurbished and used fittings will not be accepted.
2. Coated and lined same as connected pipe.
3. Provide mechanical, pushpin, flanged, or restrained joint fittings in accordance with the following tables:

Minimum Pressure Ratings for AWWA C110/A21.10 and C115/A21.15 Ductile Iron Fittings

Diameter (inches)	Rubber Gasket Joints (Push-on, Mechanical, Restrained) (psi)	Flanged Joints (psi)
3 through 24	350	350
30 through 48	250	250

Minimum Pressure Ratings for AWWA C153/A21.53 Ductile Iron Fittings		
Diameter (inches)	Rubber Gasket Joints (Push-on, Mechanical, Restrained) (psi)	Flanged Joints (psi)
3 through 24	350	Not included in C153/A21.53 (refer to C110/A21.10)
30 through 48	250	Not included in C153/A21.53 (refer to C110/A21.10)
54 through 64	250	250

4. Rubber-Gasket Joints Including Mechanical Joints, Push-On Joints, And Flanged Joints: Provide in accordance with ANSI/AWWA C111/A21.11.
5. Mechanical Joint Fittings: Provide in accordance with ANSI/AWWA C110/A21.10 and ANSI/AWWA C153/A21.53.
6. Grooved End Fittings:
   a. Provide radius-cut grooved, flexible type, conforming to ANSI/AWWA C606, ANSI/AWWA C110/A21.10, and ANSI/AWWA C153/A21.53.
7. Coat any exposed metallic hardware with a wax tape coating system meeting the requirements of Sections 09 90 00 and 09 90 10.

E. Welded Outlet: Perform welding to pipe only in manufacturer's shop.

F. Interior Lining:
1. Cement-Mortar Lining for Shop Application: Except as otherwise provided herein, clean and line interior surfaces of all ductile iron pipe, fittings, and specials in the shop with cement-mortar lining applied centrifugally in conformance with ANSI/AWWA C104/A21.4. During the lining operation and thereafter, maintain the pipe in a round condition by suitable bracing or strutting. Use only lining machine types that have been used successfully for similar work. Take precautions to prevent damage to the lining. If the lining is damaged or found faulty at the delivery site, replace the damaged or unsatisfactory portions with lining conforming to these Specifications.
   a. Lining Thickness: Provide minimum lining thickness as follows:

Nominal Pipe Diameter (inches)	Minimum Lining thickness) (inches)
3 through 12	1/8
14 through 24	3/16
30 through 64	1/4

2. Epoxy Lining: when shown on the Contract Drawings, apply epoxy lining to interior surfaces of pipe and fittings.
   a. Amine-cured novalac epoxy, containing at least 20% by volume of ceramic quartz pigment.
   b. Thickness: minimum 40 mils dry film thickness (DFT).

3. Glass Lining: When shown on the Contract Drawings, apply glass lining to interior surfaces of pipe and fittings.
    a. Formulate the glass lining for handling primarily sludge and scum. The formulation shall consist of special glasses and inorganic materials factory applied to chemically clean, gray iron. After application of the coating, place the parts in a specially designed furnace and bring up to the temperature at which the glass melts and fuses to the base metal. Continue firing the piece until fusion has completely taken place and the coating has an integral molecular bond with the metal.
    b. Lining Thickness: .008 to .012 inch thick as tested with magnetic coating thickness test equipment.
    c. Lining Hardness: 5 to 6 Mohs scale.
    d. Lining Density: 2.5 to 3.0 grams per cubic centimeter as measured in accordance with ASTM D792.
    e. Resistance to Thermal Shock: Capable of withstanding thermal shock of 350 deg F without crazing, blistering, or spalling. It shall be resistant to corrosion by solutions with a pH between 3 and 10 at 125 deg F.
    f. Gloss: No visible loss of surface gloss in the lining after immersion of a normal production run sample in an 8 percent sulfuric acid solution at 148 degrees F for a period of 10 minutes.
    g. Weight Loss: When tested in accordance with ASTM C283, weight loss shall not exceed 3 milligrams per square inch.
    h. Pin holes, crazing or fish scales which expose the metal substrate shall be limited to 0.01% of the total glass surface. The visual appearance of the glass lining should be like bright and clean opaque window glass.

G. Exterior Coating:
1. Buried: Provide asphaltic type, 1mil thick, in accordance with ANSI/AWWA C151/A21.51, ANSI/AWWA C115/A21.15, ANSI/AWWA C110/A21.10, and ANSI/AWWA C153/A21.53.
2. Exposed or Submerged: Clean, prime and paint in accordance with Section 09 90 00 – Painting and Coating. Apply rust-inhibitive primer in the fabrication shop.

H. Polyethylene Encasement:
1. Virgin polyethylene raw material conforming to ASTM D4976.
2. Elongation: 800 percent minimum, in machine and transverse directions per ASTM D882.
3. Tensile Strength: 3,600 psi minimum.
4. Dielectric Strength: 800 V per mil thickness, minimum.
5. Propagation Tear Resistance: 2,550-gram force minimum in machine and transverse directions per ASTM D1922.
6. Tube Form: conform to ANSI/AWWA C105/A21.5.
7. Film Thickness: Minimum 0.008 in (8 mil) thickness.
8. Number of Film Layers: Three.
9. Enhanced with anti-microbial additives and volatile corrosion inhibitors.

I. Bolts:
1. Flanged Connection Bolts: Carbon steel conforming to ASTM A307, Grade A hex bolts and ASTM A563 Grade A hex head nuts in accordance with Section 05 50 00 – Metal Fabrications.

2. Grooved End connection Bolts: Manufacturer's standard.

J. Gaskets:
1. Flat Faced Flange Gaskets:
a. Pipe smaller Than 54-inch Diameter:
1) Conform to ANSI/AWWA C207 and ASTM D1330, Grade 1 and Grade 2.
2) Rated for working pressure of 150 psi to 250 psi, 1/8-inch thick, red rubber (SBR).
3) Hardness: 80 (Shore A).
4) Temperature: Rated for 200 deg F.
b. Pipe 54-inch Diameter and Larger: Rated for working pressure greater than 250 psi.
c. Grooved End Joint Gaskets: Halogenated butyl, conforming to ASTM D2000 and ANSI/AWWA C606.

K. Wall spools and Sleeves
1. Provide walls spools conforming to ANSI/AWWA C110/A21.10 with connecting end type as shown on the Contract Drawings and compatible with connecting piping and valving.
2. Pressure Rating: 350 psi working pressure.
3. Incorporate a statically cast thrust color which is positioned to accommodate cast-in-place concrete placement as shown on the Contract Drawings.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests
1. General:
a. Complete testing in accordance with applicable ANSI/AWWA standards at no additional expense to Owner.
b. Engineer to have the right to witness all testing conducted by Contractor and manufacturer, provided that Contractor's schedule is not delayed for convenience of engineer.
c. Perform tests on pipe with wall thickness equal to that specified.
d. Ship only pipe that has passed the leak test.
2. Hydrostatic Proof Test:
a. On all pipe, perform the test at 500 psi for a minimum duration of 10 seconds.
b. On pipe with diameter of 30-inches and larger, additionally test to 75 percent of minimum yield strength during test duration of not less than 15 seconds.
c. Record each test cycle on a strip chart.
d. For pipe with diameter of 30-inches and larger, mark each test cycle by pipe number.
e. Inspect each pipe for leaks during the tests. Discard pipe which shows evidence of leaks. Repairing leaks by welding is not permitted.
3. Perform a 15-psi air test on weld-on outlet pipe.
4. Provide suitable gages on pipe ends (spigot end, ball and socket) at sufficiently frequent intervals to ensure compliance with standard dimensions of ANSI/AWWA C151/A21.51.
a. In addition, inspect each socket and spigot in a well-lit area for injurious defects which could affect the joint performance.

b. Remove defects by cutting off pipe ends.
c. Discard pipe with injurious defects in the bell.
d. Cause the manufacturer's quality assurance inspector to review 18-inch and larger diameter pipe for specified tolerances, including ovality.

B. Preconstruction Testing
1. Owner may, at its own cost, subject additional pipe materials, including lining and coating, to testing by an independent laboratory for compliance with this Specification.
a. Submit the additional selected samples for testing at no additional cost to Owner.
b. Any visible defects or failure to meet the quality standards herein will be grounds for rejecting the entire order.

C. Inspections
1. All pipe materials are subject to inspection at the place of manufacture and in the field, in accordance with the provisions of the referenced standards, as supplemented by the requirements herein.
2. Notify Engineer in writing of the manufacturing starting date, not less than 14 calendar days prior to the start of any phase of the pipe manufacture.
3. During manufacture of the pipe, allow Engineer access to all areas where manufacturing is in process and permit inspections necessary to confirm compliance with the Contract Documents.

PART 3 - EXECUTION

3.1 GENERAL

A. Perform operations of laying, jointing, testing for defects and for leakage in the presence of Engineer, and obtain approval. Material found to have defects will be rejected and must be promptly removed from the Site.

B. Install materials to conform to the requirements of ANSI/AWWA C600, instructions furnished by the pipe manufacturer, and to the supplementary requirements herein.

3.2 EXAMINATION

A. Verify that excavation will allow a minimum pipe cover as shown on the Contract Drawings and described elsewhere in these Specifications. If existing pipelines are less than minimum cover, connect to existing pipeline and angle pipe as necessary to achieve cover requirements.

B. Verify that excavations are to the required alignment, grades, and are dry.

C. Examine pipe and fittings for defects or damage prior to installation.

D. Verify all pipe, fittings, aggregates, and all other materials delivered to the Site meet the requirements of these Specifications.

E. Field verify existing pipe locations and structures where connections are to be made.

F. Field verify equipment locations and make modifications in piping to properly connect to equipment as necessary, prior to pipe fabrication.

3.3 PREPARATION

A. Trench Grade
   1. Grade bottom of trench by hand to specified line and grade with proper allowance for pipe thickness and pipe base. Grade to form a continuous and uniform bearing and support for pipe between bell holes.
   2. Before laying each section of pipe, check grade and correct irregularities found. Grade may be disturbed for removal of lifting tackle.

B. Bell (joint) Holes:
   1. At each joint, dig bell holes of ample dimensions in bottom of trench, and at sides were necessary, to permit joint to be made properly and to permit easy visual inspection of entire joint.

3.4 INSTALLATION

A. General
   1. Store and handle pipe, fittings, etc., carefully and protect against damage, impact shocks, and free fall. Use pipe handling equipment acceptable to Engineer. Always support pipe in a manner that will protect the pipe coating against injury whenever stored at the trench site or elsewhere. Do not install pipe where the lining or coating show defects that may be harmful as determined by Engineer. Repair damaged lining or coating to satisfaction of Engineer or furnish and install new undamaged pipe.
   2. Replace or repair all pipe damaged prior to Substantial Completion so satisfaction of Engineer.
   3. Perform trench excavation and backfill conforming to the requirements of Section 31 23 00 – Earthwork. Ensure that pipe zone material is compacted and in full contact with the haunches of the pipe and that the pipe is fully supported.
   4. Clean Pipe
      a. Before placement of pipe in the trench, thoroughly clean each pipe or fitting to remove any foreign substance which may have collected thereon and keep clean at all times thereafter. For this purpose, close the openings of all pipes and fittings in the trench during any interruption to the Work.
      b. Remove lumps, blisters, and excess asphaltic type coating from bell and spigot ends of each pipe. Wire brush outside of spigot and inside of bell and wipe clean, dry, and free from oil and grease before pipe is laid.
      c. Wipe ends of mechanical joint pipe and fittings and of rubber gasket joint pipe and fittings clean of dirt, grease, and foreign matter.

B. Laying Pipe
   1. Install pipe in accordance with ANSI/AWWA C600.
   2. Lay pipe directly on the pipe zone material. No blocking will be permitted.
   3. Direction of Laying: Lay pipe with bell end facing in direction of laying. For lines on an appreciable grade, face bells upgrade at discretion of Engineer.
   4. Mechanical Joint, Push-On Joint, and Restrained Joint Pipe: After first length of pipe is installed in trench, secure pipe in place with approved backfill material tamped under and along sides to prevent movement. Keep ends clear of backfill. After each section

is jointed, place backfill as specified to prevent movement. For restrained joint pipe and fittings, after each section is jointed and restraining devices are completely installed, fully extend the completed joint and place backfill as specified to prevent movement before installation of the next section of pipe or fitting.

5. Prevent floating of pipe prior to completion of backfill operation.
6. When using movable trench shield, prevent pipe joints from pulling apart when moving shield ahead.
7. Do not allow foreign material to enter pipe.
8. Close and block, and effectively seal open end of last laid section of pipe to prevent entry of foreign material or creep of gasketed joints when laying operations are not in progress, at close of day's work, or whenever workers are absent from Site.

C. Joining Push-On Joint Pipe and Mechanical Joint Fittings:

1. Join pipe with push-on joints and mechanical joint fittings in strict accordance with manufacturer's recommendations.
2. Provide special tools and devices, such as special jacks, chokers, and similar items required for installation.
3. Lubricate pipe gaskets using lubricant furnished by pipe manufacturer. No substitutes will be permitted.
4. Clean ends of fittings of dirt, mud, and foreign matter by washing with water and scrubbing with a wire brush, after which, slip gland and gasket on plain end of pipe. If necessary, lubricate end of pipe to facilitate sliding gasket in place, then guide fitting onto spigot of pipe previously laid.

D. Rubber Gasketed Joints

1. Immediately before joining pipe, thoroughly clean the bell end of the pipe. Place a clean rubber gasket, lubricated with an approved vegetable-based lubricant, in the bell groove. Clean and lubricate the spigot end of the pipe with a vegetable-based lubricant. Insert the spigot end of the pipe section into the bell of the previously laid joint and telescope into its proper position. Tilting of the pipe to insert the spigot into the bell will not be permitted.

E. Ball Joint Pipe

1. Assemble and install in accordance with manufacturer's recommendations.
2. Hydrostatic Test:
    a. Conduct ball joint pipe independent of other pipe systems/types being installed.
    b. Conduct the test in accordance with requirements of these Specifications and manufacturer's recommendations.

F. Cutting Pipe

1. Cut pipe for inserting valves, fittings, or closure pieces in a neat and workmanlike manner without damaging pipe or lining and so as to leave a smooth end, at right angles to axis of pipe.
2. Cut pipe with milling type cutter or saw. Do not flame cut.
3. Dress cut ends of push-on joint pipe by beveling, as recommended by manufacturer.

G. Field Welding

1. Field welding of ductile iron pipe is not allowed.
2. Welding for outlets is to be performed only in pipe manufacturer's shop.

a. Field installed outlets may be installed with saddle upon approval of Engineer.
b. Machine cut necessary opening in pipe. Do not use cutting torch.

3. Field welding of bars for restrained joint systems will not be allowed. All welding is to be performed in pipe manufacturer's shop.

H. Unforeseen Obstructions

1. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, Engineer may change the alignment and/or the grades. Make all such changes by the deflection of joints, or by using additional fittings. However, in no case shall the deflection in the joint exceed the maximum designed deflection recommended by the pipe manufacturer. No joint shall be misfit any amount that will be detrimental to the strength and water tightness of the finished joint.

I. Steep Grades

1. Except for short runs which may be permitted by Engineer, lay pipes uphill on grades exceeding 10 percent. Block pipe which is laid on a downhill grade to hold in place until sufficient support is furnished by the following pipe to prevent movement. Install all bends properly as shown on the Contract Drawings.

J. Cold Weather Protection

1. Do not install pipe on a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation. Do not install pipe unless it can be established that the trench will be backfilled before the formation of ice and frost occurs.

3.5 PIPE APPURTENANCES

A. Protection: Where the joining pipe is tape-coated, coat appurtenances with cold-applied tape in accordance with ANSI/AWWA C209, Type II. Where pipe is encased in polyethylene sleeves encase the appurtenances in polyethylene sleeves also.

B. Valve Installation:

1. Handle all valves in a manner to prevent any injury or damage to any part of the valve.
2. Clean and prepare all joints prior to installation.
3. Adjust stem packing and operate each valve prior to installation to assure proper operation.
4. Install all valves in the location shown on the Contract Drawings, with valve stems plumb.

3.6 CORROSION PROTECTION

A. Polyethylene Encasement

1. Encase pipe, fittings, and valves in accordance with ANSI/AWWA C105/A21.5, Method A.
2. Cut polyethylene tube approximately 2 feet longer than pipe length.
3. Slip tube around pipe, centering to provide 1-foot overlap on each adjacent section.
4. Pull encasement to take out slack and wrap snug around pipe.
5. Secure overlap in place and fold at quarter points of pipe length.
6. Wrap and tape encasement snug around fittings and valves.

B. Cathodic Protection
   1. Furnish and install cathodic protection, joint bonding, and test stations in accordance with the Contract Documents.
   2. Double bond all joints.

3.7 METALLIC LOCATING TAPE

A. For buried pipelines, provide a metallic locating tape laid along the centerline of the pipe trench at a depth of 18 inches below finished grade OR above top of pipe. Furnish manufacturer's literature, completely describing the tape proposed to be furnished. Do not install tape prior to receipt of written approval of Engineer.

3.8 FIELD TESTS

A. Conduct testing and disinfection of the pipeline in accordance with Section 33 13 00 – Water Pipeline Testing and Disinfection as applicable.

3.9 CLEANING

A. As pipe laying progresses, keep the pipe interior free of all debris. Completely clean the interior of the pipe of all sand, dirt, mortar splatter, and any other debris following completion of pipe laying, pointing of joints, and any necessary interior repairs prior to testing and disinfecting the completed pipeline.

3.10 PROTECTION

A. Protect the openings of all pipe and specials with suitable bulkheads to prevent unauthorized access by persons, animals, water, or any undesirable substance. At all times, provide means to prevent the pipe from floating.

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SECTION 33 11 11
STEEL PIPE (AWWA C200, MODIFIED)

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall provide mortar-lined steel pipe coated as specified herein, complete, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards: The following standards are listed for convenience only. All specified standards, whether listed or not, shall apply to the Work.

ANSI/ASTM A 20	General Requirements for Steel Plates for Pressure Vessels
ASTM E 165	Practice for Liquid Penetrant Examination
ASTM A 370	Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A 516	Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ANSI/AWWA C200	Steel Water Pipe 6 In and Larger
ANSI/AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In and Larger - Shop Applied
ANSI/AWWA C206	Field Welding of Steel Water Pipe
ANSI/AWWA C207	Steel Pipe Flanges for Waterworks Service 4 in to 144 in
ANSI/AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings
ANSI/AWWA C209	Cold Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
ANSI/AWWA C214	Tape Coating Systems for the Exterior of the Steel Water Pipelines
ANSI/AWWA C215	Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines
ANSI/AWWA C216	Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines

ANSI/AWWA C218	Coating the Exterior of Above Ground Steel Water Pipelines and Fittings
ANSI/AWWA C222	Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings
ANSI/AWWA C602	Cement-Mortar Lining of Water Pipelines 4-In (100 mm) and Larger - In Place
ANSI/ASTM A 36	Carbon Structural Steel
ANSI/ASTM A 283	Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 570	Steel Sheet and Strip, Carbon, Hot-Rolled Structural Quality
ASTM A 572	High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM C 150	Portland Cement
ANSI/AWS D1.1	Structural Welding Code – Steel
API Standard 1104	Welding Pipelines and Related Structures
AWWA M-11	Steel Water Pipe - A Guide for Design and Installation
ASME	Boiler and Pressure Vessel Code

1.3 CONTRACTOR SUBMITTALS

A. Shop Drawings: Submit shop drawings of pipe and fittings in accordance with the requirements in Section 01 33 20 – Submittal Procedures, and the following supplemental requirements as applicable. Fittings and specials shall conform to Section 33 11 12 - Steel Pipe Fabricated Specials. Contractor's submittals for steel pipe and specials shall be coordinated between the sections.

B. Fabrication Information

a. Pipe/fitting wall construction details which indicate the type and thickness of cylinder; the position, type, size, and area of reinforcement; manufacturing tolerances; maximum angular joint deflection limitations; and all other pertinent information required for the manufacture and installation of the product.

b. Welded joint details shall be submitted for all joint types, including beveled ends for alignment conformance and deep bell or butt strap joints required for control of temperature stresses.

c. Rubber gasket joint design and details complete with dimensions, tolerances, and performance or test data.

d. Pipe Fabricator's Credentials: Submit the credentials of the pipe manufacturer/fabricator. Credentials shall include reference names, telephone numbers, and descriptions of projects for pipe conforming to AWWA C200 that is of similar diameter, length, and wall thickness to the pipe

in this project. Project description shall include length, diameter, wall thickness, steel metallurgy, location of facility where pipe was manufactured/fabricated, and names of key plant personnel responsible for the manufacturing process. Submit names and qualifications of current plant personnel to be responsible for manufacture of the pipe in this project

e. Manufacturer's Written Quality Assurance/Control Program.

f. ISO 9001:2000 Certification or Steel Pipe Fabricators Association (SPFA) certification.

2. Materials: Material lists and steel reinforcement schedules which include and describe all materials to be utilized. Metallurgical test reports for steel proposed for use on the project. Submit chemical and physical test reports from each heat of steel that indicate the steel conforms to the Project Specifications.

3. Line Layout Information

a. Line layout and marking diagrams compatible with the requirements of AWWA Manual 11 (M-11) and which indicate the specific mark number of each pipe and fitting and the location of each pipe and the direction of each fitting in the completed line. In addition, the line layouts shall include: the pipe station and centerline elevation at all changes in grade or horizontal alignment; the station and centerline elevation to which the bell end of each pipe will be laid; all elements of curves and bends, both in horizontal and vertical alignment. The location of all mitered pipe sections, beveled ends for alignment conformance, and deep bell or butt strap joints for temperature stress control shall be clearly indicated on the diagrams.

b. Dimensional drawings of all valves, fittings, and appurtenances as specified in Section 40 05 00 – Piping, General.

c. Drawings showing the location and details of bulkheads for hydrostatic testing of the pipeline, and details for removal of test bulkheads and repair of the lining.

d. Details and locations of closures for length adjustment, temporary access manways, vents, and weld lead pass holes as indicated and as required for construction convenience.

4. Welding Information

a. Information regarding location, type, size, and extent of all welds with reference called out for Welding Procedure Specifications (WPS) numbers shall be shown on the shop drawings. The shop drawings shall distinguish between shop and field welds. Shop drawings shall indicate by welding symbols or sketches the details of the welded joints, and the preparation of parent metal required to make them.

b. Written welding procedures for shop and field welds, including Welding Procedure Specifications (WPS's) and Procedure Qualification Records (PQR's).

c. Written nondestructive testing procedure specifications, and nondestructive testing personnel qualifications for shop and field welds.

d. Current welder performance qualifications (WPQ's) shall be submitted for each welder used prior to its performing any Work either in the shop or field. Qualification testing shall be as specified in Article 1.4 - Quality Assurance, Paragraph F, in this Section.

e. Submit the credentials of the Contractor's certified welding inspectors (CWI's) and quality control specialist for review prior to starting any welding

in the shop or field. The credentials shall include, but not be limited to, American Welding Society QC-1 Certification.

f. Submit all nondestructive testing (NDT) data for each shop-welded and field-welded joint. This data shall include all testing on each weld joint, including re-examination of repaired welds, using radiographic, magnetic particle, dye penetrant examination, ultrasonic, or air test examination methods specified. Test data shall be reviewed and signed by the welding inspector(s).

g. Submit a welder log for field and shop welding. Log shall list all welders to be used for the Work and the types of welds each welder is qualified to perform.

h. Submit a welding map showing the sequence of welds for all field welds.

i. Submit a written weld repair procedure for each type of shop and field weld proposed for use on the Project.

j. Submit a written rod control procedure for shop and field operations demonstrating how the Contractor intends to maintain rods in good condition throughout the Work. The rod control procedure shall also demonstrate how the Contractor intends to ensure that the proper rods are used for each weld.

5. Handling and Support Information: Detail drawings indicating the type, number and other pertinent details of the slings, strutting and other methods proposed for pipe support and handling during manufacturing, transport, and installation. Calculations supporting the handling and support system design shall be submitted. Drawings and calculations shall be sealed by a registered professional engineer.

6. Control of Temperature Stresses

   a. Submit proposed sequencing of events to control temperature stresses in the pipe wall during installation prior to starting of any field welding.

   b. Submit the proposed sequencing of events or special techniques to minimize distortion of the steel as may result from shop welding procedures.

   c. Submit plan for monitoring pipeline temperatures.

7. Field Lining

   a. Submit field lining contractor's credentials.

   b. Submit a description of lining equipment and personnel to be used.

   c. Submit written procedures for pipe surface preparation, lining application, and curing.

   d. Submit cement mortar mix design.

C. Certifications: Furnish a certified affidavit of compliance for all pipe and other products, materials, or related work provided under this Section, as specified in ANSI/AWWA C200, C205, C602, and C206, respectively, and the following supplemental requirements:

1. Compliance with the additional requirements included in these Contract Documents.
2. Physical and chemical properties of all steel.
3. Hydrostatic test reports.
4. Results of production weld tests.
5. Sand, cement, and mortar tests.
6. Rubber gasket tests.
7. All materials are NSF approved for use with potable water where applicable.
8. Pipe temperature complies with Specifications prior to pouring pipe zone material, during and between periods of CLSM placement, and prior to and during welding temperature control joints (including supporting data).
9. All welds were performed in conformance with these documents.

D. All expenses incurred in making samples or collecting data for certification of tests shall be borne by the Contractor at no increased cost to the Owner.

1.4 QUALITY ASSURANCE

A. Inspection: All pipe, linings, welds, coatings, and related work shall be subject to inspection at the place of manufacture and/or the place the Work is performed in accordance with the provisions of ANSI/AWWA C200, C205, C206, C602, C209, C214, C215, and C222 as applicable, as supplemented by the requirements herein. Notify the Engineer in writing not less than 14 calendar days prior to the start of any phase of the pipe manufacture, welding, lining, coating, testing, or field operations.

B. Tests: Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of ANSI/AWWA C200, C205, C206, and C602, as applicable.

1. After the joint configuration is completed and prior to lining with cement-mortar, if applicable, each length of pipe of each diameter and pressure class shall be shop-tested and certified to a pressure of at least 75 percent of the minimum yield strength of the pipe steel. Test pressure shall be maintained for a sufficient time to observe the weld seams. There shall be no leaks. Any leaks shall be repaired and the pipe retested.
2. Production weld tests as required in ANSI/AWWA C200, except weld tests shall be conducted on each 5,000 feet of production welds at a minimum, and at least one set of tests per operator per work shift shall be performed.

C. Perform said material tests at no additional cost to the Owner. The Engineer shall have the right to witness all testing conducted by the Contractor; provided that the Contractor's schedule is not delayed for the convenience of the Engineer.

D. In addition to those tests specifically required, the Engineer may request additional samples of any material including mixed concrete and lining and coating samples for testing by the Owner. The additional samples shall be furnished at no additional cost to the Owner.

E. Welding Procedure Specifications: All welding procedures used to fabricate and install pipe shall be in accordance with the ASME Boiler and Pressure Vessel Code (BPVC) for shop welds and ANSI/AWS D1.1 for field welds. Written welding procedures shall be required for all welds, both shop and field. Welds qualified per the ASME BPVC shall include Supplementary Essential Variables for notch-tough welding. All provisions of ANSI/AWS D1.1 pertaining to notch-tough welding shall apply.

F. Welder Performance Qualifications: All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified by the Contractor under the provisions of ASME BPVC for shop welds and ANSI/AWS D1.1 for field welds. Furnish all material and bear the expense of qualifying welders.

G. Shop Nondestructive Testing: Nondestructive testing shall be performed for various weld categories as specified below. Testing shall include submitting written documentation of procedures per Section V, and acceptance criteria shall be in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code.

1. Butt Joint Welds: Spot radiographically examine pipe in accordance with Paragraph UW-52 of the ASME Boiler and Pressure Vessel Code Section VIII, Division 1. If, in the opinion of the Engineer, the butt joint welds cannot readily be radiographed, they shall be 100 percent ultrasonically examined.
2. Fillet Welds: 100 percent examine all fillet welds using the magnetic particle inspection method.
3. Groove Welds: 100 percent ultrasonically examine all groove welds that cannot be readily radiographically spot examined.
4. All Welds: Certified welding inspector shall 100 percent visually examine all welds as a minimum.
5. In addition to weld tests hereinbefore specified, doubler pads shall be air tested as stated in AWWA C206.
6. Refer to Section 33 13 00 – Water Pipeline Testing and Disinfection for field nondestructive testing.

H. Onsite Observation: The pipe fabricator shall provide an experienced staff member to train the contractor's installation crews regarding pipe handling, jointing, and backfilling. Training shall be provided for a minimum of two weeks at the beginning of the project, and as needed during construction. The staff member's duties shall include, but not be limited to, the following:
1. Observe the installation and welding of the pipe and fittings.
2. Report any concerns to the Engineer's onsite observer.
3. Answer questions and provide assistance to the Engineer and the Contractor.

I. Certified Welding Inspector (CWI): Furnish the services of a certified welding inspector(s) for all shop and field welding as specified in AWWA C200 and C206. The certified welding inspector(s) shall 100 percent visually inspect all welds, verify proper procedures are being followed using qualified welders, supervise Contractor's non-destructive testing, and witness Engineer's non-destructive testing. The welding inspector(s) shall submit written certification that all welds were performed in conformance with these documents. All shop weld tests shall be reviewed and signed by the inspector(s).

J. Pipe Manufacturer/Fabricator: The manufacturer or fabricator of the pipe shall be experienced in fabricating pipe of similar diameters and wall thicknesses required for this Work and shall have the manufacturing capability to meet the schedule requirements of this project. Experience shall include successful fabrication to AWWA C200 standards of at least 30,000 linear feet of 30-inch and larger pipe with wall thicknesses 0.25- inch or larger within the 4-year period preceding the bid date. This experience requirement shall apply to the fabrication plant facility and responsible personnel, not to the firm which owns the facility or employs the personnel.

K. Single Manufacturer: A single manufacturer shall be made responsible for coordination of design, fabrication, testing, and furnishing of mainline pipe and fabricated specials. Separate suppliers for mainline pipe and specials will not be allowed.

PART 2 - PRODUCTS

2.1 GENERAL

A. Unless otherwise indicated, steel pipe, linings and coatings shall conform to ANSI/AWWA C200, C205, C602, C209, C214, C215, C216, and C222, as applicable, subject to the following supplemental requirements. The pipe shall be of the diameter and wall thickness shown, shall be furnished complete with welded or gasket joints, as indicated in the Contract Documents, and all specials shall be provided as required in Section 33 11 12 - Steel Pipe Fabricated Specials. For pipe larger than 24 inches in diameter, the inside diameter after lining shall not be less than the nominal diameter indicated unless otherwise shown. Pipe 24 inches in diameter and smaller may be provided in standard outside diameters.

B. Markings: Legibly mark all pipes and specials in accordance with the laying schedule and marking diagram. Each pipe shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. All special pipe sections and fittings shall be marked at each end with top field centerline. The word "top" shall be painted or marked on the outside top spigot of each pipe section.

C. Handling and Storage: The pipe shall be handled by use of wide slings, padded cradles, or other devices, designed and constructed to prevent damage to the pipe coating/exterior. The use of chains, hooks, or other equipment which might injure the pipe coating/exterior will not be permitted. Stockpiled pipe shall be suitably supported and shall be secured to prevent accidental rolling and to avoid contact with mud, water, or other deleterious materials. Stockpiled pipe shall be supported on sand or earth berms free of rock exceeding 1 inch in diameter. The ends of all pipe shall be securely bulkheaded or otherwise sealed during transport to the jobsite. All pipe handling equipment and methods shall be acceptable to the Engineer.

D. Pay the cost of replacement or repair of pipe which is damaged at no increased cost to the Owner.

E. Strutting: Adequate strutting (stulling) shall be provided on all specials, fittings, and straight pipe to avoid damage or distortion to the pipe and fittings during handling, storage, hauling, and installation. The following requirements shall apply:
   1. The strutting shall be placed as soon as practicable after the pipe is fabricated or the mortar lining has been applied and shall remain in place while the pipe is loaded, transported, unloaded, installed and backfilled at the jobsite.
   2. The strutting materials, size and spacing shall be the responsibility of the Contractor and shall be adequate to prevent deflection and support the earth backfill plus any greater loads which may be imposed by the backfilling and compaction equipment. One strut shall be placed vertical oriented with the top of pipe. One set of struts shall be set 2 feet from each end of each pipe section and at a maximum interval of 15 feet in-between
   3. Any pipe damaged during handling, hauling, storage, or installation due to improper strutting shall be repaired or replaced.

F. Laying Lengths: Maximum pipe laying lengths shall not be limited unless specifically required by the Drawings. Contractor shall select lengths to accommodate the Contractor's operation.

G. Lining: The pipe lining shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness.

H. Cathodic Protection System: Cathodic protection systems shall be applied to pipelines as shown on the Drawings. Refer to Division 13 – Special Construction.

I. Closures and Correction Pieces: Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing indicated. The locations of correction pieces and closure assemblies shall be shown on the pipe layout diagrams and shall be subject to the Engineer's review. Any change in location or number of said items shall be approved by the Engineer.

J. Shop-Welded Surfaces: All weld seams on pipe surfaces that will have a flexible tape or polyolefin coating in accordance with Section 09 90 10 – Pipeline Coatings and Linings shall be ground such that the maximum weld bead height will not exceed 1/32 inch. All ground weld seams shall be smooth and free of all burrs. Do not grind into, or gouge, the adjacent pipe wall material.

2.2 MATERIALS

A. Cement: Cement for mortar shall conform to the requirements of ANSI/AWWA C205; provided, that cement for mortar coating shall be Type V, and mortar lining shall be Type II ori V, per ASTM C 150. Fly ash or pozzolan shall not be used as a cement replacement.

B. Steel: Provide steel coils for spiral welded steel pipe or steel plate for straight seam welded steel pipe per AWWA C200 and as follows:
   1. Yield Strength: 42,000 psi minimum. Measured yield strength shall not exceed 85% of measured tensile strength.
   2. Minimum Tensile Strength: 60,000 psi
   3. Coils: Steel coils shall be made from the continuous cast process or continuous cast slabs, fully killed, fine-grain practice conforming to the physical and chemical characteristics of ASTM A1018/A1018M, SS Grade 45. For sheet steel, the maximum allowable thickness variation shall be 0.010 inch under or over the nominal thickness.
   4. Plate: Steel plate shall be fully killed, conform to ASTM A20, and be manufactured to fine-grain practice conforming to the physical and chemical characteristics of ASTM A572/A572M, Grade 50. For plate steel, the maximum allowable thickness variation shall be 0.010 inch under or over the nominal thickness.

C. Pipe shall be manufactured as fabricated pipe per AWWA C200 as modified herein. ASTM pipe manufacturing standards referenced in AWWA C200 shall not be used. Pipe sections shall be fabricated by either of the following methods:
   1. Pipe sections may be spirally welded or fabricated from short cylindrical courses joined circumferentially by complete penetration butt joint welds with not more than two longitudinal seams per course. Longitudinal seams shall be staggered on both sides of the pipe.
   2. Pipe sections may be rolled or pressed from no more than three sheets the full length of the pipe and welded with no more than three longitudinal seams. Patching inserts, overlays, or pounding out of dents will not be permitted. Repair of notches or laminations on second ends will not be permitted. Damaged ends shall be removed

as a cylinder and the section end properly prepared. Distorted or flattened lengths shall be rejected. A buckled section shall be replaced as a cylinder.

D. Charpy Tests

1. General. Steel used in production manufacturing of pipe and specials shall be tested for notch toughness using Charpy V-Notch tests per ASTM A 370. The test acceptance shall be 25 foot-pounds at a test temperature of 30 degrees F.
2. Charpy V-Notch tests shall be conducted on all steel used in fabricating pipe and reinforcement materials 0.5-inch or greater in thickness. Test outside diameter wrap of two coils minimum per heat lot.
3. The Owner may elect to increase the Charpy testing to include more steel than indicated above at a negotiated price.

2.3 SPECIALS AND FITTINGS

A. Unless otherwise required, all specials and fittings shall be in accordance with Section 33 11 12 – Steel Pipe Fabricated Specials and shall conform to the dimensions of ANSI/AWWA C208.

2.4 DESIGN OF PIPE

A. General: The pipe shall be steel pipe, mortar-lined and flexible or mortar-coated as shown on the Drawings, with field welded joints or gasket as indicated. The pipe shall consist of a steel cylinder, lined with portland cement-mortar as indicated, with an exterior coating as indicated in Section 09 90 10 – Pipeline Coatings and Linings. Field lining will only be allowed where specifically indicated on the Drawings.

B. The pipe shall be manufactured, tested, inspected, and marked according to applicable requirements previously stated and except as hereinafter modified, shall conform to ANSI/AWWA C200.

C. Pipe Dimensions: The pipe shall be of the diameter and wall thickness shown on the Drawings. The minimum steel cylinder thickness for each pipe size shall be as indicated.

D. Specials Dimensions: The specials shall be of the diameter and wall thickness indicated on the Drawings, or as specified in Section 33 11 12 - Steel Pipe Fabricated Specials.

E. Joint Design: Unless otherwise shown on the Drawings, the standard field joint for steel pipe shall be a double-welded (fully circumferential)lap joint. Mechanically coupled, or flanged joints shall be required where indicated on the Drawings. Butt-strap joints shall be used only where required for closures or where indicated. The joints furnished shall have the same or higher-pressure rating as the abutting pipe. Provide air test tapped holes for each double welded lap joint as defined in Section 33 13 00 - Water Pipeline Testing and Disinfection.

F. Lap joints prepared for field welding shall be in accordance with ANSI/AWWA C200. The method used to form, shape and size bell ends shall be such that the physical properties of the steel are not substantially altered. Unless otherwise approved by the Engineer, bell ends shall be formed by an expanding press or by the pipe being moved axially over a die in such a manner as to stretch the steel plate beyond its elastic limit to form a truly round bell of suitable diameter and shape. The ends shall not be rolled. Faying surfaces of the bell and

spigot shall be essentially parallel, but in no case shall the bell slope vary more than 2 degrees from the longitudinal axis of the pipe.

G. Moderate deflections and long radius curves may be made by means of beveled joint rings, by pulling standard joints, by using short lengths of pipe, or a combination of these methods; provided that pulled joints shall not be used in combination with bevels and maximum joint deflections are not exceeded. The maximum total allowable angle for beveled joints shall be 5 degrees per pipe joint. Bevels shall be provided on the bell ends. Mitering of the spigot ends will not be permitted. The maximum allowable angle for pulled joints shall be 75 percent of the manufacturer's recommendations or the angle which results from a ¾-inch pull out from normal joint closure, whichever is less. In no case shall pulled joints result in a gap between the bell and spigot at the weld location that exceeds 1/8 inch. All horizontal deflections or fabricated angles shall fall on the alignment, as shown.

H. All vertical deflections shall fall on the alignment within laying tolerance as described in Section 3.1.

I. Shop-applied interior linings and exterior coatings shall be held back from the ends of the pipe as indicated or as otherwise acceptable to the Engineer. Holdback areas shall be coated as hereinafter specified.

J. Temperature Control Lap Joint: A special longer bell end (temperature control lap joint) shall be provided at a maximum spacing of 400 feet to account for movement of the installed pipe due to temperature changes. The pipe manufacturer shall determine the length required for the longer bell as defined by the Contractor's pipe laying procedures and the location of the special bell. Minimum temperature control lap joint length shall be as shown on the Drawings.

K. Joint Shop Coating: All holdback areas for welded joints, all butt straps, and all bell and spigot joint rings for rubber-gasketed joints shall be thoroughly cleaned and given a shop coat of rust-inhibitive primer. The surface preparation and primer shall be compatible with the intended finish coating as specified in Section 09 90 0 – Protective Coatings and Linings, Section 09 90 10 – Pipeline Coatings and Linings, as applicable.

L. Shop Fit Test
1. To ensure that joints may be fully assembled and that excessive annular space between spigots and bells does not exist, and that the pipe meets the requirements of AWWA C200, the pipe fabricator shall perform a shop fit test on a minimum of five joints. The joints to be tested shall be selected by the Engineer based on pipe measurements.
2. The shop fit test shall join the pipe ends in the shop with the proposed adjacent pipe end.
3. Record the actual annular space, with the data to include as a minimum:
4. Maximum space at any point.
5. Minimum space at any point.
6. Space at 90-degree intervals--top, bottom, and spring line on both sides.

M. The pipe ends shall be match marked after shop assembly.

2.5 CEMENT-MORTAR LINING

A. Cement-Mortar Lining for Shop Application: Where indicated on the Drawings, interior surfaces of all steel pipe, fittings, and specials shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C205. During the lining operation and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting. The lining machines shall be of a type that has been used successfully for similar work and shall be approved by the Engineer. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at the delivery site, or after installation, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications at no additional cost to the Owner.

B. The minimum lining thickness shall be in accordance with Section 09 90 10 – Pipeline Coatings and Linings.

C. The pipe shall be left bare where field joints occur as indicated. Ends of the linings shall be left square and uniform. Feathered or uneven edges will not be permitted.

D. Defective linings, as determined by the Engineer, shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective linings shall be cut back to a square shoulder to avoid feather edged joints. Temperature and shrinkage cracks in the mortar less than 1/16 inch wide need not be repaired. Pipe, specials, or fittings with cracks wider than 1/16 inch shall be rejected or repaired per AWWA C205 at the discretion of the Engineer.

E. The progress of the application of mortar lining shall be regulated in order that all hand work, including the repair of defective areas is cured in accordance with the provisions of ANSI/AWWA C205. Cement-mortar for patching shall be the same materials as the mortar for shop or machine lining, except that a finer grading of sand and mortar richer in cement shall be used when field inspection indicates that such mix will improve the finished lining of the pipe.

F. Cement-Mortar Lining: Unless otherwise indicated, all steel pipe shall be mortar-lined. The materials and design of in-place cement-mortar lining shall be in accordance with ANSI/AWWA C602 and the following supplementary requirements:
   1. Pozzolanic material shall not be used in the mortar mix.
   2. Admixtures shall contain no calcium chloride.
   3. The minimum lining thickness shall be as indicated for shop-applied cement-mortar lining and finished inside diameter after lining shall be as indicated.
   4. Temperature and shrinkage cracks in the mortar less than 1/16 inch wide need not be repaired. Pipe, specials, or fittings with mortar cracks wider than 1/16 inch shall be rejected or repaired at the discretion of the Engineer.
   5. Field applied mortar lining shall meet the requirements of this Subparagraph F.
   6. Grout mixture for field applied joint lining shall include two parts sand to one part Portland Cement by volume and potable water. NSF approved acrylic latex admixture (Flex-Con, or equal) shall be added to mortar as needed to make dough like consistency for hand packing into joint area.

G. Protection of Pipe Lining/Interior: For all pipe and fittings with plant-applied cement-mortar linings, provide a polyethylene or other suitable bulkhead on the ends of the pipe and on all

special openings to prevent drying out of the lining. All bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

2.6 EXTERIOR COATING OF PIPE

A. Exterior Coating of Steel Pipe: The exterior coating of all steel pipe shall be in accordance with Section 09 90 10 – Pipeline Coatings and Linings.

2.7 PIPE APPURTENANCES

A. Pipe appurtenances shall be in accordance with the requirements of Section 40 05 00 – Piping, General.

2.8 PIPELINE MARKING TAPE

A. Metallic tape: HyTech Detectable Tape manufactured by NorthTown Pipe Protection Products; or approved equal, having the following essential characteristics:
   a. Aluminum foil encased in high visibility inert polyethylene jacket.
   b. Total thickness: 5.0 mils, minimum.
   c. Width: 6 inches, minimum.
   d. Imprinted on one side, 1-inch-tall, permanent black lettering.
   e. Color: as listed below.
   f. Joining clips shall be manufacturer's standard
   g. Tape shall read for example "JVWCD-Buried Pipeline Below".

B. Plastic tape: Terra Tape manufactured by Reef Industries, Inc., 9209 Alemeda Genoa Road, Houston, TX 77075, www.reefindustries.com; or equal, having the following essential characteristics:
   a. Polyolefin or similar chemically inert material unsusceptible to alkalies, acids, and chemicals and solvents likely in the soil.
   b. Thickness: 4.0 mil, minimum.
   c. Width: 12 inches minimum.
   d. Color: as listed in below.
   e. Imprinted on one side, 1-inch-tall, permanent black lettering on a colored background.
   f. Tape shall read for example "JVWCD-Buried Pipeline Below".

2.9 MARKERS

A. Provide pipeline markers at the locations indicated. Markers in open areas shall be High Visibility Tri-View Utility Marking Posts as manufactured by Rhino Marking and Protection Systems (www.rhinomarkers.com). Coordinate color and lettering with Owner prior to installation. Markers shall be provided at the following locations:
   1. Both sides of street and canal crossings.
   2. At locations of cathodic protection test stations (see test station table).
   3. At the beginning and end of open areas and at a maximum interval of 500-ft.

B. Brass Caps: Caps shall be 2-1/2-inch diameter brass caps with posts set by epoxy into holes drilled into the curb adjacent to the pipeline. Brass caps and monuments shall be provided

in locations as described in the plans. Caps shall be stamped as shown on the details and shall be provided at the following locations:

1. Fittings, bends, deflections or elbows
2. Both sides of street and canal crossings
3. Within deck of concrete structures (manholes, vaults, etc.)
4. Minimum distance of 1,000LF along pipeline

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPE

A. Handling and Storage: All pipe, fittings, and specials shall be carefully handled and protected against damage to lining and coating/interior and exterior surfaces, impact shocks, and free fall. All pipe handling equipment shall be acceptable to the Engineer. Pipe shall not be placed directly on rough ground but shall be supported in a manner which will protect the pipe against injury whenever stored at the trench site or elsewhere. Pipe shall be handled and stored at the trench site in accordance with the requirements stated below. No pipe shall be installed when the lining or coating/interior or exterior surfaces show cracks or other damage that may be harmful as determined by the Engineer. Such damaged lining and coating/interior and exterior surfaces, shall be repaired to the satisfaction of the Engineer, or a new undamaged pipe shall be furnished.

B. All pipe damaged prior to Substantial Completion shall be repaired or replaced by the Contractor at no additional cost to the Owner.

C. Inspect each pipe and fitting to ensure that there are no damaged portions of the pipe. Remove or smooth out any burrs, gouges, weld splatter or other small defects prior to laying the pipe.

D. Before placement of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance, which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption to the Work.

E. Lifting points shall be no closer than the 1/3 and 2/3 points along the length of the Section. Contractor shall be responsible for selecting lifting points that, when used, do not result in damage to the pipe.

F. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.

G. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the Engineer may change the alignment and/or the grades. Such change shall be made by the deflection of joints, short lengths of pipe, by the use of beveled joint rings, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed 75 percent of the maximum deflection recommended by the pipe manufacturer or the amount that results in more than a 1/8-inch gap at the weld location, whichever is less. No joint shall be misfit

any amount which will be detrimental to the strength and water tightness of the finished joint.

H. Except for short runs which may be permitted by the Engineer, pipes shall be laid uphill on grades exceeding 10 percent. Pipe which is laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement. All bends shall be properly installed as shown.

I. Pipe struts shall be left in place until backfilling operations have been completed for pipe 42 inches in diameter and larger. Struts in pipe smaller than 42 inches may be removed immediately after laying, provided that the deflection of the pipe during and after backfilling does not exceed that specified. After the backfill has been placed to a minimum of 3 feet, the struts shall be removed by the Contractor and shall remain the property of the Contractor. Struts shall not be removed with a torch or any other method that may damage the pipe lining or coating. The parent pipe material shall not be nicked, gouged, or damaged during strut removal. All repairs of gouges or nicks in the parent material shall be made using 3/32-inch maximum diameter E-6010 welding electrodes with a maximum heat input of 5.6 kj per inch. Tack welds, stull metal, weld splatter, slag, and burrs that remain attached to the parent metal surface after cutting shall be ground to within 1/32 inch of the parent metal. Grinding shall not penetrate the parent metal. The Contractor shall notify the Engineer prior to grinding. Following grinding, all pipe surfaces at the tack weld shall be visually inspected for defects. All defects deeper than 1/16 inch shall be repaired by welding in accordance with ANSI/AWSD.1.1 and AWWA/ANSI C206. All inspection work shall be performed by a certified welding inspector.

J. For pipe backfilled with CLSM, the pipe shall be laid directly on moist sandbags or other suitable supports approved by the Engineer in preparation for CLSM pipe zone material. Sandbags shall be placed to provide at least 6 inches of CLSM below the bottom of the pipe. Sandbags shall be spaced at a maximum interval of 8 feet and one set shall be placed within 3 feet on both sides of each joint. The Contractor shall provide additional sandbags as needed to support the pipe on line and grade. For pipe bedded in granular material, no blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.

K. At all times, means shall be provided to prevent the pipe from floating. Take all necessary precautions to prevent the pipe from floating due to water entering the trench or from backfilling with CLSM. The Contractor shall assume full responsibility for any damage due to this cause and shall at its own expense restore and replace the pipe to its specified condition and grade if it is displaced due to floating. Maintain the inside of the pipe free from foreign materials and in a clean and sanitary condition until its acceptance by the Owner.

L. Bulkheads

1. Prior to shipment of pipe with cement mortar lining the lining shall be wetted then a suitable bulkhead shall be attached to each end of the pipe section. This bulkhead shall remain in place and in good condition through transit to the Project.

2. During construction the openings of all pipe and specials where the pipe and specials have been cement-mortar lined in the shop shall be protected with suitable bulkheads to maintain a moist atmosphere and to prevent unauthorized access by persons, animals, water or any undesirable substance. The bulkheads shall be designed to prevent drying out of the interior of the pipe. Introduce water into the pipe as needed to keep the mortar moist where moisture has been lost due to damaged bulkheads.

M. Pipe Cleanup: As pipe laying progresses, keep the pipe interior free of all debris. Completely clean the interior of the pipe of all sand, dirt, mortar splatter and any other debris following completion of pipe laying and any necessary interior repairs prior to testing and disinfecting the completed pipeline.

N. Installation Tolerances: Each section of pipe shall be laid in the order and position shown on the laying diagram and the following requirements:

1. Each section of pipe having a nominal diameter less than 48 inches shall be laid to line and grade, within plus or minus 2 inches horizontal deviation and plus or minus 1-inch vertical deviation.
2. Each section of pipe having nominal diameter 48 inches and larger shall be laid to line and grade, within plus or minus 5 percent of diameter horizontal deviation and plus or minus 2.5 percent of diameter vertical deviation.
3. In addition to the horizontal and vertical tolerances above, lay the pipe so that no high or low points other than those on the laying diagram are introduced.
4. Pipe deflection, after backfill but prior to installation of field-applied cement mortar lining, if applied, shall not exceed 2.25 percent for flexible coated pipe and 1.5 percent for cement mortar coated pipe. Deflection shall be measured by the difference in vertical inside diameter in the installed pipe and the manufactured pipe.
5. Pipe not conforming to these criteria or which otherwise impact the ability to complete the Work shall be removed and reinstalled in full conformance with the Contract Documents at no additional cost to the Owner.
6. For each section of pipe, record the invert elevation at the lower end and incorporate the data on the Record Drawings.

O. Protection of Pipe: At locations where the Contractor proposes to cross the installed pipeline with heavy equipment, precautions as approved by the Engineer shall be taken to protect the pipe from damage. Acceptable precautions include: backfilling the pipe trench as necessary to protect the pipe, concrete encasing the pipe, and placing steel plating over the pipe. Any damage to the pipe caused by the Contractor's operation or his equipment shall be repaired at no additional cost to the Owner.

3.2 WELDED JOINTS

A. Welding Procedures, Welding Qualifications, and Testing:

1. Field welding procedures, welders, welding operators, and tackers shall be qualified in accordance with AWS D1.1 and as defined in Section 3 of ANSI/AWWA C206 or ANSI/AWWA C200, as applicable. All qualifications shall be in accordance with all-position pipe tests as defined in Section 5 of AWS D1.1.
2. For field welding, the welder qualification testing shall be performed at the site. Previous qualifications will not be accepted. The Contractor shall obtain the services of an independent testing laboratory to perform the welder qualification onsite.

Copies of all test data and certifications shall be provided to the Engineer. All costs for welder qualification testing shall be at no increased cost to the Owner.

3. Upon completion of each field-welded joint, the welding operator shall mark his regularly assigned identification number and the last two numbers of the year in which the Work was completed, or the Contractor may have a records system that traces a welder's work completion to a specific joint. Steel stamping directly on piping will not be permitted unless "low stress" die stamps, such as interrupted dot or round nose types, are used.
4. All single welded lap joints will be inspected by the CONTRACTOR in the presence of the Engineer using magnetic particle or dye penetration methods. Field butt welds will be inspected by the CONTRACTOR in accordance with the requirements of API 1104 by the radiographic method and the acceptance criteria of API 1104. Magnetic particle testing is not required for seal welds.
5. All double welded lap joints and butt strap joints shall be air tested by the CONTRACTOR in the presence of the Engineer in accordance with Section 33 13 00 - Water Pipeline Testing and Disinfection. Repairs and retesting shall be required if any loss of pressure occurs. All double welded lap joints will also be inspected by the CONTRACTOR in the presence of the Engineer using magnetic particle or dye penetration methods.
6. The Contractor shall inform the Engineer before completed weld joints are to be backfilled so that the joint may be inspected. The Contractor shall assume all costs of exposing backfilled joints for inspection when backfilling preceded the inspection.
7. Personnel performing visual inspection of welds shall be qualified and currently certified as Certified Welding Inspectors (CWI) in accordance with AWS QC1, Standard for Qualification and Certification of Welding Inspectors. Personnel performing nondestructive tests shall be qualified and certified to the requirements of SNT-TC-1A.
    a. The Engineer may also order nondestructive testing by an independent testing laboratory in addition to any testing specified herein. Except as otherwise specified herein, all costs for the independent testing laboratory to inspect and test field welds will be paid for by the Owner. If the weld is defective, the inspection costs shall be paid for by the Contractor. Defective welds shall be repaired and retested at the Contractor's expense.
    b. Test reports of all laboratory tests shall be submitted as provided in the quality control section.

B. Where exterior welds are performed, adequate space shall be provided for welding and inspection of the joints.

C. Lap Welded Joints: During installation of welded steel pipe in either straight alignment or on curves, the pipe shall be laid so that at any point around the circumference of the joint there is a minimum lap as shown on the Drawings.

D. Butt Straps: Where used or required, shall be as shown on the Drawings.

E. After the pipe and pipe joint are properly positioned in the trench, weld and provide external joint protection for all joints except the special temperature control lap joint hereinafter specified. The length of pipe between special temperature control joints shall be backfilled to at least one foot above the top of the pipe as hereinafter specified. The special temperature control joints shall be welded after the pipe is backfilled to at least one foot above the top of

the pipe for the full distance between the temperature control joints upstream and downstream. Joint protection shall be provided for special temperature control joints after completion of the joint welds and tests as specified. Care shall be exercised during the initial backfilling to prevent movement of the pipe and to prevent any backfill material from being deposited on the special temperature control joint.

F. Control of Temperature Stresses

1. Control temperature stresses in accordance with AWWA C206, the approved temperature stress control submittal, and these Specifications. Provide special temperature control lap joints at intervals of 400 feet or less, unless otherwise approved by the Engineer.
2. To control temperature stresses, the unbackfilled special temperature control joint areas of all pipe shall be shaded from the direct rays of the sun by the use of properly supported awnings, umbrellas, tarpaulins, or other suitable materials until the pipe is backfilled at least 1 foot over the top of the pipe. The term "special temperature control joint area" is defined as the entire length of pipe left exposed near a control joint after placing the backfill between it and the other control joints in each direction. Shading materials at the joint area shall not rest directly on the pipe but shall be supported to allow air circulation around the pipe. Shading of the pipe joints need not be performed when the ambient air temperature is below 45 degrees F.
3. At intervals not exceeding 400 feet along welded reaches of the pipeline, at the first regular lap-welded field joints outside concrete encasements and structures, and where shown, the pipe shall be supplied with a special temperature control lap joint and laid with an initial lap of not less than 3 inches greater than the typical lap joint. Where temperature control lap joints occur in a traveled roadway or other inconvenient location, the location of the joint may be adjusted, as acceptable to the Engineer.
4. Provide and install thermocouple temperature gauges to monitor the temperature of the steel pipe wall on the inside top of the pipe as it lays in the trench. All pipe temperature requirements specified herein shall be measured at the top inside of the steel cylinder. Specific temperature requirements for the pipeline steel cylinder shall be met prior to installation of the controlled low strength material (CLSM), during and after placement of CLSM, and during welding of the special temperature control joints. If atmospheric conditions do not allow the conditions to be met, supplemental cooling shall be required by the Contractor. The following outlines the specific temperature control requirements.
    a. Prior to and during placement of the CLSM, the pipeline steel temperature shall be at or below 90 degrees F. The specified temperature shall be maintained for at least three hours after the placement of CLSM. The specified temperature shall be maintained until the line is fully backfilled. Provide supplemental cooling as required.
    b. Placement of CLSM shall proceed in the direction of pipe laying from one special temperature control joint to the next. During placement of CLSM, the lead end of the pipe section (toward the next special temperature control joint) shall be left unbackfilled or otherwise unrestrained such that the end of the pipe is free to move in response to expansion or contraction due to temperature changes. CLSM shall not be placed in a direction which would result in CLSM placement proceeding in a direction toward previously or simultaneously placed CLSM without the written permission of the Engineer. The direction of CLSM placement will not be limited for placement at the short

unbackfilled section immediately adjacent to the special temperature control joints.

c. During periods between CLSM placement operations, any section of pipeline that is backfilled with CLSM shall be shaded from the direct rays of the sun by the use of properly supported awnings, umbrellas, tarpaulins, or other suitable materials until the pipe is backfilled at least 1 foot over the top of the pipe. The temperature of the partially backfilled pipe shall not be allowed to exceed 110 degrees Fahrenheit at any time. Provide supplemental cooling as required. Shading materials shall not rest directly on the pipe but shall be supported to allow air circulation around the pipe. Shading of the partially backfilled pipe need not be performed when the Contractor can demonstrate to the satisfaction of the Engineer, using thermocouple data, that shading is not necessary to the Contractor to meet the specified temperature requirement.

d. Prior to welding the special temperature control joints, the pipeline extending 400 feet each direction from the joint shall be maintained at or below 85 degrees F. Additionally, the pipeline extending 400 feet each direction from the joint shall be backfilled with CLSM to at least one foot over the top of the pipe. At the specified temperature, the special temperature control joints can be welded. Begin and complete the weld during the coolest interval of suitable length within a 24-hour day. Use the thermocouple temperature data to demonstrate to the Engineer the coolest interval of the day.

e. After welding any temperature control joint, the pipe temperature for 150 feet in each direction from the control joint shall be maintained below 110 degrees F for a minimum of 24 hours after the temperature control joint area has been backfilled to at least 1 foot over the top of the pipe. This requirement is in addition to the shading and CLSM placement temperature requirements indicated herein.

G. Prior to the beginning of pouring CLSM or beginning the welding procedure, any tack welds or joint stops used to position the pipe during laying shall be removed. Any annular space between the faying surfaces of the bell and spigot shall be equally distributed around the circumference of the joint by shimming, jacking, or other suitable means. The weld shall then be made in accordance with ANSI/AWWA C206. Where more than one pass is required, all dirt, slag, and flux shall be removed before the succeeding bead is applied.

H. Testing of Joints: The pipeline joints shall be tested as specified herein and in Section 33 13 00 - Water Pipeline Testing and Disinfection.

I. Following tests of the joint, the exterior joint spaces shall be coated in accordance with these Specifications after which backfilling may be completed.

J. Joints: The pipe ends shall be cut straight on joints where butt straps are used for realignment, adjustment, or deflection, and fillet welds shall be made as indicated.

K. Repair of Welds: All welds that are defective shall be repaired by the Contractor to meet the requirements of this Section at no additional cost to the Owner. Defects in welds or defective welds shall be removed, and that section of the joint shall then be rewelded. Only sufficient removal of defective material that is necessary to correct the defect is required. After the

repair is made, the joint shall be checked by repeating the original test procedure. Welds deficient in size shall be repaired by adding weld metal.

3.3 JOINT COATING AND LINING

A. General: The interior and exterior joint recesses shall be thoroughly wiped clean and all water, loose scale, dirt and other foreign material shall be removed from the inside surface of the pipe. The grout for joint coating and lining shall be cement grout in accordance with Section 03 60 00 - Grouting, except that composition shall be one part cement to two parts sand and sufficient water for dry-pack consistency

B. Joint Coating: In accordance with the requirements of Section 09 90 10 – Pipeline Coatings and Linings.

C. Joint Lining:
1. Clean joint to remove dirt, debris, and other contaminants.
2. Apply a single application of NSF approved acrylic latex bonding admixture (Flex-Con, or equal) to wet out joint for the promotion of adhesion.
3. The grout for joint lining shall be cement grout in accordance with Section 03 60 00 – Grouting, except that composition shall be one part cement to two parts sand and sufficient water for dry-pack consistency. NSF approved acrylic latex admixture shall be added to develop a dough like consistency.
4. Mortar mixture is hand packed into the joint area.
5. Joint is troweled smooth to create a uniform transition between existing mortar lined pipe.
6. Joint area is swept clean of debris.
7. After the backfill has been completed to final grade, the interior joint recess of shop-lined pipe shall be filled with grout, tightly packed into the joint recess and troweled flush with the interior surface. All excess shall be removed. At no point shall there be an indentation or projection of the grout exceeding 1/16 inch. With pipe smaller than 24 inches in diameter, before the spigot is inserted into the bell, the bell shall be daubed with grout containing one part cement to two parts sand. The spigot end then shall be forced to the bottom of the bell and excess mortar on the inside of the joint shall be swabbed out.

3.4 CEMENT-MORTAR LINING, FIELD-APPLIED

A. Unless otherwise indicated, the Contractor shall construct the cement-mortar lining in-place after the pipeline is backfilled to approximate finished grade. The application of in-place cement-mortar lining shall be in accordance with ANSI/AWWA C602.
1. The lining machine shall be of a type that has been used successfully for a similar size of pipe. Perform all Work in a thorough and workmanlike manner by trained personnel, under the supervision of experienced personnel skilled in machine application of cement-mortar lining to pipelines of size comparable to this Work.
2. Curing of the in-place cement-mortar lining shall be in accordance with ANSI/AWWA C602, except the Contractor shall be responsible for curing and maintaining the lining until final acceptance by the Owner. Provide a system to maintain a suitably moist environment within the pipe to properly cure and maintain the lining. Provide additional protective devices as required to ensure that the airtight covers, which maintain a moist condition in the pipeline, are not damaged.

3. Defective areas encompassing the full diameter of the pipe shall be replaced by machine wherever the length measured along the pipe centerline is greater than 5 feet; otherwise defective areas may be replaced by hand.

3.5 INSTALLATION OF PIPE APPURTENANCES

A. Protection of Appurtenances: Where the joining pipe is concrete or coated with cement mortar, buried appurtenances shall be coated with a minimum thickness of one inch of cement mortar having one part cement to not more than two parts plaster sand. Following coating with cement mortar, the appurtenances shall be coated with a protective overcoat in accordance with the paragraph entitled "Protective Coating."

B. Installation of Valves: All valves shall be handled in a manner to prevent any injury or damage to any part of the valve. All joints shall be thoroughly cleaned and prepared prior to installation. Adjust all stem packing and operate each valve prior to installation to insure proper operation. Valves (body and seat) shall not be subjected to test pressures greater than manufacturer's recommendation. In some cases this may require an increase in the valve pressure class.

C. All buried valves shall be coated and protected in accordance with Section 09 90 10 - Pipeline Coatings and Linings.

D. All valves shall be installed so that the valve stems are plumb and in the location indicated.

E. Installation of Flanged Joints: Before the joint is assembled, the flange faces shall be thoroughly cleaned of all foreign material with a power wire brush. The gasket shall be centered and the connecting flanges drawn up watertight without unnecessarily stressing the flanges. All bolts shall be tightened in a progressive diametrically opposite sequence and torqued with a suitable, approved and calibrated torque wrench. All clamping torque shall be applied to the nuts only.

F. All buried flanges shall be coated and protected in accordance with Section 09 90 10 - Pipeline Coatings and Linings.

G. Flexible Coupled Joints: When installing flexible couplings, care shall be taken that the connecting pipe ends, couplings and gaskets are clean and free of all dirt and foreign matter with special attention being given to the contact surfaces of the pipe, gaskets and couplings. The couplings shall be assembled and installed in conformity with the recommendation and instruction of the coupling manufacturer.

H. Wrenches used in bolting couplings shall be of a type and size recommended by the coupling manufacturer. Coupling bolts shall be tightened so as to secure a uniform annular space between the follower rings and the body of the pipe with all bolts tightened approximately the same amount. Diametrically opposite bolts shall be tightened progressively and evenly. Final tightening shall be done with a suitable, approved and calibrated torque wrench set for the torque recommended by the coupling manufacturer. All clamping torque shall be applied to the nut only.

I. Upon completion of the coupled joint, the coupling and bare metal of the pipe shall be cleaned, primed and protected in accordance with the requirements of Section 09 90 10 - Pipeline Coatings and Linings.

3.6 CORROSION CONTROL

A. Cathodic Protection: Corrosion mitigation and testing materials shall be provided where indicated and in accordance with Division 13.

3.7 MARKING TAPE INSTALLATION

A. As shown on the Drawings.

B. Per specification 31 23 00 – Earthwork.

3.8 PIPELINE TESTING

A. The steel pipe shall be hydrostatically tested as specified in Section 33 13 00 – Water Pipeline Testing and Disinfection.

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SECTION 33 11 12
STEEL PIPE FABRICATED SPECIALS (AWWA C200, MODIFIED)

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall provide all bends, reducers, wyes, tees, crosses, outlets, manifolds and other steel plate specials, complete in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ASME B 16.9	Factory-Made Wrought Steel Butt Welding Fittings
ASTM E 165	Practice for Liquid Penetrant Examination
ANSI/AWWA C200	Steel Water Pipe 6 In and Larger
ANSI/AWWA C205	Cement Mortar Lining and Coating – Shop Applied
ANSI/AWWA C206	Field Welding of Steel Water Pipe
ANSI/AWWA C207	Steel Pipe Flanges for Waterworks
ANSI/AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings
ANSI/AWWA C602	Cement-Mortar Lining of Water Pipelines - 4 In (100 mm) and Larger - In Place
ASTM A234	Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ANSI/AWS D.1.1	Structural Welding Code - Steel
API Standard 1104	Welding Pipelines and Related Structures
AWWA M-11	Steel Water Pipe - A Guide for Design and Installation
ASME	Boiler and Pressure Vessel Code

1.3 CONTRACTOR SUBMITTALS

A. Shop Drawings: Submit shop drawings including line and layout diagrams of all steel pipe fabricated specials in accordance with the requirements in Section 01 33 20 – Submittal Procedures. All submittals required for steel pipe and related work as listed in Section 33 11 11 – Steel Pipe, shall also be required for specials. Shop drawings shall indicate the type, size, and location of all reinforcement pieces.

B. Design calculations shall be submitted to the Engineer for review prior to manufacture of steel pipe fabricated specials.

C. Certifications: A certified affidavit of compliance with referenced Specifications and these Contract Documents shall be furnished for all steel pipe fabricated specials and other products or materials provided under this Section.

1.4 QUALITY ASSURANCE

A. Inspection: All specials shall be subject to inspection at the place of manufacturer/ fabrication as outlined in Section 33 11 11 – Steel Pipe.

B. Shop Testing of Steel Pipe Fabricated Specials:

1. If steel pipe fabricated specials have been fabricated from untested straight pipe, they shall be hydrostatically tested with a pressure equal to 1-1/2 times the design working pressure shown on the Drawings. If steel pipe fabricated specials have been fabricated from successfully tested straight pipe, no hydrostatic test shall be required unless otherwise indicated. In no case shall shop test pressure be less than 150 psi. All tees with crotch plates shall be hydrostatically tested as indicated regardless of whether or not the straight pipe sections used were previously tested.
2. All welds shall be non-destructive tested at the specials fabricator's facility as specified below for various weld categories. Testing shall include submitting written documentation of procedures per Section V, and acceptance criteria shall be in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code.
    a. Butt Joint Welds: Spot radiographically examine pipe in accordance with paragraph UW-52 of the ASME Boiler and Pressure Vessel Code Section VIII, Division 1. If, in the opinion of the Engineer, the welds cannot readily be radiographed, they shall be 100 percent ultrasonically examined.
    b. Fillet Welds: 100 percent examine all fillet welds using the magnetic particle inspection method.
    c. Groove Welds: 100 percent ultrasonically examine all groove welds that cannot be readily radiographically spot examined.
    d. Welds on pipe seams for previously successfully tested straight pipe do not need to be retested.
    e. All Welds: Contractor's certified welding inspector shall 100 percent visually examine all welds as a minimum.
    f. In addition to weld tests herein before specified, doubler pads shall be air tested as stated in AWWA C206.
    g. Refer to Section 33 13 00 – Water Pipeline Testing and Disinfection for field non-destructive testing.
3. Where welded test heads or bulkheads are used, extra length shall be provided to each opening of the special. After removal of each test head, the special shall be trimmed back to the design points with all finished plate edges ground smooth, straight, recoated and prepared for the field joint.
4. Testing shall be performed before pipe and joints have been coated or lined.
5. Perform tests at no additional cost to the Owner. The Engineer shall have the right to witness all testing conducted by the Contractor, provided that the Contractor's schedule is not delayed for the convenience of the Engineer.
6. In addition to those tests specifically required, the Engineer may request additional samples of any material including mixed concrete and lining and coating samples for

testing by the Owner. The additional samples shall be furnished at no additional cost to the Owner.

C. Field Testing: Field testing shall conform to the requirements of Section 33 13 00 – Water Pipeline Testing and Disinfection.

D. Welding Procedure Specifications: All welding procedures used to fabricate pipe shall be in accordance with Section 33 11 11 – Steel Pipe.

E. Welder Performance Qualifications: All welder performance qualifications shall be in accordance with Section 33 11 11 – Steel Pipe.

F. Certified Welding Inspector: A certified welding inspector shall be provided for shop fabricated work and shall have the responsibilities outlined in Section 33 11 11 – Steel Pipe.

G. Fittings and Specials Fabricator:
1. Experienced in fabrication of fittings and specials of similar diameters and wall thickness required for the Work.
2. Demonstrate current production capability for volume of Work required for the Project.
3. Experience shall be for project requiring fabrication to AWWA C200/208 standards of at least 25 fittings 30-inch or larger pipe, with wall thickness 0.25-inch or larger within the 5-year period preceding the bid date.
4. Experience requirement shall apply to the fabrication plant facility and responsible personnel, not the firm which owns the facility or employs the personnel.
5. See Section 33 11 11 – Steel Pipe for qualifications for steel pipe fabricators..

H. Fabrication: All specials shall be fabricated in the shop. No field fabrication of specials will be allowed.

PART 2 - PRODUCTS

2.1 GENERAL

A. Steel pipe fabricated specials (specials) are defined as fittings, closure pieces, bends, elbows, reducers, wyes, tees, crosses, outlets, manifolds, steel pipe wall sleeves, and other steel plate specials wherever located, and all piping above ground or in structures.

2.2 DESIGN

A. Design: Except as otherwise provided herein, specials shall be fabricated from materials or straight pipe in full conformance with the requirements of Section 33 11 11 - Steel Pipe, ANSI/AWWA C200, and the dimensions of ANSI/AWWA C208. All fittings and specials shall be properly reinforced to withstand the internal pressure, with circumferential and longitudinal, or external loading conditions, whichever is greater. The minimum thickness of plate for pipe from which specials are to be fabricated shall be no less than the thickness of the adjacent mainline pipe, the thickness shown, or the following, whichever is thicker:

Nominal Pipe Diameter (in)	Pipe Manifolds, Piping Above Ground, and Piping in Structures	Elbows, Bends, and Reducers
30 and under	Standard Weight	Standard Weight
Over 30	3/8-inch	Same as Adjacent Pipe

B. Pipe installed on saddle supports shall be designed to limit the longitudinal bending stress to a maximum of 10,000 psi. Design shall be in accordance with the provisions of Chapter 7 of AWWA M-11, and other applicable industry standards.

C. Joints: All joints and related work for field assembly of the pipe and specials shall conform to Section 33 11 11 – Steel Pipe. All shop joints shall be complete penetration butt-welds unless otherwise shown.

2.3 FABRICATION AND MATERIALS

A. General: Reinforcement for wyes, tees, outlets, and nozzles shall be as shown. Shop welding shall conform to the applicable provisions of the ASME Boiler and Pressure Vessel Code. Field welding shall conform to ANSI/AWS D1.1 and ANSI/AWWA C206. Specials and fittings shall be equal in pressure design strength and shall have the same lining and coating as the adjoining pipe. Unless otherwise indicated, the minimum radius of elbows shall be 2.5 times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11-1/4 degrees resulting in a maximum deflection angle of 22.5 degrees per miter weld as recommended in AWWA C208.

B. Specials and fittings that cannot be mechanically lined and coated shall be lined and coated by hand-application, using the same materials as are used for the pipe and in accordance with the applicable AWWA or ASTM Standards, and as modified in Section 09 90 10 - Pipeline Coatings and Linings, or by other applicable sections in these Specifications. Coating and lining applied in this manner shall provide thickness and protection equal to that specified for the pipe. Fittings may be fabricated from pipe that has been mechanically lined and/or coated. Areas of lining and coating that have been damaged by such fabrication shall be removed and reapplied by hand-applications.

C. Access manholes with covers shall be as indicated. All threaded outlets shall be forged steel suitable for 3,000-psi service, and shall be as manufactured by Vogt or equal.

D. Moderate deflections and long radius curves may be made by means of beveled joint rings, by pulling standard joints, by using short lengths or pipe, or a combination of these methods; provided that pulled joints shall not be used in combination with bevels and maximum joint deflections are not exceeded. The maximum total allowable angle for beveled joints shall be 5 degrees per pipe joint. Bevels shall be provided on the bell ends. Mitering of the spigot ends will not be permitted. The maximum allowable angle for pulled joints shall be 75 percent of the manufacturer's recommendations or the angle which results from a 3/4-inch pull out from normal joint closure, whichever is less. In no case shall pulled joints result in a gap between the bell and spigot at the weld location that exceeds 1/8 inch. All horizontal deflections or fabricated angles shall fall on the alignment, as shown.

E. All vertical deflections shall fall on the alignment and at locations adjacent to underground obstructions, points of minimum earth cover, and pipeline outlets and structures, the pipe angle points shall match the angle points indicated.

F. Outlets, Tees, Wyes, and Crosses
   1. Outlets 14-inch and smaller shall be fabricated from ASTM A 53, Type E or S, Grade B, standard weight steel pipe in the standard outside diameters, i.e., 14, 12-3/4-inch, 10-3/4-inch, 8-5/8-inch, 6-5/8-inch, and 4-1/2-inch. Wall thickness and collar reinforcing shall be as shown.
   2. In lieu of collar reinforcement as shown, pipe or specials with outlets may be fabricated in their entirety of steel plate having a thickness equal to the sum of the pipe wall plus the required reinforcement.
   3. Where required by Manual M-11 or other industry standard, the design procedure for crotch plate reinforcement, such reinforcement shall be required.

G. Steel Welding Fittings: Steel welding fittings for pipe spools and fittings smaller than 24 inches in diameter shall be in accordance with ANSI B16.9 conforming to ASTM A 234. Use standard weight. Taper pipe wall at welds at 4:1 for connection to pipe of different wall thicknesses. The Contractor shall be fully responsible for coordinating the difference in diameter convention between these specials and AWWA C200/C208 pipe and fittings to provide complete piping systems as shown.

H. Ends for Mechanical-Type Couplings: Except as otherwise indicated, where mechanical-type couplings are indicated, the ends of pipe shall be banded with Type C collared ends using double fillet welds. Where pipe 12-inch and smaller is furnished in standard schedule thicknesses, and where the wall thickness equals or exceeds the coupling manufacturer's minimum wall thickness, the pipe ends may be grooved.

I. Lining: All requirements pertaining to thickness, application and curing of cement mortar lining indicated for straight pipe shall apply to specials, with the following provision. If the special cannot be lined centrifugally or with field lining equipment, it shall be lined by hand. In such case, the lining shall be reinforced with welded wire fabric positioned approximately in the center of the lining and in accordance with AWWA C205 for lining of specials.

J. Coating: All requirements pertaining to thickness, application and curing of coating indicated for straight pipe shall apply to specials. Unless otherwise indicated the coating on the buried portion of a pipe section passing through a structure wall shall extend 4" into the vault.. Pipe above ground or in structures shall be shop primed and field-painted in accordance with Section 09 90 00 – Protective Coatings and Linings.

K. Marking: A mark indicating the true vertical axis of the special shall be placed on the top and bottom of the special.

L. Shop Welded Surfaces: All weld seams on pipe surfaces that will have a flexible tape or polyolefin coating in accordance with AWWA C209, C214, C215, or C216 shall be ground such that the maximum weld bead height will not exceed 1/32 inch. All ground weld seams shall be smooth and free of all burrs.

M. Portions of wall sleeves that penetrate into hydraulic structures and will be embedded into concrete shall be shop lined and coated in accordance with requirements for submerged conditions as outlined in Section 09 90 00 – Protective Coatings.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide all fittings, closure pieces, elbows, bends, reducers, wyes, tees, crosses, outlets, manifolds, and other steel plate specials, bolts, nuts, gaskets, jointing materials, and all other appurtenances as indicated to provide a complete and workable installation. Where pipe support details are indicated, the supports shall conform thereto and shall be placed as indicated; provided, that the support for all exposed piping shall be complete and adequate regardless of whether or not supporting devices are specifically indicated. Where indicated, concrete thrusts blocks and welded joints shall be provided. At all times when the Work of installing pipe is not in progress, all openings into the pipe and the ends of the pipe in trenches or structures shall be kept tightly closed to prevent entrance of animals and foreign materials.

B. Take all necessary precautions to prevent the pipe from floating due to water entering the trench or from backfilling with CLSM. The Contractor shall assume full responsibility for any damage due to this cause and shall at its own expense restore and replace the pipe to its specified condition and grade if it is displaced due to floating. Maintain the inside of the pipe free from foreign materials and in a clean and sanitary condition until its acceptance by the Owner.

C. Unless otherwise indicated, all specials shall be installed in full conformance with Section 33 11 11 – Steel Pipe, and other applicable sections of these Contract Documents.

END OF SECTION

SECTION 33 13 00
WATER PIPELINE TESTING AND DISINFECTION

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall perform flushing and testing of all pressure pipelines and appurtenant piping and disinfection of all pipelines and appurtenant piping for potable and fire water, complete.

B. This specification applies to all pipelines requiring hydrostatic tests (water medium) regardless of the pipeline service medium.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ANSI/AWWA B300	Hypochlorites
ANSI/AWWA B301	Liquid Chlorine
ANSI/AWWA C206	Field Welding of Steel Water Pipe
ANSI/AWWA C651	Disinfecting Water Mains

1.3 CONTRACTOR SUBMITTALS

A. A testing schedule, including proposed plans for water conveyance, control, disposal, and disinfection shall be submitted in writing for approval a minimum of 14 days before testing is to start.

B. Provide verification of pressure gauge recertification for pressure gauges to be used for testing.

C. A copy of the Utah Pollutant Discharge Elimination System (UPDES) permit application shall be submitted a minimum of 30 days prior to the proposed date to start testing. A copy of the approved UPDES permit shall be submitted prior to the start of testing.

D. Chlorine residual test data and bacteriological test data shall be submitted to document the results of the pipeline disinfection. Tests shall be conducted 24 hours after the start of disinfection.

PART 2 - PRODUCTS

2.1 MATERIALS REQUIREMENTS

A. All test equipment, chemicals for chlorination, temporary valves, bulkheads, or other water control equipment and materials shall be determined and furnished by the Contractor subject

to the Engineer's review. No materials shall be used which would be injurious to the construction or its future function.

B. Used pressure gauges shall be recertified prior to testing.

C. Chlorine for disinfection shall be in the form of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite granules or tablets.

D. Liquid chlorine shall be in accordance with the requirements of ANSI/AWWA B301. Liquid chlorine shall be used only:
   1. In combination with appropriate gas flow chlorinators and ejectors;
   2. Under the direct supervision of an experienced technician;
   3. When appropriate safety practices are observed.

E. Sodium hypochlorite and calcium hypochlorite shall be in accordance with the requirements of ANSI/AWWA B300 - Hypochlorite.

PART 3 - EXECUTION

3.1 GENERAL

A. Visually inspect the pipeline and remove all construction debris, silt, mortar, etc. from the pipeline prior to filling for hydrostatic testing. Coordinate with Engineer and Owner for scheduling of final visual inspection.

B. Water for testing and disinfecting water pipelines shall be furnished by the Contractor. The Contractor shall make all necessary provisions for conveying the water from the source to the points of use, and disposal of the water (and dechlorinating - where applicable).

C. All pipelines shall be tested. Disinfection shall be accomplished by chlorination for all pipelines providing potable water or connected to a potable water system. All chlorinating and testing operations shall be performed in the presence of the Engineer or the Owner representative.

D. Disinfection operations shall be scheduled to assure the maximum degree of sterility of the facilities at the time the Work is accepted by the Owner. Samples for bacteriological testing shall be collected by the Contractor, and testing shall be performed by the Owner laboratory and at the expense of the Contractor. Results of the bacteriological testing shall be satisfactory with the State Department of Health or other appropriate regulatory agency.

E. Pipeline pressure tests will include the following tests:
   1. Air test of double welded lap joints.
   2. Hydrostatic pressure test of the complete pipeline, in segments as required to match pipe pressure class.
   3. Contractor shall conduct the discharge in accordance with the Utah Pollutant Discharge Elimination System (UPDES) permit from the Utah Division of Environmental Quality (UDEQ). The Contractor shall apply a reducing agent to the discharged water to neutralize the chlorine residual and meet the chlorine residual limit required under the permit. The Owner shall conduct the water quality sampling of the discharge as required by the permit. The Contractor shall notify local agencies,

secure appropriate other permits and approvals, and provide erosion control measures for any releases as appropriate. Release of water after pipeline testing and disinfection have been completed shall be only if acceptable to the Engineer.

F. Notification: Notify the Engineer at each of the following stages:
1. Three working days prior to the start of filling the pipeline with water.
2. Three working days prior to the start of chlorination.
3. Twenty-four hours before withdrawing samples for bacteriological testing.
4. Three working days prior to the start of flushing.

3.2 VISUAL INSPECTION

A. All welds shall be 100% visually inspected in accordance with ANSI/AWS D1.1, Table 6.1; Visual Inspection Acceptance Criteria for Statically Loaded Non-Tubular Connections.

3.3 AIR TEST

A. All double welded lap joint or double gasket Carnegie joint shall be pressure tested to a minimum of 40-psi air pressure for a period of 10 minutes per AWWA C206. No air leakage will be allowed.

B. If the test pressure drops below 40 psi, paint the welds with a soap solution. Mark any leaks indicated by the escaping gas bubbles.

C. Any joints which leak shall be repaired and retested.

3.4 HYDROSTATIC TESTING OF PIPELINES

A. Prior to hydrostatic testing, all pipelines shall be flushed or blown out as appropriate. Test all pipelines either in sections or as a unit. No section of the pipeline shall be tested until all field-placed concrete or mortar has attained an age of 7 days. The test shall be made by closing valves when available, or by placing temporary bulkheads in the pipe and filling the line slowly with water. The Contractor shall be responsible for ascertaining that all test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to or movement of the adjacent pipe. Any unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test, to avoid movement and damage to piping and equipment. Provide sufficient temporary air tapping in the pipelines to allow for evacuation of all entrapped air in each pipe segment to be tested. In section tested where no air valves exist, provide temporary air valves for the automatic venting of air and vacuum protection. After completion of the tests, such temporary air valves are to be removed and taps shall be permanently plugged. Care shall be taken to see that all air vents are open prior to and during filling.

B. The pipeline shall be filled at a rate not to exceed 2-feet per second as calculated by using the cross-sectional area based on the inside diameter of the pipe and which will not cause any surges or exceed the rate at which the air can be released through the air valves at a reasonable velocity and all the air within the pipeline shall be properly purged. After the pipeline or section thereof has been filled, it shall be allowed to stand under a slight pressure for at least 24 hours to allow the concrete or mortar lining, as applicable, to absorb what water it will and to allow the escape of air from any air pocket. No personnel shall be within or enter any vault or confined space subject to flooding during the initial filling and for a 24

hour period. After the 24 hour period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to the Engineer shall be taken.

C. The hydrostatic test shall consist of holding the test pressure on the pipeline for a period of 4 hours. The test pressure for distribution and transmission pipelines shall be a minimum of 125 percent of the working pressure in the pipeline, or as indicated on the drawings, measured at the lowest point of the pipeline section being tested. All drain lines as part of the system shall be tested to match the adjacent pipeline. All visible leaks shall be repaired in a manner acceptable to the Engineer.

D. The maximum allowable leakage for distribution and transmission pipelines shall be;
   1. Pipe with welded joints shall have no leakage.
   2. The maximum leakage for yard piping shall be as shown on the Piping Schedule.
   3. 10 U.S. gallons per inch of diameter per mile of pipe per 24 hours for pipe with 40-foot or greater lengths between joints and with rubber-gasketed joints and
   4. 20 U.S. gallons per inch of diameter per mile of pipe per 24 hours for pipe with 20-foot or less lengths between joints and with rubber-gasketed joints.

E. In the case of pipelines that fail to pass the prescribed leakage test, determine the cause of the leakage, take corrective measures necessary to repair the leaks, and again test the pipelines at no additional cost to the Owner.

F. The pipeline shall be drained after successful completion of the hydrostatic test.

G. All hydrostatic tests are to be completed in the presence of the Engineer. Upon completion, complete the form in Section 33 13 00a for each hydrostatic pressure test.

3.5 DISINFECTING PIPELINES

A. General: All potable water pipelines shall be disinfected in accordance with the requirements of ANSI/AWWA C651 - Disinfecting Water Mains as modified herein.

B. Prior to disinfecting the pipeline for potable water services and before placing into service for other water pipelines, flush the pipeline to remove any debris, rocks, or other foreign material that may have entered the pipe.
   1. For Pipeline <36-inch diameter, flushing shall be carried out such that the velocities in the pipe exceed 2.5 feet per second. For Pipelines >36-inch diameter pipelines shall be swept clean prior to flushing and flushing shall be provided at highest velocity available from the water source up to a maximum of 2.5 feet per second.
   2. Provide all required material, labor and equipment to complete flushing. Contractor shall provide the water for flushing. Make appropriate provisions and preparations for disposal of flushing water, satisfying all local, state and federal rules, laws, regulations and ordinances.

C. Continuous Feed Method: Disinfect in accordance with ANSI/AWWA C651 except that:
   1. The water in the pipe shall contain 50 mg/l free chlorine as measured at the pipeline extremities.
   2. After 24 hours of disinfection, the residual free chlorine shall be at least 25 mg/l at the pipeline extremities.
   3. Chlorinated water with greater than 25 mg/free chlorine may not be allowed to sit in the pipeline for periods of longer than 36 hours from initial chlorination. Upon

successful completion of chlorination steps 1 and 2 above, the pipeline shall be immediately flushed of high chlorinated water.

D. Slug Feed Method: Disinfect in accordance with ANSI/AWWA C651.

E. Chlorinating Valves: During the process of chlorinating the pipelines, all valves and other appurtenances shall be operated while the pipeline is filled with the heavily chlorinated water.

F. Final Flushing: After the applicable retention period, the heavily chlorinated water shall be flushed from the pipeline until chlorine measurements show that the concentration in the water leaving the pipeline is no higher than that generally prevailing in the system or is acceptable for domestic use. If there is any question that the chlorinated discharge will cause damage to the environment, a reducing agent shall be applied to the water to neutralize thoroughly the chlorine residual remaining in the water. See the appendix of AWWA C651 for acceptable neutralization methods for heavily chlorinated water.

G. Sampling Ports: The Contractor shall provide sampling ports along the pipeline as defined in AWWA C651. Taps may be made at manways and air valves to help facilitate the spacing requirement.

H. Bacteriological Testing: After final flushing and before the pipeline is placed in service, two consecutive sets of samples shall be collected at least 24 hours apart by the Contractor from the end of the line, vaults, and at other locations as designated by the Engineer, and shall be tested by the Owner for bacteriological quality in accordance with the requirements of AWWA C651 and additional requirements specified herein. For this purpose, the pipe shall be refilled with fresh potable water and left for a period of 24 hours before the first set of bacteriological samples are collected. The second set of Bacteriological samples are then collected a minimum of 24 hours after the initial set of samples. If the initial disinfection fails to produce two satisfactory sets of bacteriological results or if other water quality is affected, the new main may be re-flushed and shall be resampled. If check samples also fail to produce acceptable results, the main shall be re-chlorinated by the continuous-feed or slug method until satisfactory results are obtained that being two consecutive sets of acceptable samples taken 24 hours apart.

I. Bacteriological Testing completed on Mondays through Thursdays may utilize the services of the JVWCD laboratory. Bacteriological testing needing services Friday through Sunday or on holidays to be completed and paid for by the Contractor at an independent, certified, 3rd party laboratory approved by the Owner.

3.6 CONNECTIONS TO EXISTING SYSTEM

A. Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a minimum one percent hypochlorite solution before they are installed. Thorough flushing shall be started as soon as the connection is completed and shall be continued until discolored water is eliminated.

END OF SECTION

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HYDROSTATIC PRESSURE TEST RECORD

Client: _____ Project: _____

Pipeline/Location: _____ Project No.: _____ Date_____

Pipe Size: _____ Pipe Service and Material: _____

Test Location: _____

Begin Station _____

End Station _____

Appurtenances Tested: _____

Test Duration: _____

Start Time _____

End Time _____

Specification: _____

Test Pressure & gauge _____

Location: _____

Time	Ambient Temp. (F)	Pressure (PSIG)

Remarks

_____

_____

Test Personnel: _____

Signature: _____ Date _____

Company Performing Test: _____

Owner/Engineer's Rep. Signature: _____ Date: _____

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DIVISION 40
PROCESS INTEGRATION

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SECTION 40 05 00
PIPING, GENERAL

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall furnish and install all piping systems shown and specified, in accordance with the requirements of the Contract Documents. Each system shall be complete with all necessary fittings, hangers, supports, anchors, seismic restraints, expansion joints, flexible connectors, valves, accessories, heat tracing, insulation, lining and coating, testing, disinfection, excavation, backfill and encasement, to provide a functional installation.

B. The piping shown is intended to define the general layout, configuration, routing, method of support, pipe size, and pipe type. The mechanical drawings are not pipe construction or fabrication drawings. It is the Contractor's responsibility to develop the details necessary to construct all mechanical piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, connectors, etc., for a complete and functional system.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ANSI/ASME B1.20.1	Pipe Threads, General Purpose (inch)
ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys
ANSI/AWWA C207	Steel Pipe Flanges for Water Works Service, Sizes 4 in through 144 in.
ANSI/AWWA C606	Grooved and Shouldered Joints
ANSI/AWS D1.1	Structural Welding Code
ASTM A 307	Specification for Carbon Steel Bolts and Studs, 6,000 psi Tensile
ASTM A 325	Specification for High-Strength Bolts for Structural Steel Joints
ASTM D 792	Test Methods for Specific Gravity and Density of Plastics by Displacement
ASTM D 2000	Classification System for Rubber Products in Automotive Applications

1.3 CONTRACTOR SUBMITTALS

A. Submit complete shop drawings and certificates, test reports, affidavits of compliance, of all piping systems, in accordance with the requirements in Section 01 33 20 – Submittal

Procedures, and as indicated in the individual piping sections. The shop drawings shall include all necessary dimensions and details on pipe joints, fittings, fitting specials, valves, appurtenances, design calculations, and material lists. The submittals shall include detailed layout, spool, or fabrication drawings which show all pipe spools, spacers, adapters, connectors, fittings, and pipe supports and seismic restraints necessary to accommodate the equipment and valves provided in a complete and functional system.

B. All expenses incurred in making samples for certification of tests shall be borne by the Contractor at no increased cost to the Owner.

C. Submit as part of the shop drawings a statement from the pipe fabricator certifying that all pipes will be fabricated subject to a recognized Quality Control Program. An outline of the program shall be submitted to the Engineer for review prior to the fabrication of any pipe.

1.4 QUALITY ASSURANCE

A. Inspection: All pipe shall be subject to inspection at the place of manufacture. During the manufacture of the pipe, the Engineer shall be given access to all areas where manufacturing is in progress and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.

B. Tests: Except where otherwise indicated, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable specifications and standards. Welds shall be tested as indicated. Perform all tests at no additional cost to the Owner.

C. Welding Requirements: All welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.

D. Welder Qualifications: All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local, approved testing agency not more than 6 months prior to commencing Work on the pipeline. Machines and electrodes similar to those used in the Work shall be used in qualification tests. Furnish all material and bear the expense of qualifying welders at no increased cost to the Owner.

E. NSF/ANSI 61 for Drinking Water System Components: All materials that will contact potable water shall comply with the requirements of the NSF/ANSI 61 Standard.

1.5 MANUFACTURER'S SERVICE REPRESENTATIVE

A. Where the assistance of a manufacturer's service representative is advisable, in order to obtain perfect pipe joints, supports, or special connections, furnish such assistance at no additional cost to the Owner.

1.6 MATERIAL DELIVERY, STORAGE, AND PROTECTION

A. All piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and stored off the ground, to provide protection against oxidation

caused by ground contact. All defective or damaged materials shall be replaced with new materials.

1.7 CLEANUP

A. After completion of the Work, all remaining pipe cuttings, joining and wrapping materials, and other scattered debris, shall be removed from the site. The entire piping system shall be handed over in a clean and functional condition.

PART 2 - PRODUCTS

2.1 GENERAL

A. All pipes, fittings, and appurtenances shall be furnished in accordance with the requirements of the applicable Sections of Division 33 and this Section.

B. Miscellaneous Small Pipes: Miscellaneous small pipes and fittings shall be provided by the Contractor in accordance with the requirements of Section 40 05 10 - Mill Piping - Exposed and Buried and this Section.

C. Pipe Supports: All pipes shall be adequately supported in accordance with the requirements of Section 40 05 07 - Pipe Supports, and as indicated.

D. Lining: All requirements pertaining to thickness, applications, and curing of pipe lining, are in accordance with the requirements of the applicable Sections of Divisions 9 and33, unless otherwise indicated.

E. Coating: All requirements pertaining to thickness, application, and curing of pipe coating, are in accordance with the requirements of the applicable Sections of Division 33, unless otherwise indicated. Pipes above ground or in structures shall be field-painted in accordance with Section 09 90 00 Protective Coatings and Linings or 09 90 10 – Pipeline Coatings and Linings.

F. Pressure Rating: All piping systems shall be designed for the maximum expected pressure as defined in Section 33 13 00 - Water Pipeline Testing and Disinfection, or as indicated on the piping schedule, or as indicated on the Drawings.

2.2 PIPE FLANGES

A. Flanges: Where the design pressure is 150 psi or less, flanges shall conform to either ANSI/AWWA C207 Class D or ANSI B16.5 150-pound class. Where the design pressure is greater than 150 psi, up to a maximum of 275 psi, flanges shall conform to either ANSI/AWWA C207 Class E, Class F, or ANSI B16.5 150-pound class. However, AWWA flanges shall not be exposed to test pressures greater than 125 percent of rated capacity. For higher test pressures, the next higher rated AWWA flange or an ANSI-rated flange shall be selected. Where the design pressure is greater than 275 psi up to a maximum of 700 psi, flanges shall conform to ANSI B16.5 300-pound class. Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown. Attachment of the flanges to the pipe shall conform to the applicable requirements of ANSI/AWWA C207.

Flanges for miscellaneous small pipes shall be in accordance with the standards specified for these pipes. Contractor to confirm flange compatibility of pipeline and adjoining equipment.

B. Blind Flanges: Blind flanges shall be in accordance with ANSI/AWWA C207, or with the standards for miscellaneous small pipes. All blind flanges for pipe sizes 12 inches and over shall be provided with lifting eyes in form of welded or screwed eye bolts.

C. Flange Coating: All machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.

D. Flange Bolts: Contractor shall supply all bolts and nuts in conformance with Section 05 50 00 – Metal Fabrications. Studs and bolts shall extend through the nuts a minimum of 1/4 inch. All-thread studs shall be used on all valve flange connections, where space restrictions preclude the use of regular bolts.

E. Insulating Flanges: Insulating flanges shall have bolt holes 1/4 inch diameter greater than the bolt diameter.

F. Insulating Flange Sets: Insulating flange sets shall be provided by the Contractor where shown. Each insulating flange set shall consist of an insulating gasket, insulating sleeves and washers and a steel washer. Insulating sleeves and washers shall be one piece when flange bolt diameter is 1-1/2 inches or smaller and shall be made of acetal resin. For bolt diameters larger than 1-1/2 inches, insulating sleeves and washers shall be two-piece and shall be made of polyethylene or phenolic. Steel washers shall be in accordance with ASTM A 325. Insulating gaskets shall be full-face.

G. Insulating Flange Manufacturers, or Equal
1. JM Red Devil, Type E
2. Maloney Pipeline Products Co., Houston
3. PSI Products, Inc., Burbank, California
4. Calpico, Inc., South San Francisco, California

H. Flange Gaskets: provide flange gaskets for all pipe flanges. Gaskets for flanged joints shall be full-faced, 1/16-inch thick compressed sheets of asbestos-free aramid fiber base, with nitrile binder and nonstick coating, suitable for temperatures to 400 degrees F, a pH of 1 to 11, and pressures to 500 psig. Blind flanges shall have gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange. Ring gaskets shall not be permitted.

I. Flange Gasket Manufacturers, or Equal
1. TEADIT, Style 1161/1082 San
2. Garlock, Style 3760 (NSF 61 approved)

2.3 THREADED INSULATING CONNECTIONS

A. General: Threaded insulating bushings, unions, or couplings, as appropriate, shall be used for joining threaded pipes of dissimilar metals and for piping systems where corrosion control and cathodic protection are involved.

B. Materials: Threaded insulating connections shall be of nylon, Teflon, polycarbonate, polyethylene, or other nonconductive materials, and shall have ratings and properties to suit the service and loading conditions.

2.4 MECHANICAL-TYPE COUPLINGS (GROOVED OR BANDED PIPE)

A. Construction: Cast mechanical-type couplings shall be provided where shown. The couplings shall conform to the requirements of ANSI/AWWA C606. Bolts and nuts shall conform to the requirements of Section 05 50 00 – Metal Fabrications. All gaskets for mechanical-type couplings shall be compatible with the piping service and fluid utilized, in accordance with the coupling manufacturer's recommendations. The wall thickness of all grooved piping shall conform with the coupling manufacturer's recommendations to suit the highest expected pressure. To avoid stress on equipment, all equipment connections shall have rigid-grooved couplings, or harness sets in sizes where rigid couplings are not available, unless thrust restraint is provided by other means. The Contractor shall have the coupling Manufacturer's service representative verify the correct choice and application of all couplings and gaskets, and the workmanship, to assure a correct installation.

B. Couplings for Steel Pipe, Manufacturers, or Equal
   1. Rigid coupling: Victaulic Zero-Flex Style 07.
   2. Flexible coupling: Victaulic Standard Style 77.
   3. Direct grooving of pipe is not permitted. Grooves shall be cut into grooved end adapters and not rolled.

C. Ductile Iron Pipe Couplings, Manufacturers, or Equal
   1. Gustin-Bacon.
   2. Victaulic Style 31 (flexible or rigid grooving).
   3. Note: Ductile iron pipe couplings shall be furnished with flush seal gaskets.

D. Couplings for PVC Pipe, Manufacturers, or Equal
   1. Gustin-Bacon.
   2. Victaulic Style 775.
   3. Note: Couplings for PVC pipe shall be furnished with radius cut or standard roll grooved pipe ends. Grooved end couplings shall be used on PVC pipe only for Schedule 80 vent piping at the vaults. Grooved end couplings shall not be used for PVC C905 water pipe.

2.5 SLEEVE-TYPE COUPLINGS

A. Construction: Sleeve-type couplings shall be provided where indicated, in accordance with ANSI/AWWA C219 unless otherwise indicated, and shall be of steel with steel bolts, without pipe stop, and shall be of sizes to fit the pipe and fittings. The middle ring shall be not less than 1/4 inch in thickness and shall be either 5 or 7 inches long for sizes up to and including 30 inches and 10 inches long for sizes greater than 30 inches, for standard steel couplings, and 16 inches long for long-sleeve couplings. The followers shall be single-piece contoured mill section welded and cold-expanded as required for the middle rings. They shall be of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket. Bolts and nuts shall conform to the requirements of Section 05 50 00 – Metal Fabrications. Buried sleeve-type couplings shall be epoxy-coated at the factory.

B. Pipe Preparation: The ends of the pipe, where indicated, shall be prepared for flexible steel couplings. Plain ends for use with couplings shall be smooth and round for a distance of 12 inches from the ends of the pipe, with outside diameter not more than 1/64 inch smaller than

the nominal outside diameter of the pipe. The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point, to proof-test the weld to the strength of the parent metal. The weld of the middle ring shall be subjected to air test for porosity.

C. Gaskets: Gaskets for sleeve-type couplings shall be rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions. Gaskets for wastewater and sewerage applications shall be Buna "N," grade 60, or equivalent suitable elastomer.

1. The rubber in the gasket shall meet the following specifications:
   a. Color - Jet Black.
   b. Surface - Nonblooming.
   c. Durometer Hardness - 74 " 5.
   d. Tensile Strength - 1,000 psi Minimum.
   e. Elongation - 175 percent Minimum.
2. The gaskets shall be immune to attack by impurities normally found in water or wastewater. All gaskets shall meet the requirements of ASTM D 2000, AA709Z, meeting Suffix B13 Grade 3, except as noted above. All gaskets shall be compatible with the piping service and fluid utilized.

D. Insulating Couplings: Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket which assembles over a rubber sleeve of an insulating compound in order to obtain insulation of all coupling metal parts from the pipe.

E. Restrained Joints: All sleeve-type couplings on pressure lines shall be harnessed unless thrust restraint is provided by other means. Harnesses shall be in accordance with the requirements of the appropriate reference standard, or as shown.

F. Manufacturers, or Equal
1. Dresser, Style 38.
2. Ford Meter Box Co., Inc., Style FC1 or FC3.
3. Smith-Blair, Style 411.
4. Baker, Series 200

2.6 FLANGED END CONNECTORS AND DISMANTLING JOINTS

A. Flanged coupling adapters and dismantling joint couplings shall be in accordance with AWWA C219.

B. Dismantling joints for connecting flanged pipe shall be AWWA C219 compliant. Provide studs and nuts to seal gasket separate and independent from tie-bar restraint system.

C. All dismantling joints shall be the restrained type per AWWA M-11. Tie-bar restraint system shall conform to ASTM A193-B7 per AWWA M-11 and be designed to withstand the test pressure shown on the Drawings.

D. All dismantling joints shall use standard flanges in accordance with AWWA C207. The thickness of the dismantling joint flanges shall be equal to or greater than the class of flange that is connected to as required by the test pressure as shown on the drawings. Buried flanges shall be wrapped with petroleum wax tape per AWWA C217. Flanged coupling adapters and dismantling joints shall be epoxy lined and coated. Tie rods shall be 316 stainless steel.

E. Manufacturers, or Equal
   1. Smith-Blair, Style 972 or 975
   2. Baker, Series DJ
   3. Romac DJ 400

2.7 FLEXIBLE CONNECTORS

A. Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, and other vibrating equipment, and where shown. Flexible connectors for service temperatures up to 180 degrees F shall be flanged, reinforced Neoprene or Butyl spools, rated for a working pressure of 40 to 150 psi, or reinforced, flanged duck and rubber, as best suited for the application. Flexible connectors for service temperatures above 180 degrees F shall be flanged, braided stainless steel spools with inner, annular, corrugated stainless steel hose, rated for minimum 150 psi working pressure, unless otherwise shown. The connectors shall be 9 inches long, face-to-face flanges, unless otherwise shown. The final material selection shall be approved by the manufacturer. Submit manufacturer's shop drawings and calculations.

2.8 EXPANSION JOINTS

A. All piping subject to expansion and contraction shall be provided with sufficient means to compensate for such movement, without exertion of undue forces to equipment or structures. This may be accomplished with expansion loops, bellow-type expansion joints, or sliding-type expansion joints. Expansion joints shall be of stainless steel, monel, rubber, or other materials, best suited for each individual service. Submit detailed calculations and manufacturer's shop drawings, guaranteeing satisfactory performance of all proposed expansion joints, piping layouts showing all anchors and guides, and information on materials, temperature and pressure ratings.

2.9 PIPE THREADS

A. All pipe threads shall be in accordance with ANSI/ASME B1.20.1.

2.10 AIR AND GAS TRAPS

A. Air and gas pipes shall be sloping to low points, provided with drip legs, shutoff valves, strainers and traps. The traps shall be piped to the nearest drain. Air and gas traps shall be not less than 150-pound iron body float type with copper or stainless steel float. Bracket, lever, and pins shall be of stainless steel. Drain traps shall have threaded connections.

B. Manufacturers, or Equal
   1. Armstrong Machine Works.
   2. Spirax Sarco, Inc.

PART 3 - EXECUTION

3.1 GENERAL

A. All pipes, fittings, and appurtenances shall be installed in accordance with the requirements of the applicable Sections of Division 33. The lining manufacturer shall take full responsibility

for the complete, final product and its application. All pipe ends and joints at screwed flanges shall be epoxy-coated, to assure continuous protection.

B. Where core drilling is required for pipes passing through existing concrete, core drilling locations shall be determined by radiograph of concrete construction to avoid damage to embedded raceways and rebars.

C. Flanges shall be installed at least 6-inches from a wall. Fittings shall be installed with sufficient clearance for maintenance and removal and reinstallation.

3.2 FIELD TESTING

A. All piping shall be tested in accordance with applicable standards and the contract documents.

END OF SECTION

SECTION 40 05 07
PIPE SUPPORTS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall provide pipe supports, seismic restraints, hangers, guides, and anchors, complete, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. General: Submittals shall be in accordance with Section 01 33 20 – Submittal Procedure.

B. Shop Drawings: Shop drawings shall include the following information:
   1. Drawings of pipe supports, restraints, hangers, anchors, and guides
   2. Calculations for special supports and anchors.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Code Compliance: Piping systems and pipe connections to equipment shall be properly anchored and supported to prevent undue deflection, vibration, dislocation due to seismic events and line pressures, and stresses on piping, equipment, and structures. Supports and parts thereof shall conform to the requirements of ASME B31.1 – Power Piping, except as supplemented or modified below. Supports for plumbing piping shall be in accordance with the latest edition of the applicable plumbing code or local administration requirements.

B. Structural Members: Wherever possible, pipes shall be supported from structural members. Where it is necessary to frame structural members between existing members, such supplementary members shall be provided at no additional cost to the Owner. All supplementary members shall be in accordance with the requirements of the building code and the American Institute of Steel Construction and shall be acceptable to the Engineer.

C. Pipe Hangers: Pipe hangers shall be capable of supporting the pipe in all conditions of operation, allowing free expansion and contraction of the piping, and preventing excessive stress on equipment. Hangers shall have a means of vertical adjustment after erection. Hangers shall be designed to prevent becoming disengaged by any movement of the supported pipe. Hangers subject to shock, seismic disturbances, or thrust imposed by the actuation of safety valves, shall include hydraulic shock suppressors. Hanger rods shall be subject to tensile loading only.

D. Hangers Subject to Horizontal Movements: At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit such movement. Where horizontal pipe movement is greater than 1/2-inch, or where the hanger rod deflection from the vertical is greater than 4 degrees from the cold to the hot position of the pipe, the hanger rod and structural attachment shall be offset in such a manner that the rod is vertical in the hot position.

E. Spring-Type Hangers: Spring-type pipe hangers shall be provided for piping subject to vibration or vertical expansion and contraction, such as engine exhausts and similar piping. Spring-type hangers shall be sized to the manufacturer's printed recommendations and the loading conditions encountered. Variable spring supports shall be provided with means to limit misalignment, buckling, eccentric loading, or to prevent overstressing of the spring, and with means to indicate at all times the compression of the spring. Supports shall be capable of accommodating at least four times the maximum travel due to thermal expansion.

F. Thermal Expansion: Wherever expansion and contraction of piping is expected, a sufficient number of expansion loops or joints shall be provided, together with the necessary rolling or sliding supports, anchors, guides, pivots, and restraints permitting the piping to expand and contract freely in directions away from the anchored points. Components shall be structurally suitable to withstand loads imposed.

G. Heat Transmission: Supports, hangers, anchors, and guides shall be so designed and insulated, that excessive heat will not be transmitted to the structure or to other equipment.

H. Riser Supports: Where practical, risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.

I. Freestanding Piping: Free-standing pipe connections to equipment such as chemical feeders and pumps shall be firmly attached to steel frames fabricated from angles, channels, or I-beams anchored to the structure. Exterior, free-standing overhead piping shall be supported on fabricated pipe stands consisting of pipe columns anchored to concrete footings, with horizontal, welded steel angles and U-bolts or clamps securing the pipes.

J. Materials of Construction:
   1. General: Pipe support assemblies, including framing, hardware, and anchors, shall be steel construction, galvanized after fabrication, unless otherwise indicated.
   2. Submerged Supports: Submerged piping, as well as piping, conduits, and equipment in hydraulic structures within 24 inches of the water level, shall be supported with support, assemblies, including framing, hardware, and anchors, constructed of Type 316 stainless steel, unless otherwise indicated.
   3. Corrosive: Piping in chemical and corrosive areas shall be supported with support assemblies, including framing, hardware, and anchors, constructed of Type 316 stainless steel or FRP, unless otherwise indicated.

K. Point Loads: Any meters, valves, heavy equipment, and other point loads on PVC, FRP, and other plastic pipes, shall be supported on both sides, according to manufacturer's recommendations to avoid undue pipe stresses and failures. To avoid point loads, all supports on PVC, FRP, and other plastic piping shall be equipped with extra wide pipe saddles or galvanized steel shields.

L. Noise Reduction: To reduce transmission of noise in piping systems, copper tubes in buildings and structures shall be wrapped with a 2-inch wide strip of rubber fabric or similar, suitable material at each pipe support, bracket, clip, or hanger.

2.2 SUPPORT SPACING

A. Supports for piping with the longitudinal axis in approximately a horizontal position shall be spaced to prevent excessive sag, bending, and shear stresses in the piping, with special

consideration given where components such as flanges and valves impose concentrated loads. Pipe support spacing shall not exceed the maximum spans in the tables below. For temperatures other than ambient temperatures, or those listed, and for other piping materials or wall thicknesses, the pipe support spacings shall be modified in accordance with the pipe manufacturer's recommendations. Vertical supports shall be provided to prevent the pipe from being overstressed from the combination of all loading effects.

1. Support Spacing for Schedule 40 and Schedule 80 Steel Pipe

Nominal Pipe Diameter (inches)	Maximum Span (feet)
1/2	6
3/4 and 1	8
1 - 1/4 to 2	10
3	12
4	14
6	17
8 and 10	19
12 and 14	23
16 and 18	25
20 and Greater	30

2. Support Spacing for Welded Fabricated Steel Pipe

Maximum Spans for Pipe Supported in Minimum **120 degree** contact saddles (feet)

Nominal Pipe Diameter (inches)	3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1
24	33	37	41	43	45	47				
26	34	38	41	44	46	48				
28	34	38	41	44	47	49				
30	34	38	42	45	48	49				
32	34	39	42	45	48	50				
34	35	39	42	46	48	50				
36	35	39	43	46	49	51	55			
38	35	39	43	46	49	51	55			
40	35	40	43	47	49	52	56			
42	--	40	43	47	50	52	56			
45	--	40	44	47	50	53	57			
48	--	40	44	47	50	53	58	61		
51	--	41	44	48	51	53	58	62		
54	--	41	44	48	51	54	58	62		
57	--	41	44	48	51	54	59	63		
60	--	41	45	48	52	54	59	63	67	70
63	--	41	45	49	52	55	60	64	67	71
66	--	41	45	49	52	55	60	64	68	71
72	--	41	45	49	52	55	61	65	69	72
78	--	41	45	49	53	56	61	66	69	73
84	--	41	46	50	53	56	62	66	70	74
90	--	41	46	50	53	56	62	67	71	74
96	--	42	46	50	54	57	62	67	71	75

3. For steel pipe sizes not presented in this table, the support spacing shall be designed so that the stress on the pipe does not exceed 5,000 psi. Maximum deflection of pipe shall be limited to 1/360th of the span and shall be calculated by using the formula:

$$L = \sqrt{\frac{7500tD}{32t + D}}$$

Where:
- t = Thickness (inches)
- D = Diameter (inches)
- L = Maximum span (feet)

4. Support Spacing for Ductile-Iron Pipe:

Normal Pipe Diameter (inches)	Maximum Span (feet)
All diameters	Two supports per pipe length or 10 feet (one of the 2 supports located at joint)

5. Support Spacing for Copper Tubing:

Normal Pipe Diameter (inches)	Maximum Span (feet)
1/2 to 1 - 1/2	6
2 to 4	10
6 and greater	12

6. Support Spacing for Schedule 80 PVC Pipe:

Normal Pipe Diameter (inches)	Maximum Span at 100 degrees F (feet)
1/2	4
3/4	4.5
1	5
1 - 1/4	5.5
1 - 1/2	5.75
2	6.25
3	7.5
4	8.25
6	10
8	11
10	12.25
12	13.25

7. Support Spacing for Schedule 80 Polypropylene Pipe:

Normal Pipe Diameter (inches)	Maximum Span at 100 degrees F (feet)
1/2	3

3/4	3.5
1	3.75
1 - 1/4	4
1 - 1/2	4.25
2	4.5
3	5.5
4	6
6	7.25
8	8
10	8.75
12	9.5

8. Support Spacing for Fiberglass Reinforced Plastic (FRP) Pipe:

Normal Pipe Diameter (inches)	Maximum Span at 100 degrees F (feet)
2	8.8
3	10
4	11
6	12.7
8	13.4
10	14
12	15.4
14	16.2
16	17.3
16 and Greater	18

2.3 MANUFACTURED SUPPORTS

A. Stock Parts: Where not specifically indicated, designs which are generally accepted as exemplifying good engineering practice and use stock or production parts, shall be utilized wherever possible. Such parts shall be locally available, new, of best commercial quality, designed and rated for the intended purpose.

B. Manufacturers, or Equal
1. Basic Engineers Inc., Pittsburgh, PA.
2. Bergen-Paterson Pipesupport Corp., Woburn, MA.
3. Grinnell Corp. (Supply Sales Company), Cranston, RI
4. NPS Products, Inc., Westborough, MA.
5. Power Piping Company, Pittsburgh, PA.

2.4 COATING

A. Galvanizing: Unless otherwise indicated, fabricated pipe supports other than stainless steel or non-ferrous supports shall be blast-cleaned after fabrication and hot-dip galvanized in accordance with ASTM A 123 - Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

B. Other Coatings: Other than stainless steel or non-ferrous supports, all supports shall receive protective coatings in accordance with the requirements of Section 09 90 00 – Protective Coatings and Linings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Pipe supports, seismic restraints, hangers, brackets, anchors, guides, and inserts shall be fabricated and installed in accordance with the manufacturer's printed instructions and ASME B31.1 - Power Piping. Concrete inserts for pipe hangers and supports shall be coordinated with the form work.

B. Appearance: Pipe supports and hangers shall be positioned to produce an orderly, neat piping system. Hanger rods shall be vertical, without offsets. Hangers shall be adjusted to line up groups of pipes at the proper grade for drainage and venting, as close to ceilings or roofs as possible, without interference with other work.

3.2 FABRICATION

A. Quality Control: Pipe hangers, supports, and seismic restraints shall be fabricated and installed by experienced welders and fitters, using the best welding procedures available. Fabricated supports shall be neat in appearance without sharp corners, burrs, and edges.

END OF SECTION

SECTION 40 05 10
MILL PIPING – EXPOSED AND BURIED

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall furnish and install all exposed and buried mill piping (pipe diameter 6 inches and less) as shown and in accordance with Contract Documents. This section applies to all mechanical Work and associated piping systems.

B. All work shall be in strict accordance with the International Plumbing Code, and codes of the State of Utah, City of Herriman, and any other authorities having jurisdiction. The Contractor shall have required certifications and be thoroughly familiar with the local codes. The Contractor shall obtain and pay for all necessary permits.

C. This section outlines requirements for the following small (pipe diameter 6 inches and less) mechanical piping and associated accessories:
1. Small steel pipe
2. Solvent welded PVC pipe and Valves
3. CPVC pipe and Valves
4. PVDF pipe

D. The Contractor shall furnish hoses, hose racks and signage where indicated on the Drawings and as indicated herein.

1.2 REFERENCE STANDARDS

A. Commercial Standards

ANSI/ASME B16.3	Malleable Iron Threaded Fittings
ANSI/ASME B16.4	Gray Iron Threaded Fittings,
ASMEB16.5	Pipe Flanges and Flanged Fittings,
ANSI B16.11	Forged Steel Fittings, Socket-Welding and Threaded
ANSI B16.12	Cast-Iron Threaded Drainage Fittings
ANSI/ASME B16.15	Cast Bronze Threaded Fittings, Classes 125 and 250
ANSI B16.21	Nonmetallic Flat Gaskets for Pipe Flanges
ANSI B16.22	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASTM A 53	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 74	Specification for Cast Iron Soil Pipe and Fittings

ASTM A 105	Specification for Carbon Steel, Forgings for Piping Applications
ASTM A 106	Specification for Seamless Carbon Steel Pipe for High Temperature Service
ASTM A 312	Specification for Seamless and Welded Austenitic Stainless Steel Pipe
ASTM A 518	Specification for Corrosion-Resistant High-Silicon Iron Castings
ASTM B 43	Specification for Seamless Red Brass Pipe, Standard Sizes
ASTM B 62	Specification for Composition Bronze or Ounce Metal Castings
ASTM B 88	Specifications for Seamless Copper Water Tube
ASTM C 599	Specification for Conical Process Glass Pipe and Fittings.
ASTM D 1785	Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2996	Specification for Filament-Wound Reinforced Thermosetting Resin Pipe
ASTM D 3222	Specification for Unmodified Poly (Vinylidene Fluoride) (PVDF) Molding, Extrusion, and Coating Materials
ASTM D 4101	Specification for Propylene Plastic Injection and Extrusion Materials
ASTM F 441	Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

B. Chlorine Institute Pamphlet 6 - Piping Systems for Dry Chlorine

1.3 CONTRACTOR SUBMITTALS

A. For the materials and equipment items supplied under the provisions of this Section, submit copies of the manufacturer's product specifications and performance details according to the requirements of Section 01 33 20 - Submittal Procedures.

B. Product information for all valves shall be submitted in accordance with Section 40 05 51 – Valves, General.

PART 2 - PRODUCTS

2.1 SMALL STEEL PIPE (SYSTEMS 1, 2, 3 AND 6)

A. Unless otherwise indicated, galvanized steel pipe and black steel pipe in sizes 6 inches in diameter and smaller shall conform to the requirements of ASTM A 53 or ASTM A 106, as called out in the piping schedule and shall be Schedule 40 or 80 as indicated. Galvanized steel pipe shall not be cement mortar lined unless otherwise indicated. Fittings for galvanized steel pipe shall be of galvanized malleable iron, with NPT or grooved ends. Black pipe may have welded joints, with standard or extra strong welding fittings, or fittings indicated. Wall thickness of wrought-steel pipe shall comply with ASME B36.10M.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threaded ends according to ASME B1.20.1.
2. Steel Threaded Fittings: ASME B16.11, forged steel with threaded ends according to ASME B1.20.1.
3. Steel Welding Fittings: ASME B16.9, wrought steel or ASME B16.11, forged steel.
4. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends according to ASME B1.20.1. Unions shall be as manufactured by Henry Valve Company; Vogt Valve Co.; or equal.
5. Cast-Iron Flanges and Flanged Fittings: ASME B16.1, Class 125.
6. Joint Compound and Tape: Suitable for natural gas.
7. Steel Flanges and Flanged Fittings: ASME B16.5.
8. Gasket Material: Thickness, material, and type suitable for natural gas.

2.2 COPPER TUBING (SYSTEM 24)

A. Hard Copper Tube and Fittings: ASTM B 88, Type L and ASTM B 88, Type M water tube, drawn temper.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings. Solder Filler Metals: ASTM B 32, 95-5 tin antimony.
3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
5. Copper Pressure-Seal-Joint Fittings:
    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Elkhart Products Corporation; Industrial Division; NIBCO INC.; Viega; Plumbing and Heating Systems.
    b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
    c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
6. Copper Push-on-Joint Fittings:
    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        1) NVent LLC.
    b. Description: Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22; with stainless-steel teeth and EPDM-rubber O-ring seal in each end instead of solder-joint ends.

B. Soft Copper Tube and Fittings: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.
   1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
   2. Copper Pressure-Seal-Joint Fittings:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Elkhart Products Corporation; Industrial Division; NIBCO INC.; Viega; Plumbing and Heating Systems.
      b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
      c. NPS 3 and NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 HOSE BIBBS AND HYDRANTS

A. All hose bibbs and hydrants in exposed locations subject to freezing shall be the non-freeze type. Hose bibbs connected to a non-potable water supply shall be provided with plastic or stainless-steel warning signs "DO NOT DRINK," in clearly legible letters, and permanently attached at the hose bibb. Hose bibbs shall be provided with vacuum breakers as furnished by Crane Co., American Standard, or equal.

B. Manufacturers, or Equal:

Dwg. Callout	Fixture Type	Description
HB-1	Non-freeze Post-type	Exposed bronze hydrant, post-type, depth of bury to suit local conditions; minimum 4 feet. 1. Woodward Mfg. Co., Model Iowa Y1
HB-2	Non-freeze wall-type	Heavy duty bronze hydrant with nickel-bronze face, hinged cover, recessed box, and key. Length to suit wall. 1. Josam Mfg. Co., Series 71000 2. Jay R. Smith Mfg. Co., Fig. 5510/5511 3. Zurn Industries, Inc., Fig. Z-1300
HB-3	Hose valves	Heavy duty bronze hydrant, with composition disc, handwheel, cap and chain. Sizes 1 1/2-inch and 2 1/2 inch: 1. Fire-End and Croker Corp, Model 180 2. James Jones (Watts Regulator Co., Nos. J-383 and J-344, respectively Size 1-inch, without cap and chain: 1. Apollo (Conbraco Industries, Inc.), Model 70-805 2. Fire-End and Croker Corp, Model 180 Size 3/4-inch, without cap and chain: 1. Apollo (Conbraco Industries, Inc.) Model 70-804, or 78-104 2. Chicago Faucet No.7T 3. Ford Meter Box Co., Model B8H-233HB2

4. Woodford Manufacturing Co., Model Y24 or 24P

HB-4	Wall box type	Recessed, with nickel-bronze box, hinged cover, and key. 1. Josam Mfg. Co., Series 71020 2. Jay R. Smith Mfg. Co., Series 5710 3. Zurn Industries, Inc., Fig. Z-1345

2.4 WALL-MOUNTED HOSE RACKS

A. The Contractor shall provide wall-mounted hose racks at locations indicated. Racks shall be all welded steel construction, of minimum 8-gage sheet steel, hot-dip galvanized after fabrication, and shall have a capacity to hold 100 feet of 3/4-inch or 1-1/2-inch hose. Where racks are located in the open, they shall be supported from two 2- by 2- by 1/4-inch galvanized steel angle posts set in a concrete base or as indicated.

2.5 HOSES AND NOZZLES

A. The Contractor shall furnish the following lengths of hose:
1. 1 - 50 ft lengths of 3/4-inch diameter hose
2. 1 - 75 ft lengths of 1-inch diameter hose

B. Each length of hose shall be provided with male and female connectors and nozzle. Hoses shall be seamless extruded rubber with dacron cotton exterior designed for a working pressure of at least 200 psi.

C. Nozzles shall be capable of complete shut-off and shall produce a solid straight stream and up to a 90-degree conical fog. Nozzle material shall be polished brass. Nozzles shall have rubber bumpers.

D. Nozzle Manufacturers, or Equal:
1. W.D. Allen Mfg. Co., Illinois
2. Fire-End and Crocker Corp., New York
3. Halprin Supply Co., Illinois
4. Western Fire Equipment Co., California

2.6 GASKETS AND BOLTS

A. Except as otherwise indicated, gaskets for flanged joints shall be in accordance with the requirements of Section 40 05 00 - Piping, General.

B. Except as otherwise indicated, bolts shall conform to the requirements of Section 05 50 00 – Metal Fabrications.

2.7 INSULATING CONNECTIONS

A. Insulating bushings, unions, couplings or flanges, as appropriate, shall be used for joining pipes of dissimilar metals, and for piping systems where corrosion control and cathodic protection are involved.

2.8 PIPE SUPPORTS

A. Pipe Supports, hangers, anchors, seismic restraints, and guides shall be in accordance with the requirements of Section 40 05 07 - Pipe Supports.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Small Steel Pipe: Buried galvanized or black steel pipe shall be coated as specified in Section 09 90 00 – Protective Coatings and Linings or provided with an extruded high density polyethylene coating with minimum thickness of 35 mils.

B. Plastic Pipe: PVC, CPVC, and FRP pipe joints shall be solvent-welded in accordance with the manufacturer's instructions. Expansion joints or pipe bends shall be provided to absorb pipe expansion over a temperature range of 100 degrees F, unless otherwise indicated. Care shall be taken to provide sufficient supports, anchors, and guides, to avoid stress on the piping. Obtain the services of the pipe manufacturer, to instruct the pipe fitters in the correct way of making solvent welded and threaded joints. Only clean, fresh primer and solvent shall be used at all times at the recommended temperatures.

C. Drain Traps: Drain traps shall be installed at low points in air and gas lines or elsewhere where indicated. Liquid outlets shall be piped to the nearest floor drain or open sump.

D. Couplings: Pipe couplings shall be installed in strict accordance with the manufacturer's printed recommendations, using the correct style coupling and gasket for any given application.

E. Gaskets for Flanged Joints: Gaskets shall be in accordance with the requirements of Section 40 05 00 - Piping, General.

F. Insulating Connections: All insulating connections shall be installed in accordance with manufacturer's printed instructions. Care shall be exercised to prevent damage to insulating fittings, while making up the joints.

3.2 CONTINUITY BONDS

A. Where required by the Contract Documents, all metallic pipe joints, except field-welded joints and insulating joints, shall be continuity bonded in accordance with the requirements of Section 40 05 00 - Piping, General.

END OF SECTION

SECTION 40 05 50
MISCELLANEOUS VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall provide miscellaneous valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 40 05 51 - Valves, General, apply to this Section.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 40 05 51 – Valves, General and Section 01 33 20 – Submittal Procedures.

PART 2 - PRODUCTS

2.1 AIR-VACUUM AND AIR-RELEASE VALVES

A. Air and Vacuum Valves: Air and vacuum valves shall be per AWWA C512 and suitable for potable water. 1-inch through 3-inch valves with NPT threaded inlet and outlet, 4-inch and larger valves with ANSI Class flanged inlet and outlet to match pressure rating shown on Drawings. Air and vacuum valves shall be capable of venting large quantities of air while pipelines are being filled and allowing air to re-enter while pipelines are being drained. They shall be of the size indicated, with flanged or screwed ends to match piping. Bodies shall be of high-strength cast iron or ductile Iron, fusion bonded epoxy lined and coated. The float, seat, all wetted parts and moving parts shall be constructed of Type 316 stainless steel. Seat washers and gaskets shall be of a material insuring water tightness with a minimum of maintenance. Valves shall be designed for minimum 150 psi water-working pressure, unless otherwise indicated.

B. Air-Release Valves: Air-release valves shall vent accumulating air while system is in service under pressure and be of the size indicated. Valves shall meet the same general requirements as indicated for air and vacuum valves except that the vacuum feature will not be required. Valves shall be designed for a minimum water-working pressure of 150 psi, unless otherwise indicated.

C. Combination Air Valves: Combination air valves shall combine the characteristics of air and vacuum valves and air release valves by exhausting accumulated air in systems under pressure and releasing or re-admitting large quantities of air while a system is being filled or drained, respectively. Valves shall have the same general requirements as indicated for air and vacuum valves. Where valves are 2-inch or less the combination air valve may be single body style. Where combination air valves are 4-inch or larger dual body valves styles shall be provided.

D. Manufacturers
   1. APCO (Valve and Primer Corporation)

2. Crispin - Multiplex Manufacturing Company
3. GA Industries
4. Val-Matic (Valve and Manufacturing Corporation)
5. Engineer approved equal.

2.2 BACKFLOW PREVENTER VALVES

A. General: Backflow preventers shall work on the reduced pressure principle. They shall consist of 2 spring-loaded check valves, automatic differential pressure relief valve, drain valves, and shut-off valves. The body material shall be bronze or cast iron for a working pressure of not less than 150 psi, with bronze or stainless steel trim. Drain lines with air gaps shall be provided. The backflow preventer valves shall be in accordance with AWWA C511 standard.

B. The number and sizes of backflow preventors required are given on the Contract Drawing P&IDs.

C. Manufacturers
1. Cla-Val Company
2. Febco (CMB Industries)
3. Hersey Products
4. Watts, ACV
5. Wilkins Regulator Division (Zurn Industries)
6. Engineer approved equal.

2.3 CORPORATION STOPS

A. Unless otherwise indicated, corporation stops shall be made of solid brass for key operation, with screwed ends with corporation thread or iron pipe thread, as required. Note that corporation stops on special chemical diffuser ports shall be 316 stainless steel – unless indicated otherwise.

B. Manufacturer
1. Ford Meter Box Company, Inc.
2. James Jones Company (Watts, ACV)
3. Mueller Company
4. Engineer approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Backflow preventers shall be installed in utility water lines where required by applicable codes or regulations, and where indicated on Contract Drawings.

B. Valves shall be installed in accordance with the manufacturer's printed recommendations, and with Section 40 05 51.

C. Backflow preventers, as well as air and vacuum release valves, shall have piped outlets to the nearest acceptable drain, firmly-supported, and installed in such a way as to avoid splashing and wetting of floors and obstruction of traffic.

D. All air valves shall be installed and operational at the time of filling, draining, disinfecting or pressure testing of the pipeline.

END OF SECTION

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SECTION 40 05 51
VALVES, GENERAL

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall provide valves, actuators, and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all valves and valve actuators except where otherwise indicated. Valves and actuators in particular locations may require a combination of units, sensors, limit switches, and controls indicated in other Sections of the Specifications.

C. Where a valve is to be supported by means other than the piping to which it is attached, the Contractor shall obtain from the valve manufacturer a design for support and foundation. The design, including drawings and calculations sealed by an engineer, shall be submitted with the Shop Drawings. When the design is approved, the support shall be provided.

D. Unit Responsibility: A single manufacturer shall be made responsible for coordination of design, assembly, testing, and furnishing of each valve; however, the Contractor shall be responsible to the Owner for compliance with the requirements of each valve section. Unless indicated otherwise, the responsible manufacturer shall be the manufacturer of the valve.

E. Single Manufacturer: Where two or more valves of the same type and size are required, the valves shall be furnished by the same manufacturer.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 20 - Submittal Procedures.

B. Shop Drawings: Shop Drawings shall contain the following information:
   1. Valve name, size, Cv factor, pressure rating, identification number (if any), and specification section number.
   2. Complete information on valve actuator, including size, manufacturer, model number, limit switches, and mounting.
   3. Cavitation limits for control valves.
   4. Assembly drawings showing part nomenclature, materials, dimensions, weights, and relationships of valve handles, handwheels, position indicators, limit switches, integral control systems, needle valves, and control systems.
   5. Complete wiring diagrams and control system schematics.
   6. Valve Labeling: A schedule of valves to be furnished with stainless steel tags, indicating in each case the valve location and the proposed wording for the label.

C. Technical Manual: The Technical Manual shall contain the required information for each valve.

D. Spare Parts List: A Spare Parts List shall contain the required information for each valve assembly, where indicated.

E. Factory Test Data: Where indicated, signed, dated, and certified factory test data for each valve requiring certification shall be submitted before shipment of the valve. The data shall also include certification of quality and test results for factory-applied coatings.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. General: Valves and gates shall be new and of current manufacture. Shut-off valves 6-inches and larger shall have actuators with position indicators. Gate valves 18-inches and larger or where chain wheel is required, shall be furnished with spur gear and hand wheel. Buried valves shall be provided with valve boxes and covers containing position indicators and valve extensions. Manual shut-off valves mounted higher than 7-feet above working level shall be provided with chain actuators.

B. Valve Actuators: Unless otherwise indicated, valve actuators shall be in accordance with Section 40 05 52 - Valve and Gate Actuators.

C. Protective Coating: The exterior surfaces of all valves and the wet interior surfaces of ferrous valves of sizes 4-inches and larger shall be epoxy coated in accordance with Section 09 90 00 – Protective Coatings and Linings. The valve manufacturer shall certify in writing that the required coating has been applied and tested in the manufacturing plant prior to shipment, in accordance with these Specifications. Flange faces of valves shall not be epoxy coated.

D. Valve Labeling: Except when such requirement is waived by the construction manager in writing, a label shall be provided on shut-off valves and control valves except for hose bibbs and chlorine cylinder valves. The label shall be of 1/16-inch Type 316 stainless steel, minimum 1-inches by 2-inches in size, , and shall be permanently attached to the valve or on the wall adjacent to the valve as directed by the construction manager. Label shall have model numbers, ratings, valve number, size and all other pertinent valve information stamped or permanently affixed to the tag.

E. Valve Testing: As a minimum, unless otherwise indicated or recommended by the reference Standards, valves 3-inches in diameter and smaller shall be tested in accordance with manufacturer's standard and 4-inches in diameter and larger shall be factory tested as follows:

1. Hydrostatic Testing: Valve bodies shall be subjected to internal hydrostatic pressure equivalent to twice the water rated pressure of the valve. Metallic valves rating pressures shall be at 100 degrees F and plastic valves shall be 73 degrees, or at higher temperature according to type of material. During the hydrostatic test, there shall be no leakage through the valve body, end joints, or shaft seals, nor shall any part of the valve be permanently deformed. The duration shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 10 minutes.
2. Seat Testing: Valves shall be tested for leaks in the closed position with the pressure differential across the seat equal to the water rated pressure of the valve. The duration of test shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 10 minutes. Leakage past the closed valve shall not exceed 1 fluid ounce per hour per inch diameter for metal seated valves and drop-tight for resilient seated valves.

3. Performance Testing: Valves shall be shop operated from fully closed to fully open position and reverse under no-flow conditions in order to demonstrate the valve assembly operates properly.

F. Certification: Prior to shipment, the Contractor shall submit for valves over 12-inches in size, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, or ASTM.

G. Valve Marking: Valve bodies shall be permanently marked in accordance with MSS SP25 - Standard Marking Systems for Valves, Fittings, Flanges, and Unions.

2.2 MATERIALS

A. General: Materials shall be suitable for the intended application. Materials in contact with potable water shall be listed as compliant with NSF Standard 61. Materials not indicated shall be high-grade standard commercial quality, free from defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended. Unless otherwise indicated, valve and actuator bodies shall conform to the following requirements:
   1. Cast Iron: Close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Castings, Class 30, or to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   2. Ductile Iron: ASTM A 536 - Ductile Iron Castings, or to ASTM A 395 - Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
   3. Steel: ASTM A 216 - Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service, or to ASTM A 515 - Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service.
   4. Bronze: ASTM B 62 - Composition Bronze or Ounce Metal Castings, and valve stems not subject to dezincification shall conform to ASTM B 584 - Copper Alloy Sand Castings for General Applications.
   5. Stainless Steel: Stainless steel valve and operator bodies and trim shall conform to ASTM A 351 - Steel Castings, Austenitic, for High-Temperature Service, Grade CF8M, or shall be Type 316 stainless steel.
   6. PVC: Poly Vinyl Chloride materials for valve body, flanges, and cover shall conform to Cell Classification 12454.
   7. CPVC: Chlorinated Poly Vinyl Chloride materials for valve body, flanges, and cover shall conform to Cell Classification 23447.
   8. NSF Standard 61: Materials shall be listed for use in contact with potable water.

2.3 VALVE CONSTRUCTION

A. Bodies: Valve bodies shall be cast, molded (in the case of plastic valves), forged, or welded of the materials indicated, with smooth interior passages. Wall thicknesses shall be uniform in agreement with the applicable standards for each type of valve, without casting defects, pinholes, or other defects that could weaken the body. Welds on welded bodies shall be done by certified welders and shall be ground smooth. Valve ends shall be as indicated, and be rated for the maximum temperature and pressure to which the valve will be subjected.

B. Valve End Connections: Unless otherwise indicated, valves 2-1/2 inches diameter and smaller may be provided with threaded end connections. Valves 3-inches and larger shall have flanged end connections.

C. Bonnets: Valve bonnets shall be clamped, screwed, or flanged to the body and shall be of the same material, temperature, and pressure rating as the body. The bonnets shall have provision for the stem seal with the necessary glands, packing nuts, or yokes.

D. Stems: Valve stems shall be of the materials indicated, or, if not indicated, of the best commercial material for the specific service, with adjustable stem packing, O-rings, Chevron V-type packing, or other suitable seal. Bronze valve stems shall conform to ASTM B 584, except that zinc content shall not exceed 16 percent.

E. Stem Guides: Stem guides shall be provided, spaced 10-feet on centers unless the manufacturer can demonstrate by calculation that a different spacing is acceptable. Submerged stem guides shall be 304 stainless steel.

F. Internal Parts: Internal parts and valve trim shall be as indicated for each individual valve. Where not indicated, valve trim shall be of Type 316 stainless steel or other best suited material.

G. Nuts and Bolts: Nuts and bolts on valve flanges and supports shall be in accordance with Section 05 50 00 – Metal Fabrications.

2.4 VALVE ACCESSORIES

A. Valves shall be furnished complete with the accessories required to provide a functional system.

2.5 SPARE PARTS

A. The Contractor shall furnish the required spare parts suitably packaged and labeled with the valve name, location, and identification number. The Contractor shall also furnish the name, address, and telephone number of the nearest distributor for the spare parts of each valve. Spare parts are intended for use by the Owner, after expiration of the correction of defects period.

2.6 MANUFACTURERS

A. Manufacturer's Qualifications: Valve manufacturers shall have a successful record of not less than 5 years in the manufacture of the valves indicated.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

A. General: Valves, actuating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the manufacturer's written instructions and as indicated. Gates shall be adequately braced to prevent warpage and bending under the intended use. Valves shall be firmly supported to avoid undue stresses on the pipe.

B. Access: Valves shall be installed with easy access for actuation, removal, and maintenance and to avoid interference between valve actuators and structural members, handrails, or other equipment.

C. Valve Accessories: Where combinations of valves, sensors, switches, and controls are indicated, the Contractor shall properly assemble and install such items so that systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on Shop Drawing submittals.

END OF SECTION

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SECTION 40 05 52
VALVE AND GATE ACTUATORS

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall provide valve and gate actuators and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to valves and gates except where otherwise indicated in the Contract Documents.

C. Unit Responsibility: The valve or gate manufacturer shall be made responsible for coordination of design, assembly, testing, and installation of actuators on the valves and gates; however, the Contractor shall be responsible to the Owner for compliance of the valves, gates, and actuators with the Contract Documents.

D. Single Manufacturer: Where 2 or more valve or gate actuators of the same type or size are required, the actuators shall be produced by the same manufacturer.

E. The requirements of Section 26 00 00 - Electrical General Provisions apply to the Work of this Section.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 20 – Submittal Procedures and Section 40 05 51 - Valves, General.

B. Shop Drawings: Shop Drawing information for actuators shall be submitted together with the valve and gate submittals as a complete package.

C. Calculations: Selection calculations showing dynamic seating and unseating torques versus output torque of actuator.

D. Technical Manuals: The Contractor shall furnish technical manuals for the butterfly valves, butterfly valve manual actuators, and butterfly valve electric motor actuators under one cover and in accordance with the requirements of Section 01 33 20 – Submittal Procedures.

PART 2 - PRODUCTS

2.1 GENERAL

A. Unless otherwise indicated, shut-off and throttling valves and externally actuated valves and gates shall be provided with manual or power actuators. The Contractor shall furnish actuators complete and operable with mounting hardware, motors, gears, controls, wiring, solenoids, handwheels, levers, chains, and extensions, as applicable. Actuators shall have the torque ratings equal to or greater than required for valve seating and dynamic torques, whichever is greater, and shall be capable of holding the valve in any intermediate position between fully-open and fully-closed without creeping or fluttering. Actuator torque ratings

for butterfly valves shall be determined in accordance with AWWA C504 - Rubber-Seated Butterfly Valves. Wires of motor-driven actuators shall be identified by unique numbers.

B. Manufacturers: Where indicated, certain valves and gates may be provided with actuators manufactured by the valve or gate manufacturer. Where actuators are furnished by different manufacturers, the Contractor shall coordinate selection to have the fewest number of manufacturers possible.

C. Materials: Actuators shall be current models of the best commercial quality materials and be liberally-sized for the required torque. Materials shall be suitable for the environment in which the valve or gate is to be installed.

D. Actuator Mounting and Position Indicators: Actuators shall be securely mounted by means of brackets or hardware specially designed and sized for this purpose and be of ample strength. The word "open" shall be cast on each valve or actuator with an arrow indicating the direction to open in the counter-clockwise direction. Gear and power actuators shall be equipped with position indicators. Where possible, manual actuators shall be located between 48- and 60-inches above the floor or the permanent working platform.

E. Standard: Unless otherwise indicated and where applicable, actuators shall be in accordance with AWWA C 540 - Power-Actuating Devices for Valves and Slide Gates.

F. Functionality: Electric, pneumatic, and hydraulic actuators shall be coordinated with the power requirements of Division 26.

G. Fasteners: Fasteners shall be in accordance with Section 05 50 00 - Metal Fabrications.

H. Protective Coatings: Protective coatings shall be in accordance with Section 09 90 00 – Protective Coatings and Linings.

2.2 MANUAL ACTUATORS

A. General: Unless otherwise indicated, valves and gates shall be furnished with manual actuators. Valves in sizes up to and including 4-inches shall have direct acting lever or handwheel actuators of the manufacturer's best standard design. Larger valves and gates shall have gear-assisted manual actuators, with an operating pull of maximum 60 pounds on the rim of the handwheel. Buried and submerged gear-assisted valves, gates, gear-assisted valves for pressures higher than 250 psi, valves 30-inches in diameter and larger, and where so indicated, shall have worm gear actuators, hermetically-sealed water-tight and grease-packed. Other valves 6-inches to 24-inches in diameter may have traveling nut actuators, worm gear actuators, spur or bevel gear actuators, as appropriate for each valve.

B. Buried Valves: Unless otherwise indicated, buried valves shall have extension stems to grade, with square nuts or floor stands, position indicators, and cast-iron or steel pipe extensions with valve boxes, covers, and operating keys. Where so indicated, buried valves shall be in cast-iron, concrete, or similar valve boxes with covers of ample size to allow operation of the valve actuators. Covers of valve boxes shall be permanently labeled as required by the local Utility Company or the Engineer. Wrench nuts shall comply with AWWA C 500 - Metal - Seated Gate Valves for Water Supply Service.

C. Chain Actuator: Manually-activated valves with the stem located more than 7-feet above the floor or operating level shall be provided with chain drives consisting of sprocket-rim chain wheels, chain guides, and operating chains provided by the valve manufacturer. The wheel and guide shall be of ductile iron, cast iron, or steel, and the chain shall be hot-dip galvanized steel or stainless steel, extending to 5-feet 6-inches above the operating floor level. The valve stem of chain-actuated valves shall be extra strong to allow for the extra weight and chain pull. Hooks shall be provided for chain storage where chains interfere with pedestrian traffic.

D. Floor Stands: Valve actuator floor stands shall be cast iron or fabricated steel pedestals. The centerline of the actuator shall be approximately 42 to 48 inches above the base of the pedestal.

E. Floor Boxes: Hot dip galvanized cast iron or steel floor boxes and covers to fit the slab thickness shall be provided for operating nuts in or below concrete slabs. For operating nuts in the concrete slab, the cover shall be bronze-bushed.

F. Tee Wrenches: Buried valves with floor boxes shall be furnished with 2 operating keys or 1 key per 10 valves, whichever is greater. Tee wrenches sized so that the tee handle will be 2 to 4 feet above ground, shall fit the operating nuts.

G. Manual Worm Gear Actuator: The actuator shall consist of a single or double reduction gear unit contained in a weather-proof cast iron or steel body with cover and minimum 12-inch diameter handwheel. The actuator shall be capable of 90 degree rotation and shall be equipped with travel stops capable of limiting the valve opening and closing. The actuator shall consist of spur or helical gears or worm gearing. The gear ratio shall be self-locking to prevent "back-driving." The spur or helical gears shall be of hardened alloy steel and the worm gear shall be alloy bronze. The worm gear shaft and the handwheel shaft shall be of 17-4 PH or similar stainless steel. Gearing shall be accurately cut with hobbing machines. Ball or roller bearings shall be used throughout. Output shaft end shall be provided with spline to allow adjustable alignment. Actuator output gear changes shall be mechanically possible by simply changing the exposed or helical gearset ratio without further disassembly of the actuator. Gearing shall be designed for a 100 percent overload. The entire gear assembly shall be sealed weatherproof. Manual worm gear actuators shall be Auma GS Series, Limitorque HBC Series, no “Or-Equals”**.**

H. Traveling-Nut Actuator: The actuator shall consist of a traveling-nut with screw (Scotch yoke) contained in a weatherproof cast iron or steel housing with spur gear and minimum 12-inch diameter handwheel. The screw shall run in 2 end bearings, and the actuator shall be self-locking to maintain the valve position under any flow condition. The screw and gear shall be of hardened alloy steel or stainless steel, and the nut and bushings shall be of alloy bronze. The bearings and gear shall be grease-lubricated by means of nipples. Gearing shall be designed for a 100 percent overload.

I. Schedule for Manual Actuator Types: For a complete schedule of manual actuators required on project valves (3” diameter and larger), see Contract Drawing M-03

2.3 ELECTRIC MOTOR ACTUATORS

A. General

1. Equipment Requirements: Where electric motor actuators are indicated, an electric motor-actuated valve control unit shall be attached to the actuating mechanism housing by means of a flanged motor adapter piece.

2. Gearing: The motor actuator shall include the motor, reduction gearing, reversing starter, torque switches, and limit switches in a weather-proof NEMA 4 assembly. The actuator shall be a single or double reduction unit consisting of spur or helical gears and worm gearing. The spur or helical gears shall be of hardened alloy steel, and the worm gear shall be alloy bronze. Gearing shall be accurately cut with hobbing machines. Power gearing shall be grease- or oil-lubricated in a sealed housing. Ball or roller bearings shall be used throughout. Actuator output speed changes shall be mechanically possible by simply removing the motor and changing the exposed or helical gearset ratio without further disassembly of the actuator.
3. Starting Device: Except for modulating valves, the unit shall be so designed that a hammer blow is imparted to the stem nut when opening a closed valve or closing an open valve. The device should allow free movement at the stem nut before imparting the hammer blow. The actuator motor must attain full speed before stem load is encountered.
4. Switches
    a. Electronic Type Switches: Limit switches or valve position shall be sensed by a 15 bit, optical, absolute position encoder. The open and closed positions shall be stored in a permanent, non-volatile memory. The encoder shall measure valve position continuously, including both motor and hand wheel operation, with or without use of battery. An electronic torque sensor shall be furnished. The torque limit may be adjusted from 40 to 100 percent of rating in 1 percent increments. The motor shall be de-energized if the torque limit is exceeded. A boost function shall be included to prevent torque trip during initial valve unseating, and a “jammed valve” protection feature with automatic retry sequence shall be incorporated to de-energize the motor if no movement occurs. Valve actuators with electronic type switches shall be as manufactured by Limitorque or Auma Actuators, Inc.
    b. The actuator shall be wired in accordance with the schematic diagram. Wiring for external connections shall be connected to marked terminals. . A calibration tag shall be mounted near each switch correlating the dial setting to the unit output torque. Switches shall not be subject to breakage or slippages due to over-travel. Traveling-nuts, cams, or micro switch tripping mechanisms shall not be used. Limit switches shall be of the heavy-duty open contact type with rotary wiping action.
5. Handwheel Operation: A permanently attached handwheel shall be provided for emergency manual operation. The handwheel shall not rotate during electrical operation. The maximum torque required on the handwheel under the most adverse conditions shall not exceed 60 lb.ft, and the maximum force required on the rim of the handwheel shall not exceed 60 lb. An arrow and either the word "open" or "close" shall be cast or permanently affixed on the handwheel to indicate the appropriate direction to turn the handwheel. A clutch lever shall be provided to put actuator into handwheel operation. Valves with electric motor actuators having stems more than 7-feet above the floor shall be provided with chain activator handwheels. The clutch lever shall be provided with a cable secured to the chain to allow disengagement for manual operation.
6. Motor: The motor shall be of the totally enclosed, non-ventilated, high-starting torque, low-starting current type for full voltage starting. It shall be suitable for operation on 240 volt, 1-phase 60 Hz current, and have Class F insulation and a motor frame with dimensions in accordance with the latest revised NEMA MG Standards. The observed temperature rise by thermometer shall not exceed 55 degrees C above

an ambient temperature of 40 degrees C when operating continuously for 15 minutes under full rated load. With a line voltage ranging between 10 percent above to 10 percent below the rated voltage, the motor shall develop full rated torque continuously for 15 minutes without causing the thermal contact protective devices imbedded in the motor windings to trip or the starter overloads to drop-out. Bearings shall be of the ball type, and thrust bearings shall be provided where necessary. Bearings shall be provided with suitable seals to confine the lubricant and prevent the entrance of dirt and dust. Motor conduit connections shall be watertight. Motor construction shall incorporate the use of stator and rotor as independent components from the valve operation such that the failure of either item shall not require actuator disassembly or gearing replacement. . Two Class B thermal contacts or solid state thermistors imbedded within the motor windings shall be provided to protect against over-temperature damage. Each electric motor actuator shall be provided with a local disconnect switch or circuit breaker to isolate power from the motor and controller during maintenance activities.

B. Electric Motor Actuators

1. General: Where indicated, modulating electric motor actuators shall be the ac modulating type complete with a local control station with power disconnect switch or circuit breaker, provided with open/stop/close and local/off/remote selector switches on the actuator local control station, and open/close status lights.
2. Actuator Appurtenances: The actuator for each valve shall be provided with a padlockable disconnect switch, open and closed status lights, open, close and lockout stop pushbuttons, a local/off/remote selector switch, and other devices indicated. The disconnect switches in certain applications are required to be located remotely from the actuator body itself, as shown on the Contract Drawings. The local control station may also be provided as an integral part of the actuator or remotely as otherwise indicated or required to permit operation by a person at floor elevation and within sight of the valve actuator. The Contractor shall provide conduit and wiring between the actuator controls and the valve actuator for these applications.
3. Control Module: The control module shall be of the electronic solid-state ac type with control outputs for positioning the valve via 4 - 20 ma input signals.
4. Starter: The actuator shall control a solid-state reversing starter designed for minimum susceptibility to power line surges and spikes. The solid-state starter and control module shall be rated for continuous modulating applications. Power supply shall be 24480 volt, 13 phase, 60 Hz. A disconnect switch shall be included with each actuator.
5. Construction: The control unit shall be microprocessor-based and shall contain an analog/digital converter, separate input-output switches, non-volatile random access memory for storage of calibration parameters and pushbutton calibration elements for field setup. Potentiometer adjustments shall contain a PID control function internally. In addition, the controller shall contain as standard feature a loss of command signal protection selectable to lock in last or lock in pre-set valve position and a valve position output signal in 4 - 20 ma. As an alternative to the construction requirement, the motor shall be capable of modulating at a rate of 600 starts per hour at the 50 percent to 85 percent travel range of the valve. The system shall allow control of the open, close, or percent open function when the local/off/remote switch is in the remote position. Each actuator shall have a frequency shut down system which when pre-programmed, shall function as directed upon receipt of an ESD signal.

6. Open/Close Operating Speed: Provide a full close to full open or full open to full close operating time of 20 minutes minimum.
    a. Variable speed closing time
    b. First 80% closing in 10 minutes minimum
    c. Final 20% closing to shut in 10 minutes minimum
7. For a complete schedule of electric actuators required on project valves, see Contract Drawings.
8. Manufacturers:
    a. Auma Sipos Seven Series with worm gear.
    b. No equal.

C. 120 VAC Quarter-Turn and Multiturn Electric Valve Operators on Isolation Valves 3-Inch Dia. and Smaller. Where indicated on Contract Drawings, and primarily on vendor supplied equipment skids and control packages, 120 VAC electric actuators may be supplied on smaller valves of 3-inch diameter and smaller, as follows:
1. Provide 120 VAC, 1-phase motor-operated valve operator suitable for use with quarter-turn ball valves, multiturn diaphragm valves, and multiturn globe valves. Operator shall have the following characteristics and features:
    a. Reversing capacitor-start motor rated for operation on 120 V ac, 60 Hz, single phase. Output torque as required for valve application and pressure differential.
    b. Integral motor overload protection, with auto reset
    c. Permanently-lubricated gear train
    d. For open/close control, provide four single pole, double throw cam actuated limit switches (2 OPEN, 2 CLOSED). One set of limit switches shall be used for both motor control and local indication. The other set shall be available for connection to remote monitoring. Limit switch contacts shall be adjustable and shall be rated for not less than 5 amps at 120 V ac.
    e. Local Control Station: Open/Close: Corrosion-resistant, NEMA 4X, for mounting near valve actuator. Provide 2 position selector switch for LOCAL-REMOTE selection and 2 pushbuttons, OPEN and CLOSE. In addition, provide OPEN and CLOSE indicating lights operating at 120 V ac for connection to valve control limit switches.
    f. For modulating control, provide an electronic positioner and feedback potentiometer. The positioner shall utilize a 4 - 20 ma signal to adjust the valve opening. Feedback potentiometer shall be 0 - 1000 ohms.
    g. Local Control Station Modulating: Corrosion resistant, NEMA 4X, for mounting near valve actuator. Provide 2 position selector switch for LOCAL-REMOTE selection, one OPEN and one CLOSE push buttons, a resistance to current converter with 4 - 20 ma output, and a 0 to 100 percent electronic valve position indicator.
    h. Local power disconnect switch (NEMA 4X) for disconnecting 120 V ac power to valve. Disconnect shall be installed in the field within sight of the valve actuator, in accordance with the requirements of NPFA 70.
2. See Drawings for control diagram wiring interface.
3. Two wire control systems are not required for this actuator.
4. Operators shall be RCS, Asahi/America Quarter Master or equal.

PART 3 - EXECUTION

3.1 SERVICES OF MANUFACTURER

A. Field Adjustments: Field representatives of manufacturers of valves or gates with pneumatic, hydraulic, or electric actuators shall adjust actuator controls and limit-switches in the field for the required function.

3.2 INSTALLATION

A. Valve and gate actuators and accessories shall be installed in accordance with Section 40 05 51 - Valves, General. Actuators shall be located to be readily accessible for operation and maintenance without obstructing walkways. Actuators shall not be mounted where shock or vibrations will impair their operation, nor shall the support systems be attached to handrails, process piping, or mechanical equipment.

B. Inspection, Startup, and Field Adjustment: An authorized representative of the manufacturer shall visit the Site and witness the following:
   1. Installation of the equipment for not less than two (2) Work Days
   2. Inspection, checking, and adjusting the equipment for not less two (2) Work Days.
   3. Startup and field-testing for proper operation for not less than two (2) Work Days.

C. Instruction of Owner's Personnel: The authorized service representative shall visit the Site for not less than 2 Days to instruct the Owner's personnel in the operation and maintenance of the equipment including step-by-step troubleshooting procedures with necessary test equipment.

END OF SECTION

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SECTION 40 05 61
GATE VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall provide gate valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 40 05 51 - Valves, General apply to this Section.

C. The requirements of Section 40 05 52 - Valve and Gate Actuators apply to this Section.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 20 – Submittal Procedures and Section 40 05 51 – Valves, General.

PART 2 - PRODUCTS

2.1 GENERAL

A. Buried valves shall be of the inside screw, non-rising stem type. The valve actuators shall be as indicated, with counter-clockwise opening stems, in accordance with Section 40 05 52 - Valve and Gate Actuators.

B. Gate valves 18-inches and larger shall be provided with a bypass line and isolation valve.

2.2 RESILIENT-SEATED GATE VALVES

A. Construction: Resilient-seated gate valves shall conform to AWWA C515 - Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service. The valves shall be suitable for a minimum design working water pressure of 150 psig see NTS, above, with flanged, bell and spigot, or mechanical joint ends. The valve body, bonnet, and disc shall be of cast iron or ductile iron and the disc or body shall be rubber-coated. Body and bonnet wall thickness shall be equal to or greater than the minimum wall thickness as listed in Table 1 of AWWA C515. The stem, stem nuts, glands, and bushings shall be bronze, with the stem seal per AWWA C515.

B. Pressure Ratings:
   1. AWWA C515 valves 2- through 36-inch with outside screw-and-yoke (OS&Y) rising stem and 2- through 16-inch for non-rising-stem (NRS), shall be rated for 200 psig minimum design working water pressure.

C. Protective Coating: Valves shall be factory epoxy coated in accordance with Section 09 90 00 – Protective Coatings and Linings. The Contractor shall submit a test report from a coating inspector that the coating is holiday-free. The Contractor shall be aware that it may retain the services of a third-party coating applicator tester to achieve the holiday-free requirement.

D. Actuators: Unless otherwise indicated, resilient-seated gate valves shall have manual actuators in accordance with Section 40 05 52 – Valve and Gate Actuators.

E. Manufacturers, or Equal
   1. Mueller Company
   2. M & H
   3. Clow

PART 3 - EXECUTION

3.1 GENERAL

A. Gate valves shall be installed in accordance with the provisions of Section 40 05 51 – Valves, General. Care shall be taken that valves in plastic lines are well supported at each end of the valve.

END OF SECTION

SECTION 40 05 62
PLUG VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall provide plug valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 40 05 51 - Valves, General apply to this Section.

C. The requirements of Section 40 05 52 - Valve and Gate Actuators apply to this Section.

D. Plug valves shall have undergone a proof-of-design test to demonstrate that the valve components operate at the service flow, pressure, temperature, and fluid conditions, free from binding, excessive noise, and premature failures. Proof-of-design test results shall be available to the Engineer on request. The proof-of-design test shall be conducted in accordance with the applicable provisions of AWWA C517.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 40 05 51 – Valves, General.

PART 2 - PRODUCTS

2.1 ECCENTRIC PLUG VALVES (1/2-INCH TO 72-INCHES)

A. Construction: Eccentric plug valves shall be of the non-lubricated, eccentric plug design with cast iron bodies conforming to ASTM A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings, with ANSI 125 lb. flanged ends for valves 3-inches and larger, and screwed or flanged ends for smaller sizes. The plugs and shafts shall be of cast iron or ductile iron conforming to ASTM A 536 - Ductile Iron Castings, and the plugs shall be lined with a resilient coating, best suited for the specific service. The body shall be epoxy coated and be lined with a suitable elastomer, where required for a special service, or it shall be epoxy-lined in accordance with Section 09 90 00 –Protective Coatings and Linings**.** The seats shall be of nickel or stainless steel welded to the body. Top and bottom shaft bearings shall be of permanently lubricated stainless steel or Teflon coated stainless steel. Grit seals of Teflon, Nylatron, or similar suitable material shall be at the top and bottom plug journals. Valves up to and including 20-inches in size shall have an unobstructed port area of not less than 80 percent of full pipe area, and not less than 70 percent for larger valves. Eccentric plug valves shall have a pressure rating of not less than 150 psi WOG, for bubble-tight shut-off in the standard flow direction, and 25 psi WOG in the reverse flow direction. When equipped with worm gear actuator, the pressure rating shall be 150 psi WOG in both directions. The stem seal shall consist of field adjustable packing, replaceable without removal of the actuator, or of self-adjusting U-cup packing.

B. Actuators: Unless otherwise indicated, eccentric plug valves 3-inches and smaller shall have operating levers; larger valves shall have worm-gear actuators. Valve actuators shall be in accordance with Section 40 05 52 – Valve and Gate Actuators.

C. Manufacturers, or Equal
   1. DeZurik Corporation
   2. Clow Valve Company
   3. Pratt Valve
   4. Victaulic

PART 3 - EXECUTION

3.1 INSTALLATION

A. Plug valves shall be installed in strict accordance with the manufacturer's published recommendations and the applicable provisions of Section 40 05 51 – Valves, General.

B. Eccentric Plug Valves: Unless otherwise directed, the following rules shall be observed for the installation of eccentric plug valves on sewage, sludge, or other liquid systems containing solids, silt, or fine sand:
   1. The valves shall be positioned with the stem in the horizontal direction.
   2. In horizontal pipelines, the plug shall swing upwards when opening, to permit flushing out of solids.
   3. The orientation of the valve shall prevent the valve body from filling up with solids when closed; however, where the pressure differential through the valve exceeds 25 psi, the higher pressure for valves without worm gear, electric, or air operators shall be through the valve to force the plug against the seat.
   4. Valves which may be closed for extended periods (stand-by, bypass, or drain lines) and valves with reversed flow (higher pressure on downstream side, forcing the plug away from its seat), shall be equipped with worm gear operators for the full range of sizes.
   5. For special applications or when in doubt, consult with the manufacturer prior to installation.

END OF SECTION

SECTION 40 05 63
BALL VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall provide ball valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 40 05 51 - Valves, General apply to this Section.

C. The requirements of Section 40 05 52 - Valve and Gate Actuators apply to this Section.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 20 – Submittal Procedures and 40 05 51 - Valves, General.

PART 2 - PRODUCTS

2.1 METAL BALL VALVES (3-INCHES AND SMALLER)

A. General: Unless otherwise indicated, general purpose metal ball valves in sizes up to 4-inches shall have actuators in accordance with Section 40 05 52 - Valve and Gate Actuators.

B. Body: Ball valves up to and including 1.5-inches in size shall have bronze or carbon steel 2 or 3 piece bodies with screwed ends for a pressure rating of not less than 600 psi WOG. Valves 2-inches to 3-inches in size shall have bronze or carbon steel 2 or 3 piece bodies with flanged ends for a pressure rating of ANSI 125 psi or 150 psi unless otherwise indicated.

C. Balls: The balls shall be solid chrome-plated brass or bronze, or stainless steel, with standard port (single reduction) or full port openings.

D. Stems: The valve stems shall be of the blow-out proof design, of bronze, stainless steel, or other acceptable construction, with reinforced teflon seal.

E. Seats: The valve seats shall be of teflon or Buna-N, for bi-directional service and easy replacement.

F. Manufacturers, or Equal
1. Conbraco Industries, Inc. (Apollo)
2. ITT Engineered Valves
3. Neles-Jamesbury, Inc.
4. Watts Regulator
5. Worcester Controls

PART 3 - EXECUTION

3.1 GENERAL

A. Valves shall be installed in accordance with Section 40 05 51 – Valves, General. Care shall be taken that valves in plastic lines are well supported at each end of the valve.

END OF SECTION

SECTION 40 05 64
BUTTERFLY VALVES

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall provide butterfly valves and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 11 00 00 – Equipment General Provisions apply to this Section.

C. The requirements of Section 40 05 51 – Valves, General apply to this Section.

D. The requirements of Section 40 05 52 – Valve and Gate Actuators apply to this Section.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 40 05 51 – Valves, General.

B. Shop Drawings
1. Complete Shop Drawings of butterfly valves and actuators.
2. Drawings showing valve port diameter complete with dimensions, part numbers, and materials of construction.
3. Certification of proof-of-design test from the valve manufacturer.
4. Certification: The Contractor shall obtain written certification from the butterfly valve manufacturer, addressed to the Owner, stating that the butterfly valves and the valve operators will efficiently and thoroughly perform the required functions in accordance with these Specifications and as shown, and that the manufacturer accepts joint responsibility with the Contractor for coordination of all butterfly valves and valve operators, including motors, drives, controls, and services required for proper installation and operation of the completely assembled and installed units. The Contractor shall submit all such certificates to the construction manager.
5. Technical Manuals: The Contractor shall furnish technical manuals for the butterfly valves, manual operators, and electric motor valve operators under one cover and in accordance with the requirements of Section 01 33 20 – Submittal Procedures.
6. Valve Labeling: The Contractor shall submit a schedule of butterfly valves to be labeled indicating in each case the valve location and the proposed wording for the label.
7. Field Procedures: Written instructions for field procedures for erection, adjustments, inspection, and testing shall be provided prior to delivery of the butterfly valves and valve operators.

1.3 QUALITY ASSURANCE

A. Valves shall be subjected to performance, leakage, and hydrostatic tests in accordance with procedures and acceptance criteria established by AWWA C504.

PART 2 - PRODUCTS

2.1 BUTTERFLY VALVES 4-INCH AND SMALLER.

A. General: Butterfly valves for water working pressures up to 250 psi shall conform to ANSI/AWWA C504 - Rubber Seated Butterfly Valves, subject to the following requirements. Valves shall be of the size and class indicated. Flanged valves shall have Class 150 or Class 250 flanges conforming to ANSI B16-1.

B. Manual Actuators: Actuators shall conform to Section 40 05 52 Valve and Gate Actuators and to ANSI/AWWA C540 Power Actuating Devices for Valves and Sluice Gates, subject to the following requirements. Unless otherwise indicated, all manually-actuated butterfly valves shall be equipped with a handwheel and 2-inch square actuating nut and position indicator.

C. Worm Gear Actuators: All submerged and buried valves shall be equipped with worm-gear actuators, lubricated and sealed to prevent entry of dirt or water into the housing.

D. Manufacturers, or Equal
   1. De Zurik Corporation.
   2. Kennedy Valve.
   3. Mueller.

2.2 BUTTERFLY VALVES LARGER THAN 4-INCH– CLASS 150B AND 250B.

A. General: The butterfly valve shall be designed expressly for waterworks applications and shall be of the double offset design whereby the elastomeric seal is not compressed with the valve in the open position. Zero, single and API based triple offset butterfly valve designs are not acceptable. Butterfly valves for water working pressures up to 150 psi shall conform to ANSI/AWWA C504 Class 150B. Butterfly valves for water working pressures greater than 150 psi shall conform to the design requirements of ANSI/AWWA C-504, Class 250B. Valves shall be of the size and class indicated in the valve schedule or in the plans. All valves unless noted otherwise, shall be sized for bi-directional water service, full rated pressure and a line velocity of 16 feet per second and suitable for higher linebreak velocities of 50 fps. Lifting lugs will be provided for all valves 24" and larger.

B. Flanges: Class 150B flanged valves shall have ANSI B16.1 Class 125-pound flanges. Class 250B flanged valves shall comply with ANSI B16.1 Class 250 up through 48-inch unless otherwise noted or if mating to ductile iron pipe. Above 48-inch, flange outside diameter, number of bolts, diameter of bolt circle, and diameter of bolts shall comply with ANSI/AWWA C 207 Class E.

C. Body: Valve bodies shall be ductile iron, ASTM A536 65-45-12 or A536 60-40-18. Cast gray iron is not allowed due to near zero elongation and as it vulnerable to shear stress. The valve body shall include integrally cast support feet top and bottom. It shall be mechanically equipped with a fastened stainless steel stamped or engraved tag indicating manufacturer and reference build data. Valves 54-inch and larger shall include two tags diametrically opposed. The valve build data shall be made available upon request by the customer and shall be retained by the manufacturer for no less than 20 years unless noted longer. The entire valve body and flanges shall be epoxy corrosion coat protected except for the valve shaft bores.

D. Disc: The disc shall be ductile iron ASTM A536 65-45-12 or ASTM A536 60-40-18. The entire

disc and all its wetted surfaces shall be coated without exception. The disc's elastomeric seal retainer shall be 304 or 316 stainless steel. Neither bronze nor carbon steel is acceptable. Both the disc and elastomeric seal retainer shall have recesses designed to retain a dual shouldered seal under extreme localized velocities, at full differential opening and/or linebreak closing. The disc shall be mechanically fastened to the valve shaft by using Polygon "no fail" connection or equivalent stainless steel key connection or the disc shall be mechanically fastened to the valve shaft using tangential stainless steel shaft pins of type 316 or higher alloy. Disc pins shall extend completely through the valve and shall be mechanically fastened. The disc shall be completely coated except for the disc shaft bores.

E. Shaft: Valve shafts shall be dual stub shafts of stainless steel ASTM A240 or A276, Type 316, 304, 431 or 420. The valve shaft material and thickness shall be suitable for the applications pressure and velocity without the use of its safety factors. Shafts may not be turned down to fit drive splines without accompanying torsional strength reduction calculations and its effect on the safety factor.

F. Elastomeric Seal and Seal Ring: Valve seals shall be EPDM, secured to a completely coated valve disc by a 316 stainless steel, continuous non-segmented seal ring and secured by 316 stainless steel fasteners. The seal shall not scallop, cold flow or tear at localized velocities less than 300 fps. The elastomeric seal shall not be penetrated by fasteners. The valve shall be bi-directionally leak free. The elastomeric seal shall be double shouldered and extend no greater than 0.25 inches past the disc edge to seat the valve. The seal shall be designed to flex in either flow direction. The elastomeric seal shall be field replaceable and adjustable in line. It shall not require special skills or tools to replace the seat. Seat methods which do not comply or use either irreplaceable vulcanized seals or which use hardened epoxy or grout in a dovetailed groove are not acceptable.

G. Metallic Seat: The metallic valve seat shall be located in the valve body. It shall be a highly wear resistant stainless steel alloy. There shall be no gap between the valve body and metallic body seat and consequently no potential for corrosion or lifting of the seat. The seat shall be applied through a high alloy weld overlay process or other manufacturing technique. Metallic seats shall not be mechanically retained by fasteners.

H. Shaft Seals: Shaft seals shall not need periodic manual adjustment. They shall be multi-O-ring seals protecting both the OD and ID of the shaft bearings. They shall prevent pressurized system water from entering the uncoated valve disc hub and valve body shaft bore. The valve shaft shall remain non-wetted and unpressurized. The non-wetted shaft shall allow the actuator to be removed without dewatering the pipeline. It shall prevent debris and system pressurized water from entering into the uncoated valve body shaft bore. It shall prevent waters or contaminated media, external to the valve, from entering through the valve shaft under vacuum/ negative pressure conditions in the pipeline, or hydrostatic pressure conditions external to the valve. Neither manual pulldown packing glands nor braided packing are allowed. The outer shaft seals shall be a replaceable cartridge type, bolted to the valve body. Packing shall not be held in place with an adapter plate or by the valve actuator.

I. Shaft Bearings: Valve shaft bearings shall be corrosion resistant, self-lubricating sleeve type made of bronze, stainless steel or stainless steel backed PTFE. Bearing choice and consequent bearing friction shall be correctly added to valve input torque requirements.

J. Strength: The proportion and dimensions of all parts of the valve and actuator shall be designed to withstand, without failure, the stresses occurring under the testing and operating conditions. The maximum allowable stress in any material shall not exceed 1/5 of the ultimate tensile strength or 1/3 of the minimum yield strength. Class 150B valves shall be rated to 150 psi and Class 250B valves shall be rated to 250 psi applied to one side of the disc

with zero pressure applied to the other side of the disc while in the closed position, without damage or permanent deformation to any part of the valve, seat, disc or shaft. The valve shall be capable of withstanding such pressures in both directions.

K. Safety Disc Pinning: Where noted herein, where noted on the plans or in the bid documents, an integrated safety locking device shall be incorporated. The valve shall have an externally lockable disc in the closed position. Calculations shall be provided to verify that the disc cannot rotate even with the full stall output torque of the actuator. The disc shall remain in the zero leak sealed closed position even if the entire actuator is removed for safety or maintenance. With the actuator and or the adapter plate removed, the valve will not leak through the stem. The locking device shall be handwheel operated; stainless steel wetted construction, pad lockable and suitable for lockout/tag out safety procedures.

L. Manual Actuators: Actuators shall conform to Section 40 05 57 – Valve and Gate Actuators and to ANSI/AWWA C 540, subject to the following requirements. All actuators shall be self-locking and shall hold the valve disc in the closed, open and any intermediate position without creeping or fluttering. All actuators shall incorporate a mechanical stop-limiting device to prevent over travel of the disc. Unless direct buried or otherwise indicated, all manually actuated butterfly valves shall be equipped with a handwheel and external position indicator. The number of turns for direct buried valves shall be a minimum of 1.4 times the nominal valve size with no fewer than 25 turns. The valve manufacturer shall be responsible for mounting and testing the actuator. Screw-type (traveling nut) actuators are not permitted due to their inconsistent output torques through the 90 degree stroke. All manual direct buried service actuators shall be designed for a 300 foot-pound input torque against the closed and open travel stops. The owner reserves the right to field verify.

M. Worm-Gear Actuators: All valves including submerged and buried valves, shall be equipped with top tier AWWA worm-gear actuators, lubricated and sealed to prevent entry of dirt or water into the housing. Buried service valves shall be 90% or greater, grease packed. Submerged service valves in potable water applications shall be 100% grease filled with FDA approved food grade grease. Documentation for the selected grease for submerged service valves shall accompany submittals. The owner reserves the right to field verify grease levels. Non-complying gears shall be remedied by the factory, verified by the customer and signed off by both parties. Gears are recommended to be Auma and are required to be of an equal or better quality. No name or unbranded actuators will not be accepted.

N. Hardware: All fasteners and hardware in non-wetted areas shall be type 316 Stainless Steel.

O. Coatings and Linings: The manufacturer is required to have and follow a system of valve preparation and coating which assures a quality, holiday free application and which maximizes the available multi-decade protection the coating offers. Submit holiday test prior to shipment. Products for linings to be NSF 61 certified.

The manufacturer must provide their written system of valve preparation and coating. This document shall include the methodologies used (quality compliance, QC) as well as post application review (quality assurance, QA).

1. Valves 48-inch and smaller: All external and internal surfaces except for the seating surface shall be 400 degree F plus, heat bonded fusion coated. Coating damaged in shipping or installation shall be noted and properly repaired to the satisfaction of the utility or its authorized agent.

2. Valves 54-inch and larger shall be epoxy lined and coated in accordance with System No. 1. per Specification Section 09 90 00 Protective Coatings and Linings. Coating damaged in shipping or installation shall be noted and properly repaired to the

satisfaction of the utility or its authorized agent.

P. Manufacturers, No Equal

1. Av-Tek, DEX Double Offset
2. VAG Armaturen, EKN Double Offset

PART 3 - EXECUTION

3.1 INSTALLATION

A. Exposed butterfly valves shall be installed with a means of removing the complete valve assembly without dismantling the valve or operator. Installation shall be in accordance with Section 40 05 51 – Valves, General.

B. Contractor shall use the provided lifting lugs to move all project valve(s). The use of chains, lifting straps, rope or any type other strapping through the valve body is strictly prohibited. Correct lifting procedures shall be the Contractor's responsibility. As necessary, consultation with the valve manufacturer is recommended. The contractor shall be responsible for all damage and project delays resulting from improper lifting and moving procedures, these shall include but shall not be limited to pulling the valve body out of round, gouges, scratches, displacing the gear box, etc.

C. Butterfly valves 36-inch and larger must be inspected and certified by the manufacturer that the final installation meets all the manufacturers requirements, and that the actuator and disc have not changed positions from that as successfully tested at the factory.

D. Strict care shall be taken to ensure valves are not installed under stress. In no instance shall adjacent mating flanges be forced into position. A progressive and proper star cross pattern shall be used to tighten valve flange mating bolts

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SECTION 40 71 13
FLOW-MAGNETIC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   1. Instruments for instrumentation and control systems that are to be permanently installed.

B. Related Sections
   1. Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the Contractor and its Sub-Contractors to review all sections to insure a complete and coordinated project.

1.2 REFERENCES

A. All instruments shall comply with the latest edition and standards of the Instrumentation Systems and Automation Society.

1.3 DEFINITIONS

A. Definitions of terms and other electrical considerations as set forth in the:
   1. NEC: National Electrical Code.
   2. IEEE: Institute of Electrical and Electronic Engineers.
   3. ISA: Instrumentation Systems and Automation Society.
   4. NFPA: National Fire Protection Association.

1.4 SYSTEM DESCRIPTION

A. Furnish all instruments as identified on the P&IDs, instrument lists, and instrument data sheets.

B. Install and connect all instruments as per the manufacturer's recommendations for the particular installation.

C. Calibration of instruments shall be performed by the Instrumentation and Control Systems Contractor (ICSC).

1.5 SUBMITTALS

A. Furnish complete submittals in accordance with Section 01 33 20.

B. Product Data:
   1. Complete manufacturer's brochures identify instrument construction, accuracy, ranges, materials, and options.
   2. Completed instrument data sheets including catalog number and source for determining catalog number.

3. Manufacturer's installation instructions.

C. Shop Drawings:
   1. Mechanical connection diagrams.
   2. Sensor transducer mounting requirements with dimensions and elevations.
   3. Electrical connection diagrams.

D. Test Reports:
   1. Certified factory and field calibration data sheets for instruments and devices that require set-up and calibration.
      a. Including factory calibration for each instrument with stated accuracy.

E. Operating Manuals:
   1. Certified factory and field calibration data sheets for instruments and devices that require set-up and calibration.
      a. Including factory calibration for each instrument with stated accuracy.
   2. Complete installation, calibration, and testing manuals.

F. Record Drawings:
   1. Complete field calibration sheets, including range, span, PLC/PAC I/O address, register, and scaling coefficients.

1.6 QUALITY ASSURANCE

A. Manufacturer's representative shall be responsible for proving flow meter operation and 4-20 ma loop accuracy.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store all instruments in a dedicated van or structure with space conditioning to meet the recommended storage requirements provided by the manufacturer.
   1. Any instruments that are not stored in strict conformance with the manufacturer's recommendation shall be replaced at no additional costs to the Owner.

1.8 PROJECT/SITE CONDITIONS

A. All instruments must be compatible for the installed site conditions including but not limited to material compatibility, site altitude, installed temperature and humidity conditions.

1.9 WARRANTY

A. Furnish manufacturer's standard warranty, modified to agree with the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. As identified on the instrument data sheets.

B. Hardware Commonality:
   1. All instruments, which utilize a common measurement principle, for example, d/p cells, pressure transmitters, level transmitters that monitor hydrostatic head, shall be furnished by a single Manufacturer.
   2. All panel-mounted instruments shall have matching style and general appearance.
   3. Instruments performing similar functions shall be of the same type, model, or class, and shall be from a single Manufacturer.

2.2 MANUFACTURED UNITS

A. Flow Meters:
   1. Magnetic Flow Meters.
      a. General:
         1) Flanged.
         2) Low frequency electromagnetic induction type producing a DC-pulsed linear signal which is directly proportional to the liquid flow rate.
         3) Complete zero stability shall be an inherent characteristic of the flowmeter system.
         4) Each magnetic flow metering system shall include:
            a) A submersible metering tube.
            b) Signal cable with sufficient coil length for installation in the indicated location.
            c) Remote Transmitter.
            d) Flow meter grounding rings.
         5) NSF 61 certified for contact with drinking water.
         6) Rated for NEMA 6 (IP68, Type 6P) submergence conditions.
         7) Equipped with a stainless steel equipment tag.
         8) Include two stainless steel grounding rings which are in conformance with the manufacturer's bore.
      b. Source quality control.
         1) Shall be manufactured at facilities certified to the quality standards of ISO Standard 9001 - Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.
      c. Metering tube:
         1) Constructed of Type 316 stainless steel.
         2) Utilize a minimum of 2, self-cleaning electrodes.
         3) Liner in conformance with:
            a) As identified on the instrument data sheet.
            b) Manufacturer's recommendations for the intended service.
            c) Whichever is the more stringent.
         4) Electrodes in conformance with:
            a) As identified on the instrument data sheet.
            b) Manufacturer's recommendations for the intended service.
            c) Whichever is the more stringent.
         5) Meter housing NEMA 4X corrosive conditions.
         6) Meter coating consisting of epoxy painted finish.
         7) Two grounding rings:

a) Which are in conformance with the Manufacturer's bore and material recommendation for the meter's intended service.
b) Designed to protect and shield from abrasion the liner's edge interface at the meter's end.

d. Transmitter.
1) Utilize DC-pulse technique to drive flux-producing coils.
2) Display for flow rate and totalized flow in engineering units (GPM, MGD, or CFS)
3) Bi-directional flow indication with forward, reverse, and net non-volatile totalization.
4) Operator interface consisting of keypads which respond to English text entry.
5) Transmitter enclosure to have NEMA 4x rating.
6) Programmable parameters including:
a) Meter size.
b) Full scale flow rate.
c) Magnetic field frequency.
d) Time constant.
7) Self-diagnostics and automatic data checking.
8) Ambient operating temperature limits of -29 to 60 °C (-20 to 140 °F).
9) Surface (or wall) mountable, unless otherwise noted.

e. Performance requirements:
1) Time constant:
a) 0.5 to 1,000 seconds.
2) Accuracy:
a) 0.25 percent of flow rate from 10 to 100 percent of full scale for velocities over 3 ft per second.
3) Repeatability:
a) 0.25 percent of full scale.
4) Isolation:
a) Galvanic or.
b) Optical.
5) Power supply:
a) 120 VAC ± 10%.
b) 60 Hz.
6) Output/Input signal:
a) Output signal: Measured range – Current 0/4 to 20 mA analog, 24 VDC pulsed output, and Modbus TCP/IP communcication.

f. Factory testing:
1) Each flow metering system shall be hydraulically calibrated at a facility which is traceable to the National Institute of Testing Standards.
2) The calibration procedure shall conform to the requirements of MIL-STD-45662A.
3) A real-time computer generated printout of the actual calibration data indicating apparent and actual flows at 20%, 40%, 60%, 80% and 100% of the calibrated range shall be submitted to the Engineer

at least thirty (30) days prior to shipment of the meters to the project site.

g. Manufacturers:
   1) Endress+Hauser Promag W 400.
   2) Rosemount 8750W.
   3) No Equals.

2.3 SOURCE QUALITY CONTROL

A. All instruments and/or representative instruments shall be hydraulically calibrated in facilities and with instruments traceable to the National Bureau of Standards.
   1. Provide complete documentation covering the traceability of all calibration instruments prior to shipment. Provide real-time computer-generated printout of the actual calibration data indicating apparent and actual flows at 20%, 40%, 60%, 80%, and 100% of the calibrated range.
   2. Provide all required field calibration equipment for instruments.

2.4 SPARE PARTS

A. Spare parts shall be suitable packaged and labeled by part name and associated equipment number.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the complete set of plans, the process fluids, pressures, flowrates, and temperatures and furnish instruments that are compatible with installed process condition.

3.2 PREPARATION

A. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances. Weld-o-lets, valves, upstream diameters, downstream diameters, etc. for proper installation of the instruments.

3.3 INSTALLATION

A. All instruments shall be installed in strict conformance with the manufacture's recommendations.
   1. It is the Contractor's responsibility to install all instruments in conformance with manufacturer's recommendations.
   2. It is the Contractor's responsibility to notify the Engineer of any installation conditions that may be shown at variance with the manufacturer's recommendations

3.4 FIELD QUALITY CONTROL

A. The ICSC shall calibrate all instruments in the field.

3.5 ADJUSTING

A. All instruments shall be field calibrated to match the installed conditions.

3.6 CLEANING

A. All instrument enclosures shall be vacuumed clean after calibration and before commissioning.

3.7 DEMONSTRATION

A. Performance of all instruments shall be demonstrated to the Engineer prior to commissioning.

B. All instrument calibration shall be witnessed by the Owner's Representative.

C. Each and every instrument shall be tested during the Loop Validation Tests and the Owner's Representative shall witness the response in the PLC/PAC control system and associated registers.

3.8 PROTECTION

A. All instruments shall be fully protected after installation and before commissioning. The Contractor shall replace any instruments damaged prior to commissioning.

B. The Engineer shall be the sole party responsible for determining the corrective measures.

3.9 SCHEDULES

A. The following instrument data sheets are included as a guideline for the supply of the instruments. These sheets are not complete and the instrument selection shall be the Contractor's responsibility. Changes may be made to the instrument materials, ranges, etc. as part of the submittal review. The Contractor shall provide documented evidence for a differential plus or minus that results from these changes.

B. The Contractor shall supply complete instrument data sheets for each and every instrument and submit this information in accordance with paragraph 1.5 of this section.
   1. Instrument data sheets shall be furnished in both hard copy and electronic format.

END OF SECTION

SECTION 40 73 13
PRESSURE GAUGES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Instruments for instrumentation and control systems that are to be permanently installed.

B. Related Sections:
   1. Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the Contractor and its Sub-Contractors to review all sections to insure a complete and coordinated project.

1.2 REFERENCES

A. All instruments shall comply with the latest edition and standards of the Instrumentation Systems and Automation Society.

1.3 DEFINITIONS

A. Definitions of terms and other electrical considerations as set forth in the:
   1. NEC: National Electrical Code.
   2. IEEE: Institute of Electrical and Electronic Engineers.
   3. ISA: Instrumentation Systems and Automation Society.
   4. NFPA: National Fire Protection Association.

1.4 SYSTEM DESCRIPTION

A. Furnish all instruments as identified on the P&IDs, instrument lists, and instrument data sheets.

B. Install and connect all instruments as per the manufacturer's recommendations for the particular installation.

C. Calibration of instruments will be performed by the Instrumentation and Control Systems Contractor (ICSC).

1.5 SUBMITTALS

A. Furnish complete submittals in accordance with Sections 01 33 20.

B. Product Data:
   1. Complete manufacturer's brochures identify instrument construction, accuracy, ranges, materials, and options.
   2. Completed instrument data sheets including catalog number and source for determining catalog number.
   3. Manufacturer's installation instructions.

C. Shop Drawings:
   1. Mechanical connection diagrams.
   2. Sensor mounting requirements with dimensions and elevations.
   3. Electrical connection diagrams.

D. Test Reports:
   1. Certified factory and field calibration data sheets for instruments and devices that require set-up and calibration.
      a. Including factory calibration for each instrument with stated accuracy.

E. Operating Manuals:
   1. Certified factory and field calibration data sheets for instruments and devices that require set-up and calibration.
      a. Including factory calibration for each instrument with stated accuracy.
   2. Complete installation, calibration, and testing manuals.

F. Record Drawings:
   1. Complete field calibration sheets, including range, span.

1.6 QUALITY ASSURANCE

A. All instruments of similar nature must be furnished by the same manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store all instruments in a dedicated storage structure with space conditioning to meet the recommended storage requirements provided by the manufacturer.
   1. Any instruments that are not stored in strict conformance with the manufacturer's recommendation shall be replaced at no additional costs to the Owner.

1.8 PROJECT/SITE CONDITIONS

A. All instruments must be compatible for the installed site conditions including but not limited to material compatibility, site altitude, installed temperature and humidity conditions.

1.9 WARRANTY

A. Furnish manufacturer's standard warranty, modified to agree with the Contract Documents.

1.10 MAINTENANCE

A. Provide all necessary materials, fluids, etc. for calibration purposes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Ashcroft 1279 w/ Performance Plus.

B. NoShok 600/700 Series.

C. Dwyer Series 765 or Series 7000B.

D. Wika USA XSEL Series.

E. Or, Engineer Approved Equals.

2.2 MANUFACTURED UNITS

A. Pressure, Vacuum, Compound Gauges.
1. General.
a. Furnish and install pressure and vacuum gauges as specified, complete, including all fittings, snubbers, connections, gaskets, supports, and accessories in the locations shown or specified, in accordance with the Contract Documents.
b. Pressure gauges shall be provided whether or not shown on the plans:
1) On suction and discharge connection to all pumps.
2) On discharge connection from blowers and compressors.
3) On each side of pressure reducing valves.
4) In other locations as shown on the P&IDs and/or mechanical plans.
c. Vacuum gauges shall be provided whether or not shown on the plans:
1) On all supply side educator-type chemical feeders.
2) In other locations as shown on the P&IDs and/or mechanical plans.
d. Sleeve pressure gauges.
1) Shall be provided where shown on the plans.
2) Pressure shall be sensed by a flexible sleeve contained in a flanged cast iron or steel spool or wafer body, and transmitted to the gauge through a captive fluid.
3) Sleeve shall be of BUNA-A and fabricated so as to isolate the body from the process liquid.
4) Gauges shall be calibrated to read in applicable units.
5) Accuracy of ±1% - 150% of the working pressure of the system to which they are connected
2. Construction:
a. Gauges shall be industrial quality type with Type 316 stainless steel movement.
b. Phenolic case.
c. Liquid filled.
d. Unless otherwise shown or specified, gauges shall have:
1) A 4-1/2-inch dial.
2) 1/2-inch threaded connection.
3) Type pulsation dampener adapter.
a) Pulsation Dampener as manufactured by:
b) Cajon Co.
c) Weksler Instruments, Corp.
d) Ashcroft.
e) Or, Engineered Approved Equal.
4) A block and bleed valve - 1/2 inch national pipe thread process connection and bleed/calibrate valve between block valve and outlet port.
e. Gages shall be calibrated to read in applicable engineering units.

f. Accuracy of ± 0.5% - 150 % of the working pressure or vacuum of the pipe or vessel to which they are connected.
g. All gauges shall be vibration and shock resistant.
h. Gauge range shall be appropriate to the normal operation of the system where the gauge is installed, the normal reading shall be in the mid-range on the gauge.

3. Diaphragm seals:
   a. Gauges attached to system involving chemical solutions, corrosive fluids, sludge, sewage, or other liquids containing solids shall be equipped with diaphragm seals.
   b. In addition diaphragm seals shall be provided and included at the locations shown.
   c. Seals shall have clamped housings.
   d. All seals shall have 1/2 inch NPT flushing connection and fluid fill connection.
   e. Diaphragm Seals as manufactured by:
      1) Ashcroft Type 101.
      2) Ametek Type S Series.
      3) NoShok Type 10/10H.
      4) Or, Engineer Approved Equal.
4. Gauges general as manufactured by:
   a. Ashcroft Type 1279 w/ Plus Performance.
   b. Dwyer Series 7000B.
   c. Wika XSEL Model 212.34 (213.34 as required).
   d. Ametek Model 1929.
   e. NoShok 700 Series.
   f. Or, Engineer Approved Equal.
5. Gauges sleeve pressure as manufactured by:
   a. Red Valve Co., Inc.
   b. Onyx.
   c. NoShok Type 40.
   d. Or, Engineer Approved Equal.
6. Snubbers as manufactured by:
   a. Ashcroft, Model 311.
   b. Dwyer, Series PS.
   c. NoShok, Model 5025/5050
   d. Or, Engineer Approved Equal.
7. Pulsation dampeners as manufactured by:
   a. Cajon Co.
   b. Weksler Instruments, Corp.
   c. Ashcroft.
   d. Or, Engineer Approved Equal.

2.3 ACCESSORIES

A. Gauges shall be liquid filled or have some equivalent anti-vibration/-bounce technology.

2.4 SOURCE QUALITY CONTROL

A. All instruments and/or representative instruments shall be calibrated to in facilities and with instruments traceable to the National Bureau of Standards.

1. Provide complete documentation covering the traceability of all calibration instruments.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the complete set of plans, the process fluids, pressures, and temperatures and furnish instruments that are compatible with installed process condition.

3.2 PREPARATION

A. Coordinate the installation with all trades to insure that the mechanical system has all necessary appurtenances. Weld-o-lets, valves, orientation, etc. for proper installation of the instruments.

3.3 INSTALLATION

A. All instruments shall be installed in strict conformance with the manufacturer's recommendations.
   1. It is the Contractor's responsibility to install all instruments in conformance with manufacturer's recommendations.
   2. It is the Contractor's responsibility to notify the Engineer of any installation conditions that may be shown at variance with the manufacturer's recommendations
   3. Install two 2-valve instrument manifolds for each gauge pressure transmitter.
   4. Bolt 3-valve manifolds at non-flange diaphragm type differential pressure transmitters in place of standard flange adapters.
   5. Install root valves at process taps except insertion elements.
   6. Install gauge valves on process connections to instruments where multiple instruments are connected to one tap or where root valves are not readily accessible.
   7. All gauges shall be installed with the face in the vertical position.
   8. In strict accordance with the manufacturers printed instructions.
   9. At the locations shown on the drawings, when so shown.
   10. Care shall be taken to minimize the effect of water hammer or vibrations on the gauges.
   11. In extreme cases, and with the approval of the Engineer, gauges may be mounted independently, with flexible connectors.

3.4 FIELD QUALITY CONTROL

A. The ICSC shall perform Calibration and Loop Validation Testing.

3.5 ADJUSTING

A. All instruments shall be field verified.

3.6 DEMONSTRATION

A. Performance of all instruments shall be demonstrated to the Engineer prior to commissioning.

3.7 PROTECTION

A. All instruments shall be fully protected after installation and before commissioning. The Contractor shall replace any instruments damaged prior to commissioning.
   1. The Engineer shall be the sole party responsible for determining the corrective measures.

3.8 SCHEDULES

A. The Contractor shall supply complete instrument data sheets for each and every instrument and submit this information in accordance with Paragraph 1.5 of this section.
   1. Instrument data sheets shall be furnished in both hard copy and electronic format.

END OF SECTION

SECTION 40 73 26
PRESSURE TRANSMITTERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   1. Instruments for instrumentation and control systems that are to be permanently installed.

B. Related Sections
   1. Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the Contractor and its Sub-Contractors to review all sections to insure a complete and coordinated project.

1.2 REFERENCES

A. All instruments shall comply with the latest edition and standards of the Instrumentation Systems and Automation Society.

1.3 DEFINITIONS

A. Definitions of terms and other electrical considerations as set forth in the:
   1. NEC: National Electrical Code.
   2. IEEE: Institute of Electrical and Electronic Engineers.
   3. ISA: Instrumentation Systems and Automation Society.
   4. NFPA: National Fire Protection Association.

1.4 SYSTEM DESCRIPTION

A. Furnish all instruments as identified on the P&IDs, instrument lists, and instrument data sheets.

B. Install and connect all instruments as per the manufacturer's recommendations for the particular installation.

C. Calibration of instruments will be performed by the Instrumentation and Control Systems Contractor (ICSC).

1.5 SUBMITTALS

A. Furnish complete submittals in accordance with Sections 01 33 20.

B. Product Data:
   1. Complete manufacturer's brochures identify instrument construction, accuracy, ranges, materials, and options.
   2. Completed instrument data sheets including catalog number and source for determining catalog number.
   3. Manufacturer's installation instructions.

C. Shop Drawings:
   1. Mechanical connection diagrams.
   2. Sensor transducer mounting requirements with dimensions and elevations.
   3. Electrical connection diagrams.

D. Test Reports:
   1. Certified factory and field calibration data sheets for instruments and devices that require set-up and calibration.
      a. Including factory calibration for each instrument with stated accuracy.

E. Operating Manuals:
   1. Certified factory and field calibration data sheets for instruments and devices that require set-up and calibration.
      a. Including factory calibration for each instrument with stated accuracy.
   2. Complete installation, calibration, and testing manuals.

F. Record Drawings:
   1. Complete field calibration sheets, including range, span, PLC/PAC I/O address, register, and scaling coefficients.

1.6 QUALITY ASSURANCE

A. All instruments of similar nature must be furnished by the same manufacturer.

B. Manufacturer's representative shall be responsible for proving transmitter operation and 4-20 ma loop accuracy.

C. Instruments shall be manufactured at facilities certified to the quality standards of ISO Standard 9001 - Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store all instruments in a dedicated van or structure with space conditioning to meet the recommended storage requirements provided by the manufacturer.
   1. Any instruments that are not stored in strict conformance with the manufacturer's recommendation shall be replaced at no additional costs to the Owner.

1.8 PROJECT/SITE CONDITIONS

A. All instruments must be compatible for the installed site conditions including but not limited to material compatibility, site altitude, installed temperature and humidity conditions.

1.9 WARRANTY

A. Furnish manufacturer's standard warranty, modified to agree with the Contract Documents.

1.10 MAINTENANCE

A. Provide all necessary materials, fluids, etc. for calibration purposes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. As identified on the instrument list.

B. Hardware Commonality:
1. All instruments, which utilize a common measurement principle, for example, d/p cells, pressure transmitters, level transmitters that monitor hydrostatic head, shall be furnished by a single Manufacturer.
2. All panel-mounted instruments shall have matching style and general appearance.
3. Instruments performing similar functions shall be of the same type, model, or class, and shall be from a single Manufacturer.

2.2 EQUIPMENT

A. Pressure Transmitters Direct
1. General
   a. Pressure transmitters shall be 2-wire devices.
   b. Continuously adjustable span, zero and damping adjustments.
   c. Integral LCD meter scaled in engineering units.
   d. Solid state circuitry.
   e. Accuracy shall be ± 0.20% of span.
   f. Process wetted materials as identified on Instrument Data Sheets.
   g. Body material as identified on Instrument Data Sheets.
   h. Process connections shall be 1/2-inch NPT.
   i. Diaphragm seals shall be provided and included at the locations shown.
   j. Rangeability: 20:1.
   k. Integral transient protection.
   l. Factory calibrated for span and range.
2. Ranges:
   a. As noted on the Instrument Data Sheets
3. As manufactured by:
   a. Rosemount Model 3051.
   b. Endress+Hauser Cerabar Series.
   c. Kobold PAS Heavy-Duty Series.
   d. Foxboro IGP/IAP Series.
   e. Azbil AT9000 Series.
   f. Or, Engineer Approved Equals.

B. Pressure Transmitters - Differential
1. General
   a. Continuously adjustable span, zero and damping adjustments.
   b. Integral LCD meter scaled in engineering units.
   c. Solid state circuitry.
   d. Accuracy shall be ± 0.20 percent of span.
   e. Process wetted materials as identified on Instrument Data Sheets.
   f. Body material as identified on Instrument Data Sheets.
   g. Process connections shall be 1/2-inch NPT.
   h. Diaphragm seals shall be provided and included at the locations shown.
   i. Rangeability: 20:1.

j. Integral transient protection.
k. Factory calibrated for span and range.

2. Ranges:
   a. As noted on the Instrument Data Sheets
3. As manufactured by:
   a. Rosemount Model 3051.
   b. Or, Engineer Approved Equals.

2.3 SOURCE QUALITY CONTROL

A. All instruments and/or representative instruments shall be calibrated to in facilities and with instruments traceable to the National Bureau of Standards.
   1. Provide complete documentation covering the traceability of all calibration instruments.
   2. Provide 3 copies of calibration curve – One with the instrument, one to the engineer and a third copy in the O&M located with its corresponding ISA data sheet. Calibration curve shall be matched by instrument tag.

B. Manufacturer's representative shall be responsible for proving flow meter operation and 4-20 mA loop accuracy.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the complete set of plans, the process fluids, pressures, and temperatures and furnish instruments that are compatible with installed process condition.

3.2 PREPARATION

A. Coordinate the installation with all trades to insure that the mechanical system has all necessary appurtenances, weld-o-lets, valves, upstream diameters, downstream diameters, etc. for proper installation of the instruments.

3.3 INSTALLATION

A. All instruments shall be installed in strict conformance with the manufacture's recommendations.
   1. It is the Contractor's responsibility to install all instruments in conformance with manufacturer's recommendations.
   2. It is the Contractor's responsibility to notify the Engineer of any installation conditions that may be shown at variance with the manufacturer's recommendations

3.4 ADJUSTING

A. All instruments shall be field calibrated by the ICSC to match the installed conditions.

3.5 CLEANING

A. All instrument enclosures shall be vacuumed clean after calibration and before commissioning.

3.6 DEMONSTRATION

A. Performance of all instruments shall be demonstrated to the Engineer prior to commissioning.

B. All instrument calibration shall be witnessed by the Owner's Representative.

C. Each and every instrument shall be tested during the Loop Validation Tests and the Owner's Representative shall witness the response in the PLC/PAC control system and associated registers.

3.7 PROTECTION

A. All instruments shall be fully protected after installation and before commissioning. The Contractor shall replace any instruments damaged prior to commissioning.
   1. The Engineer shall be the sole party responsible for determining the corrective measures.

3.8 SCHEDULES

A. Changes may be made to the instrument materials, ranges, etc. as part of the submittal review. The Contractor shall provide documented evidence for a differential plus or minus that results from these changes.

B. The Contractor shall supply complete instrument data sheets for each and every instrument and submit this information in accordance with paragraph 1.5 of this section.
   1. Instrument data sheets shall be furnished in both hard copy and electronic format.

END OF SECTION

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SECTION 40 73 37
PRESSURE-SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
   1. Instruments for instrumentation and control systems that are to be permanently installed.

B. Related Sections
   1. Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the CONTRACTOR and its Sub-Contractors to review all sections to insure a complete and coordinated project.

1.2 REFERENCES

A. All instruments shall comply with the latest edition and standards of the Instrumentation Systems and Automation Society.

1.3 DEFINITIONS

A. Definitions of terms and other electrical considerations as set forth in the:
   1. NEC: National Electrical Code.
   2. IEEE: Institute of Electrical and Electronic Engineers.
   3. ISA: Instrumentation Systems and Automation Society.
   4. NFPA: National Fire Protection Association.

1.4 SYSTEM DESCRIPTION

A. Furnish all instruments as identified on the P&IDs, instrument lists, and instrument data sheets.

B. Install and connect all instruments as per the manufacturer's recommendations for the particular installation.

C. Calibration of instruments will be performed by the Instrumentation and Control Systems Contractor (ICSC).

1.5 SUBMITTALS

A. Furnish complete submittals in accordance with Sections 01 33 20.

B. Product Data:
   1. Complete manufacturer's brochures identify instrument construction, accuracy, ranges, materials, and options.
   2. Completed instrument data sheets including catalog number and source for determining catalog number.

3. Manufacturer's installation instructions.

C. Shop Drawings:
   1. Mechanical connection diagrams.
   2. Sensor transducer mounting requirements with dimensions and elevations.
   3. Electrical connection diagrams.

D. Test Reports:
   1. Certified factory and field calibration data sheets for instruments and devices that require set-up and calibration.
      a. Including factory calibration for each instrument with stated accuracy.

E. Operating Manuals:
   1. Certified factory and field calibration data sheets for instruments and devices that require set-up and calibration.
      a. Including factory calibration for each instrument with stated accuracy.
   2. Complete installation, calibration, and testing manuals.

F. Record Drawings:
   1. Complete field calibration sheets, including range, span, PLC/PAC I/O address, register, and scaling coefficients.

1.6 QUALITY ASSURANCE

A. All instruments of similar nature must be furnished by the same manufacturer.

B. Instruments shall be manufactured at facilities certified to the quality standards or ISO Standard 9001 – Quality Systems – Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store all instruments in a dedicated storage structure with space conditioning to meet the recommended storage requirements provided by the manufacturer.
   1. Any instruments that are not stored in strict conformance with the manufacturer's recommendation shall be replaced at no additional costs to the OWNER.

1.8 PROJECT/SITE CONDITIONS

A. All instruments must be compatible for the installed site conditions including but not limited to material compatibility, site altitude, installed temperature and humidity conditions.

1.9 WARRANTY

A. Furnish manufacturer's standard warranty, modified to agree with the Contract Documents.

1.10 MAINTENANCE

A. Provide all necessary materials, fluids, etc. for calibration purposes.

PART 2 - – PRODUCTS

2.1 MANUFACTURERS

A. As identified in Section 40 75 01 – Instrument List.

2.2 EQUIPMENT

A. Pressure Transmitters Direct
   1. Ranges:
      a. As noted in Section 40 75 01 – Instrument List
   2. As Manufactured By:
      a. See Section 40 75 01 – Instrument List
      b. Or engineer-approved equal.

2.3 SOURCE QUALITY CONTROL

A. All instruments and/or representative instruments shall be calibrated to in facilities and with instruments traceable to the National Bureau of Standards.
   1. Provide complete documentation covering the traceability of all calibration instruments.
   2. Provide 3 copies of calibration curve – One with the instrument, one to the engineer, and a third copy in the O&M located with its corresponding ISA data sheet. Calibration curve shall be matched by instrument tag.

PART 3 - – EXECUTION

3.1 EXAMINATION

A. Examine the complete set of plans, the process fluids, pressures, and temperatures and furnish instruments that are compatible with installed process condition.

3.2 PREPARATION

A. Coordinate the installation with all trades to insure that the mechanical system has all necessary appurtenances, weld-o-lets, valves, upstream diameters, downstream diameters, etc. for proper installation of the instruments.

3.3 INSTALLATION

A. All instruments shall be installed in strict conformance with the manufacture's recommendations.
   1. It is the CONTRACTOR's responsibility to install all instruments in conformance with manufacturer's recommendations.
   2. It is the CONTRACTOR's responsibility to notify the ENGINEER of any installation conditions that may be shown at variance with the manufacturer's recommendation.

3.4 FIELD QUALITY CONTROL

A. The ICSC shall calibrate all instruments in the field during the Calibration and Loop Validation Tests.

3.5 ADJUSTING

A. All instruments shall be field calibrated to match the installed conditions.

3.6 CLEANING

A. All instrument enclosures shall be vacuumed clean after calibration and before commissioning.

3.7 DEMONSTRATION

A. Performance of all instruments shall be demonstrated to the ENGINEER prior to commissioning.

B. All instrument calibration shall be witnessed by the OWNER's Representative.

C. Each and every instrument shall be tested during the Loop Validation Tests and the OWNER's Representative shall witness the response in the PLC/PAC control system and associated registers.

3.8 PROTECTION

A. All instruments shall be fully protected after installation and before commissioning. The CONTRACTOR shall replace any instruments damaged prior to commissioning at no additional cost to the OWNER.
   1. The ENGINEER shall be the sole party responsible for determining the corrective measures.

3.9 SCHEDULES

A. The following instrument data sheets are included as a guideline for the supply of the instruments. These sheets are not complete and the instrument selection shall be the CONTRACTOR's responsibility. Changes may be made to the instrument materials, ranges, etc. as part of the submittal review. The CONTRACTOR shall provide documented evidence for a differential plus or minus that results from these changes.

B. The CONTRACTOR shall supply complete instrument data sheets for each and every instrument and submit this information in accordance with paragraph 1.5 of this section.
   1. Instrument data sheets shall be furnished in both hard copy and electronic format.

END OF SECTION

SECTION 40 75 99
INSTRUMENT LIST

PART 1 - GENERAL

1.1 INSTRUMENT LIST

A. Instrument list is shown on the following page.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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Instrument List			
Tag	**Location**	**Device**	**Description**
RC-CL-01	JVWCD Chlorination Building	Chorine Residual Analyzer	Analytical Technologies Inc. Q46H-62 Chlorine Monitor. Supply with constant head flowcell and 25-ft cable.No equals. Refer to Contract Drawings.
RC-PH-01		pH and Temperature Analyzer	Analytical Technologies Inc. Q46 pH Monitor P-1-1-1 with Q25P2-1-1 Differential pH Sensor. Hach Part #9180100 Flow Cell Well. No equals. Refer to Contract Drawings.
RC-CL-02		Chorine Residual Analyzer	Analytical Technologies Inc. Q46H-62 Chlorine Monitor. Supply with constant head flowcell and 25-ft cable.No equals. Refer to Contract Drawings.
RC-CL-03		Chorine Residual Analyzer	Analytical Technologies Inc. Q46H-62 Chlorine Monitor. Supply with constant head flowcell and 25-ft cable.No equals. Refer to Contract Drawings.
RIV-LSH-01	Rosecrest Interconnect Vault	Flood Switch	Model GEMS Sensor Level Switch LS-270 series P/N 43765.
RIV-ZSC-01		Intrusion Switch	Model Schneider Electric Class 9007 or Engineer Approved Equal.
RIV-PIT-01		Pressure Transmitter	Rosemount Model 3051. Refer to Specification 40 73 26.
RIV-FM/FIT-01		Flow Meter	Endress + Hauser Promag W 400 or Rosemount 8750W.
RIV-FM/FIT-02		Flow Meter	Endress + Hauser Promag W 400 or Rosemount 8750W.
RC-PIT-01	Rosecrest Reservoir Vault	Pressure / Tank Level Transmitter	Rosemount Model 3051. Refer to Specification 40 73 26.
RRV-LSH-01		Flood Switch	Model GEMS Sensor Level Switch LS-270 series P/N 43765.
RRV-ZSC-02		Intrusion Switch	Model Schneider Electric Class 9007 or Engineer Approved Equal.
RRV-ZSC-03		Intrusion Switch	Model Schneider Electric Class 9007 or Engineer Approved Equal.
RRV-PIT-01		Pressure Transmitter	Rosemount Model 3051. Refer to Specification 40 73 26.
RRV-PSH-01		Pressure Switch	SOR (Series NN), adjustable pressure switch with at least 1 NC contact that opens on increasing pressure and is set to open at > 100 psi. See Specification 40 73 37.
RRV-FM/FIT-01		Flow Meter	Endress + Hauser Promag W 400 or Rosemount 8750W.
RRV-FM/FIT-02		Flow Meter	Endress + Hauser Promag W 400 or Rosemount 8750W.

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APPENDIX A

GEOTECHNICAL INVESTIGATION
JVWCD ROSECREST PIPELINE

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JVWCD

ROSECREST PIPELINE

Salt Lake County, Utah

Prepared for:
Bowen Collins & Associates

February 2025

RB&G ENGINEERING, INC.

202301-040 Task 24-02

RB&G ENGINEERING, INC.

March 12, 2025

Bowen Collins & Associates
Attn: Lindsay Minck, P.E.
154 East 14075 South
Draper, UT 84020

Re: Geotechnical Investigation – JVWCD Rosecrest Pipeline

Dear Ms. Minck:

A Geotechnical Investigation has been completed for the Jordan Valley Water Conservancy District Southwest Rosecrest Pipeline project in Salt Lake County, Utah. The results of this study are summarized in the report transmitted herewith.

We appreciate the opportunity of providing this service for you. If there are any questions relating to the information contained herein, please call.

Sincerely,

RB&G ENGINEERING, INC.

Jacob S. Price, P.E., Principal

PROFESSIONAL ENGINEER
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GEOTECHNICAL INVESTIGATION

JVWCD
Rosecrest Pipeline

Salt Lake County, Utah

Prepared for:
Bowen Collins & Associates

February 2025

RB&G ENGINEERING, INC.

JVWCD ROSECREST PIPELINE

Salt Lake County, Utah

Geotechnical Investigation

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RB&G ENGINEERING, INC.

JVWCD ROSECREST PIPELINE

Salt Lake County, Utah

Geotechnical Investigation

1 INTRODUCTION

This report outlines the findings of a geotechnical investigation performed for the proposed Jordan Valley Water Conservancy District (JVWCD) Rosecrest Pipeline project, located primarily in the city of Herriman, Salt Lake County, Utah. RB&G Engineering is serving as a geotechnical consultant to Bowen Collins & Associates, who has been retained by JVWCD for design of the project.

Figure 1 is a Vicinity Map showing the approximate location of the project relative to the surrounding area. The primary purpose of this investigation was to evaluate the characteristics of the subsurface soils throughout the alignment to provide geotechnical information for pipeline design.

1.1 PROJECT DESCRIPTION

The project will include construction of a new pipeline parallel to the existing pipeline extending from the reservoir at 5601 Emmaline Drive along Rosecrest Road (5600 West) to 13400 South. The project scope also includes replacement of valves, piping, and appurtenances associated with the interconnect vault at 13400 South Rosecrest Road, along with potential relocation of the vault. The project location and vicinity are shown on Figure 1. Figures 2a through 2d show the approximate locations of borings completed for the project.

2 GEOLOGICAL AND EXISTING CONDITIONS

2.1 REGIONAL GEOLOGY

The Wasatch Front consists of a series of down dropped valleys which extend from Utah Valley to the south through the Salt Lake Valley, Davis, Ogden and Weber Counties to the north. The Salt Lake Valley is a large sediment filled basin bounded by the Traverse Mountains to the south, the

Oquirrh Mountains to the west, and the abruptly climbing Wasatch Mountains to the east. The valley is the result of Basin and Range extensional faulting associated with the Salt Lake City segment of the Wasatch Fault Zone, which trends predominately north-south near the base of the Wasatch Mountains. The Wasatch Fault is classified as a normal, down to the west, fault. The valley floor contains thousands of feet of alluvium and lacustrine (lake-bottom) soil deposits.

During the Pleistocene (23,000 to 11,000 years ago), the climate became much colder and wetter compared to recent historical conditions. Glaciation was common at high altitudes, while lower altitudes received more rain. During this time, Lake Bonneville (the largest of the Pleistocene lakes) began spreading over much of northern and central Utah and extended into several valleys of southeastern Idaho. The lake experienced several cycles of regression and transgression during a 3,500-year period before reaching an elevation of about 5,090 feet (msl) and breaching into the Snake River Plain near Zenda, Idaho (Bonneville Phase). The lake stabilized at the Red Rock Pass threshold at an elevation of approximately 4,740 feet (Provo Phase) about 14,500 years ago. During Lake Bonneville times, thousands of feet of clay, silt, sand and gravel were deposited within the valleys along the Wasatch Front. Changes to a drier and warmer climate eventually resulted in the overall regression of the lake to the modern-day levels of the Great Salt Lake and Utah Lake.[1]

2.2 GEOLOGY OF PROJECT AREA

The surficial soils throughout the project area have been mapped[2,3] primarily as lacustrine sand and silt deposits (Qlsb and Qlgb) with a band of young alluvial deposits (Qaly) and stream-terrace deposits (Qat1) where the Rose Creek stream channel crosses the proposed alignment.

2.3 GEOLOGIC HAZARDS

Based upon geologic mapping of the project area, the water pipeline alignment does not cross known faults. The project alignment is located about 9.6 miles to the west of the mapped surface expression of the Wasatch fault zone (WFZ). The Oquirrh fault zone is located about 10 miles west of the project. Geologic hazards applicable to the project include ground shaking, subsidence, and liquefaction during a seismic event on the Wasatch fault zone or other fault systems in the vicinity. Seismic hazards are discussed in further detail in the next section of this report.

---

[1] *Major Levels of Great Salt Lake and Lake Bonneville*, Utah Geological Survey Map 73, by D.R. Currey, G. Atwood, and D.R. Mabey, April 1984.
[2] *Geologic Map of the Tickville Spring Quadrangle, Salt Lake and Utah Counties, Utah*, Utah Geological Curvey Map 290DR, by R.F. Biek, B.J. Solomon, J.D. Keith, and T.W. Smith, 2021
[3] *Geologic Map of the Copperton Quadrangle, Salt Lake County, Utah*, Utah Geological Curvey Map 219DM, by R.F. Biek, B.J. Solomon, T.W. Smith, and J.D. Keith, 2018

2.4 FAULTING AND SEISMICITY

Ground shaking, subsidence, and liquefaction are among potential seismic hazards that apply to the project area and much of the Salt Lake Valley. The potential for the project to be affected by surface rupture associated with a mapped fault is low.

The WFZ is characterized as an active normal fault with down to the west displacement. The Salt Lake section of the WFZ can generate earthquake magnitudes in the order of 7.2, however, a simultaneous rupture of multiple segments of the WFZ could theoretically produce an earthquake with a magnitude of 7.5.

Earthquake considerations applicable to the project, including site class and mapped ground acceleration values, are discussed in Section 5.3 of this report.

2.5 EXISTING SITE CONDITIONS

The natural topography of the project area slopes down from south to north at about a 7 percent grade from the reservoir on the south end of the project to about Rose Creek. North of Rose Creek the terrain climbs at about a 4 percent grade to about High Spirit Court (13772 South), where it then slopes down toward the north at about a 2 percent grade to 13400 South.

The project area generally consists of residential development with some churches, schools, and parks. On the north end there is commercial development along 13400 South.

3 GEOTECHNICAL EXPLORATION METHODS

3.1 SUBSURFACE EXPLORATIONS

Geotechnical borings were planned for 6 locations along the proposed pipeline alignment to evaluate the subsurface soil and water conditions. The boring locations are shown on Figure 2 and logs depicting conditions encountered and interpreted from the borings are included in the appendix. Each of the boring numbers includes the prefix “24-B” to indicate that the borehole was completed in the year 2024. This prefix is generally omitted from the discussion that follows.

The geotechnical borings for the project were performed using CME 55 rotary drill rigs, with a tri-cone rock bit and NW casing, HQ casing advancer system, or HWT casing advancer system used to advance the borings. Water was used as the drilling fluid. During the subsurface exploration, sampling was generally conducted at 3-foot depth intervals. Both disturbed and undisturbed samples were obtained during the field explorations. The boring logs are included in the appendix to this report.

Disturbed samples were obtained by driving a 2-inch or 2.5-inch (O.D.) split spoon sampling tube through a depth of 18 inches using a 140-pound weight dropped from a height of 30 inches. NWJ

drill rods were used during the drilling and sampling. The hammers used for sampling are tested annually as outlined in ASTM D 4633. Based on the most recent of these tests, the ratio of actual energy delivered to the theoretical maximum energy of a 140-pound weight after a 30-inch free fall averages 0.76 for the automatic trip hammer on the 08-CME-55 drill rig and 0.87 for the hammer on the 20-CME-55 drill rig.

The number of hammer blows required to drive the sampling spoon through each 6-inch increment of penetration is shown on the boring logs. The sum of the last two blow counts, which represents the number of blows recorded while driving the sampling spoon through 12 inches, is defined as the penetration value, *N*. Sampler refusal (more than about 50 blows required to drive through a 6-inch interval) was encountered at some depths, in which case the number of blows corresponding to the observed penetration is shown on the boring log.

Penetration values corrected for overburden and hammer energy provide a good indication of the in-place density of sandy soil; however, they only provide an indication of the relative stiffness of cohesive soil, since the penetration resistance of soil of this type is a function of moisture content. Corrections applied to the blow counts recorded in the field to calculate the corrected standard penetration $(N_1)_{60}$ values shown on the boring logs were as follows:

- Sampler size correction for 2.5-inch OD sampler (where applicable): multiply by 0.938.
- Hammer energy correction from 76% or 87% average measured hammer energy ratio to 60% standard energy ratio: multiply by 1.27 and 1.45, respectively.
- Overburden correction: multiply by $C_N = (P_a / \sigma'_v)^{0.5} \leq 1.7$

  where: P_a = atmospheric pressure, approximated as 2,000 psf,

  σ'_v = effective vertical stress, calculated using assumed average total soil unit weights of 115 pcf above the water table and 120 pcf below the water table, and hydrostatic pore pressure calculated from the measured or estimated groundwater level.

The Standard Penetration Test (SPT) corrections listed above are basic corrections based on generalized interpretations and assumptions. More refined and/or additional corrections may be appropriate for specific design applications.

Considerable care must be exercised in interpreting the penetration value in gravelly-type soil, particularly where the size of the granular particles exceeds the inside diameter of the sampling spoon. If the spoon can be driven through the full 18 inches with reasonable sample recovery, the penetration value generally provides a good indication of the in-place density of gravelly-type soil.

Relatively undisturbed samples of intact soil were obtained within the borings by pushing thin walled (Shelby) sampling tubes into the subsurface soil using the hydraulic pressure on the drill rig. The tubes had nominal outside diameters of 2.75 inches and nominal wall thickness of 0.06 inch. The depths at which Shelby tube samples were obtained are identified on the boring logs.

Miniature vane shear tests, which provide an indication of the undrained shearing strength of cohesive soil, were performed during the field explorations. The results of these tests are shown on the boring logs as "torvane" values in units of tons per square foot.

Soil samples were classified visually in the field and reviewed in the laboratory according to the Unified Soil Classification System. A description of the Unified Soil Classification System is included in the appendix, and the symbols designating soil types according to this system are presented on the boring logs.

3.2 LABORATORY TESTING

Laboratory tests performed during this investigation to define the characteristics of the subsurface soils included in-place dry unit weight (ASTM D 7263), natural moisture content (ASTM D 2216), Atterberg limits (ASTM D 4318), grain size analysis (ASTM C 117, C 136), unconfined compressive strength (ASTM D 2166), direct shear (ASTM D 3080) and one-dimensional consolidation (ASTM D 2435). Electrochemical testing, including soil pH, resistivity, and percentages of sulfates, chlorides, and soluble salts in the soil were also conducted on selected samples.

Grain size analysis and Atterberg limits were used to evaluate soil classification designations. Density and moisture content determinations were conducted to evaluate in-place conditions. Consolidation, unconfined compression, and direct shear tests were performed to assess soil compressibility and strength characteristics for design. The results of laboratory tests performed during this investigation are presented on the boring logs and summarized on tables and plots located in the appendix.

4 SUBSURFACE SOIL AND WATER CONDITIONS

The soil profile encountered in the borings is summarized in the following Table. All Borings except for Boring 3 were dry after drilling. Boring 3 encountered water at a depth of 14.6 ft below the surface measured the day after drilling. Boring 3 was located at the lowest elevation of the project borings, near Rose Creek.

Boring (listed from North to South)	Boring Depth (ft)	Location	Pavement Section	Silt / Clay in Soil Profile	Sand in Profile	Gravel in Profile
1	31.5	13400 South	7.5” Asphalt, 10” Gravel with Silt & Sand (GP-GM), then 4”+ clayey gravel with sand (GC)	2.5’ to 10’ 23’ to 24.5’	28.5’ to 30’	10’ to 23’ 24.5’ to 27’ 28’ to 28.5’
4	31.5	Rosecrest Road	6” Asphalt, 18”+ Silty Gravel with Sand	5’ to 8’ 26’ to 29’	n/a	2.5’ to 5’ (fill?) 8’ to 26’ 29’ to 31.5’
2	22.5	Rosecrest Road	6.5” Asphalt, 18”+ Clayey Gravel with Sand (GC)	9.5’ to 10.5’ 12’ to 22.5’	2.5’ to 5’	5’ to 9.5’ 10.5’ to 12’
3	20	Rosecrest Road	6” Asphalt, ~7” Sand with Silt and Gravel (GP-GM), 9”+ Sand with Silt and Gravel (SP-SM)	2.5’ to 5’ 8’ to 20’	5’ to 8’	n/a
5	21	Emmaline Drive	6” Asphalt, 18”+ Silty Sand with Gravel and Sand with Silt and Gravel	n/a	5’ to 8’	8’ to 20.5’
6	15.5	JVWCD Driveway Shoulder	No pavement	n/a	0’ to 2’	2’ to 15’

Properties of the materials tested in the laboratory are summarized in the following subsections.

4.1 CLAY

Plasticity, gradation, and strength properties of the tested lean clay, sandy lean clay, lean clay with sand, and sandy silty clay (CL and CL-ML) samples obtained during the subsurface explorations are summarized below.

TABLE 2 PROPERTIES OF CLAY SAMPLES

Soil Property	No. of Tests	Range	Average
Dry Unit Weight (pcf)	2	96.4 – 101.2	N/A
Moisture Content (%)	6	21.8 – 25.8	24.3
Liquid Limit (%)	6	22 - 30	26
Plasticity Index (%)	6	4 – 11	8
Gravel Content (%)	6	0 – 27	9
Sand Content (%)	6	14 - 45	27
Silt/Clay Content (%)	6	53 – 83	65
Undrained Shear Strength from Torvane (psf)	9	320 - 1780	809
Unconfined Compressive Strength (psf)	1	564	564

One-dimensional consolidation testing was performed on two relatively undisturbed samples of lean clay obtained from the project borings. The results of these tests indicate the cohesive soils along the alignment are moderately compressible at load intensities exceeding about 1 tsf. The consolidation test specimens were initially loaded to 0.5 tsf in their as-received moisture condition, after which each specimen was inundated and allowed to absorb moisture. None of the tested samples exhibited significant volume change upon wetting. This observation suggests the cohesive soils do not have notable potential for moisture sensitivity problems such as collapse or expansion.

4.2 SILT

Plasticity, gradation, and strength properties of the tested silt and silt with sand (ML) samples obtained during the subsurface explorations are summarized below.

TABLE 3 PROPERTIES OF SILT SAMPLES

Soil Property	No. of Tests	Range	Average
Moisture Content (%)	3	16.3 – 19.1	17.9
Liquid Limit (%)	2	19 – 22	N/A
Plasticity Index (%)	2	1 - 21	N/A
Gravel Content (%)	3	27 – 28	7
Sand Content (%)	3	27 – 28	27
Silt/Clay Content (%)	3	60 – 70	65
$(N_1)_{60}$	5	9 – 67	33

4.3 SAND

The results of laboratory classification and strength tests performed on samples of native sands including sand with silt, sand with silt and gravel, clayey sand, clayey sand with gravel, silty clayey sand, silty sand, and silty sand with gravel (SP-SM, SC, SC-SM, and SM) are tabulated below.

TABLE 4 PROPERTIES OF SAND SAMPLES

Soil Property	No. of Tests	Range	Average
Moisture Content (%)	3	11.4 – 16	13
Gravel Content (%)	3	22 – 41	30
Sand Content (%)	3	46 – 68	54
Silt/Clay Content (%)	3	10 – 27	16
$(N_1)_{60}$	4	12 – 99	67

One SC-SM sample was identified as containing plastic fines. Atterberg limits testing of this sample indicates a liquid limit of 22 and a plasticity index of 4.

4.4 GRAVEL

USCS classifications of the predominantly gravelly native soil types tested in the laboratory included gravel with clay and sand, gravel with silt and sand, clayey gravel with sand, and silty gravel with sand (GP-GC, GP-GM, GC, GM). Tested properties of these samples included the following.

TABLE 5 PROPERTIES OF GRAVEL SAMPLES

Soil Property	No. of Tests	Range	Average
Dry Unit Weight (pcf)	1	104.4	104.4
Moisture Content (%)	5	8.7 – 20.4	13
Liquid Limit (%)	3	24 – 32	28
Plasticity Index (%)	3	5 – 16	10
Gravel Content (%)	5	36 – 59	48.6
Sand Content (%)	5	18 – 41	33
Silt/Clay Content (%)	5	5 – 46	19
$(N_1)_{60}$	17	15 – 96	60

Nine of the sampling attempts in Borings 5 and 6 encountered refusal in gravel layers, with the sampler typically driven less than 6 inches. Based on observations during drilling between samples these gravels may include cobbles and boulders.

Direct shear testing was performed on one specimen of clayey gravel with sand cut from the shelby tube sample obtained at a depth of 11 feet in Boring 2. The test results indicated a friction angle of 23.9 degrees with 1786 psf cohesion.

4.5 CORROSION POTENTIAL AND CONTAMINANTS

Electrochemical properties were tested for nine samples. The results of these tests are summarized below.

TABLE 6 ELECTROCHEMICAL PROPERTIES TESTED SAMPLES

Boring Number	Sample Depth (ft)	Soil Type	pH	Resistivity (ohm-cm)	Sulfates (ppm)	Chlorides (ppm)	Soluble Salts (%)
24-B1	3-4.5	CL-ML	8.2	450	40	433	2.15
24-B1	6-7.5	CL-ML	8.1	510	51	361	2.19
24-B2	3-4,5	SM	8.6	2800	<11	77	0.33
24-B3	6-7.5	SM, SP-SM	8.1	2000	30	160	0.13
24-B4	12-13.5	GP-GM	7.6	1100	40	129	0.32
24-B5	6-7.5	SM	8.4	1400	29	106	0.55
24-B6	0-1.5	SP-SM	8.7	3300	135	66	0.49

The tested pH, resistivity values, and sulfate contents are typical of natural soils in the Salt Lake valley. The resistivity values in the silty clay in the upper 10 feet of Boring 1 are low and suggest very aggressive potential for corrosion of steel placed in contact with this soil. The granular soils tested in Borings 2 through 4 generally correspond to aggressive to moderately aggressive potential for steel placed in contact with the soil.

The clayey samples tested from Boring 1 also had somewhat elevated chloride contents, which further suggest potential for accelerated corrosion of metal infrastructure installed in the ground.

The tested water-soluble sulfate contents indicate a sulfate exposure class S0 in accordance with the American Concrete Institute Structural Concrete Building Code (ACI 318-19). No special concrete requirements are indicated by ACI 318-19 for soils in this category.

No visual evidence or odors indicative of contamination were observed in the samples obtained during this investigation.

5 ENGINEERING ANALYSIS & RECOMMENDATIONS

5.1 FOUNDATION RECOMMENDATIONS

We understand that proposed vaults near Borings 24-B2, 24-B4, 24-B6 will have mat foundations with floor elevations 12 to 14 ft below the existing surface.

The native soils at the vault foundation level near Boring 24-B6 on the south end are very dense gravels with an allowable bearing capacity of over 5,000 psf. We recommend a modulus of subgrade reaction of 100 pci be used for design of the vault mat foundation/floor slab for this location.

The native soils at the vault foundation level near Boring 24-B2 could consist of lean clay with gravel or clayey gravel. To provide an adequate and uniform bearing surface for this vault, we recommend that the foundation / floor not be placed directly on these soils. We recommend that the excavation extend at least 1 foot below the footing level, and that the over-excavation include the entire vault footprint plus a horizontal distance of at least 2 feet on all sides. The over-excavation should be backfilled with compacted fill as discussed in Section 5.2.3. If these recommendations are followed, an allowable bearing capacity of 1,300 psf may be used for the vault near Boring 24-B2. This bearing capacity applies to the undrained and unconfined subsurface conditions during initial construction and will improve as the structure is backfilled providing vertical confinement over the bearing soils. We recommend a modulus of subgrade reaction of 50 pci for this vault mat foundation/floor slab.

The native soils at the vault foundation level near Boring 24-B4 near the north end of the alignment likely consist of several feet of dense granular soil but the bearing capacity will be controlled by underlying soft clay layers. We recommend an allowable bearing capacity of 1,500 psf and a modulus of subgrade reaction of 60 pci be used for design of the vault mat foundation/floor slab for this location.

5.2 TRENCH CONSTRUCTION RECOMMENDATIONS

It is anticipated that pipeline construction will be performed within open trenches. Due to site constraints, it is anticipated that shoring will be required for excavations within or adjacent to existing roadway alignments.

5.2.1 EXCAVATION

Trench excavation should comply with OSHA safety standards. For un-shored excavations, the non-cohesive soils in the project area generally vary between OSHA Type A and Type B soils, which can usually accommodate slopes of ¾H:1V to 1H:1V (horizontal to vertical), respectively, for excavation slopes up to 20 feet deep. If the roadway will be open to traffic during construction, the soils should be treated as Type B or worse and cut at no steeper than 1H:1V unless site-specific soil type determinations are made to justify steeper unshored slopes.

Some softer cohesive soils, including most of the clay in the top 8 feet of Boring 1 and selected clay layers identified as "soft" in Borings 2 and 4 fall under OSHA Type C soils. Type C soils should be sloped as 1.5H:1V or flatter in excavations as deep as 20 feet. Excavations deeper than about 5 feet will often be in a Type B over Type C scenario, which will generally limit slopes in un-shored excavations to be no steeper than 1.5H:1V.

OSHA requires daily inspections of excavations by a competent person as well as inspections prior to the start of work, as needed throughout the shift, after every rainstorm, and after other hazard increasing occurrences (OSHA 1926.651(k)(1)). The competent person is responsible for classifying soil and rock deposits in accordance with OSHA 1926 Subpart P Appendix A.

Shoring for the project should be designed by an experienced engineer licensed in the State of Utah. Shoring design is typically performed by an engineer working for the contractor selected to construct the project. This approach allows the shoring design to utilize materials and equipment readily available to the contractor. It is recommended that the shoring design be reviewed by an experienced engineer on behalf of the Owner prior to installation. Lateral earth pressures that may be considered for shoring design are discussed in Section 5.2 of this report.

5.2.2 DEWATERING

Groundwater, and indications thereof, were only encountered in B3 at 14.6 feet below the surface. Dewatering on a significant scale is not likely to be necessary for the project; however, it is possible that some collection and removal of water perched on clayey soil layers will be required. Groundwater control in clayey soils can typically be conducted most efficiently using sumps and drain trenches.

5.2.3 BACKFILL

The trench for the proposed pipeline will be excavated beneath the existing roadway. Lean clay and sandy soils obtained from the project excavations and used as backfill can adequately support the roadway provided the fill soil is properly moisture conditioned, placed, and compacted. We recommend that native cohesive soils used to backfill the trenches be moisture conditioned to within 2% of the optimum moisture content as determined by ASTM D 698 (standard proctor), the backfill be placed in loose lifts not exceeding 12 inches, and the soil be compacted to an in-place unit weight equal to at least 95% of the maximum laboratory density determined by ASTM D 698. We recommend the trench backfill be compacted to at least 92% of the maximum laboratory density in open areas where structures or pavement will not be constructed.

The in-place moisture content of samples from the borings of the existing clay soil within the likely excavation zone was greater than the optimum moisture content. Compaction of these soils will require moisture conditioning (drying) the soil to within 2% of the optimum moisture content. Moisture conditioning could be accomplished by spreading the soil and allowing it to dry to near optimum moisture content, or by using lime or other additives to absorb the excess moisture. Alternatively, the trenches could be backfilled with imported granular fill to facilitate moisture-conditioning and compaction.

If imported soil is used as trench backfill above the pipe zone, it is recommended that this soil be granular with less than 30% fines. We recommend the backfill have a maximum size of 3 inches and less than 30% retained on the ¾ inch sieve. The fraction finer than a No. 40 sieve should have a plasticity index less than 6.

It is recommended that granular fill placed below structure foundations be relatively well-graded sandy gravel having a maximum size of 3 inches, less than 30% retained on the ¾ inch sieve, and 5 to 20 percent passing a No. 200 sieve. The fraction finer than a No. 40 sieve should have a plasticity index less than 6. Fill placed below structures should be placed in lifts not exceeding 8-inches thick.

Both imported granular fill and native granular soils used to backfill trenches locations where structures or pavement will be constructed should be compacted to at least 95% of ASTM D1557. We recommend that granular fill be compacted to at least 92% of ASTM D1557 at locations where structures or pavement will not be constructed.

We recommend that bedding and backfill within the pipe zone comply with the more stringent of APWA and JVWCD standards. Construction of the pavement sections at the top of the trenches, including subbase, base, and pavement materials, should meet the more stringent of APWA or

Herriman City standards. Utah Department of Transportation standards should be met for any work that may impact state routes or other UDOT facilities.

5.3 LATERAL EARTH PRESSURES

The following equation can be used to compute lateral earth pressures:

$$P = \frac{1}{2} \gamma K H^2$$

Where P = total lateral force on wall, plf
K = earth pressure coefficient
γ = unit weight of soil (125 pcf)
H = height of retained soil against wall

The earth pressure coefficient used in designing earth retaining structures for the project will depend upon the amount of shear resistance mobilized within the retained soil. Active lateral earth pressures can typically be assumed in design of retaining systems that are relatively flexible and can deflect at least 0.2 percent of the wall height at the top of the wall. For the native soils at this project site, we recommend an active earth pressure coefficient of 0.4 be used to calculate the lateral earth pressures. If the project includes flexible retaining systems that will only retain granular compacted fill, an active earth pressure coefficient of 0.3 can be used for design.

If earth retaining structures are rigid and/or restrained such that deflections will be less than 0.2 percent of the wall height during backfilling, and the backfill is granular soil, we recommend an at-rest earth pressure coefficient of 0.50 be used to calculate the lateral earth pressure. This condition may be appropriate for the designing the walls of manholes or other rigid structures that will be backfilled with granular soil.

If passive earth pressure will be relied upon to restrain lateral movement, we recommend a coefficient of 2.4 be used for the native soils at the site. The passive earth pressure coefficient can be increased to 3.3 if granular compacted backfill is used to restrain lateral movement.

The resultant earth pressure force for the conditions described above can be assumed to act horizontally at a vertical distance above the base of the wall equal to 1/3 of the height of the retained or resisting soil mass.

If seismic design is required for project retaining structures, the additional active earth pressure due to the Maximum Considered Earthquake (MCE) may be estimated using a coefficient of 0.29 or 0.22 for native soils or granular backfill respectively. The seismic ground motion will also reduce the available passive resistance. This reduction may be accounted for as an earth pressure acting in the direction opposite the passive resistance and computed using a coefficient of 0.6. The pressure diagrams for these incremental seismic forces may be roughly approximated as inverted

triangles, such that the resultant forces of the seismic components act at heights of approximately 2H/3 above the base of the wall.

All of the above recommendations assume the surface of the soil retained behind the structure or shoring is essentially horizontal (i.e., no backslope). It should also be recognized that the pressures calculated by the above equation are earth pressures only and do not include hydrostatic pressures. Where hydrostatic pressures may exist behind a retaining structure, we recommend either the wall be designed to resist hydrostatic pressure, or that a drainage system be placed behind the wall to prevent the development of hydrostatic pressures.

5.4 SEISMIC CONSIDERATIONS

Based upon conditions encountered in the project borings and our experience in the project vicinity the site can be classified as Site Class D for seismic design in accordance with ASCE 7.

Mapped probabilistic peak ground acceleration (PGA) values and spectral acceleration (SA) values for periods of 0.2 and 1.0 second have been calculated for latitude 40.49780ºN, longitude 112.02449ºW near the center of the alignment using the USGS U.S. Seismic Design Maps with the ASCE 7-22 design standard. The seismic design parameters are tabulated below.

TABLE 7 SITE CLASS D DESIGN AND MCE GROUND MOTION VALUES

Period	Design	MCE
PGA (0 sec)	n/a	0.56 g (PGA_M)
0.2 sec SA	0.89 g (S_{DS})	1.33 g (S_{MS})
1.0 sec SA	0.62 g (S_{D1})	0.93 g (S_{M1})

We do not anticipate at this time that seismic design will be a significant aspect of the project. However, we can provide more detailed geotechnical/seismic recommendations for use with ASCE 7-16 or ASCE7-22 if needed.

5.4.1 MITIGATION OF SEISMIC HAZARDS

One sample of saturated loose silt was encountered at a depth of about 20 feet in Boring 3. Similar loose / soft layers of silty clay and/or lean clay were encountered at similar depths in other borings but the groundwater was below the depth investigated in the other borings. Based on the other borings, we anticipate that the thickness of the liquefiable silt layer in Boring 3 is no more than 5 ft. This layer is susceptible to liquefaction induced settlement of up to 2 inches during the design seismic event. This silt layer is not susceptible to lateral spread due to the fines content (amount of material passing the No. 200 sieve). No known active faults are mapped near enough to the proposed pipeline to pose major or unique hazards in terms of fault surface rupture or subsidence.

No special design provisions or mitigation of liquefaction or lateral spread hazards are recommended for the project.

5.5 OTHER DESIGN AND CONSTRUCTION CONSIDERATIONS

While Type I or Type II cement is acceptable, it is recommended that Type II or Type V cement be used for concrete in contact with the native soils due to its increased resistance to sulfate attack. A blended hydraulic cement having at least moderate resistance to sulfate attack (ASTM C 595 designation "MS") may be considered equivalent to Type II Portland cement in this respect.

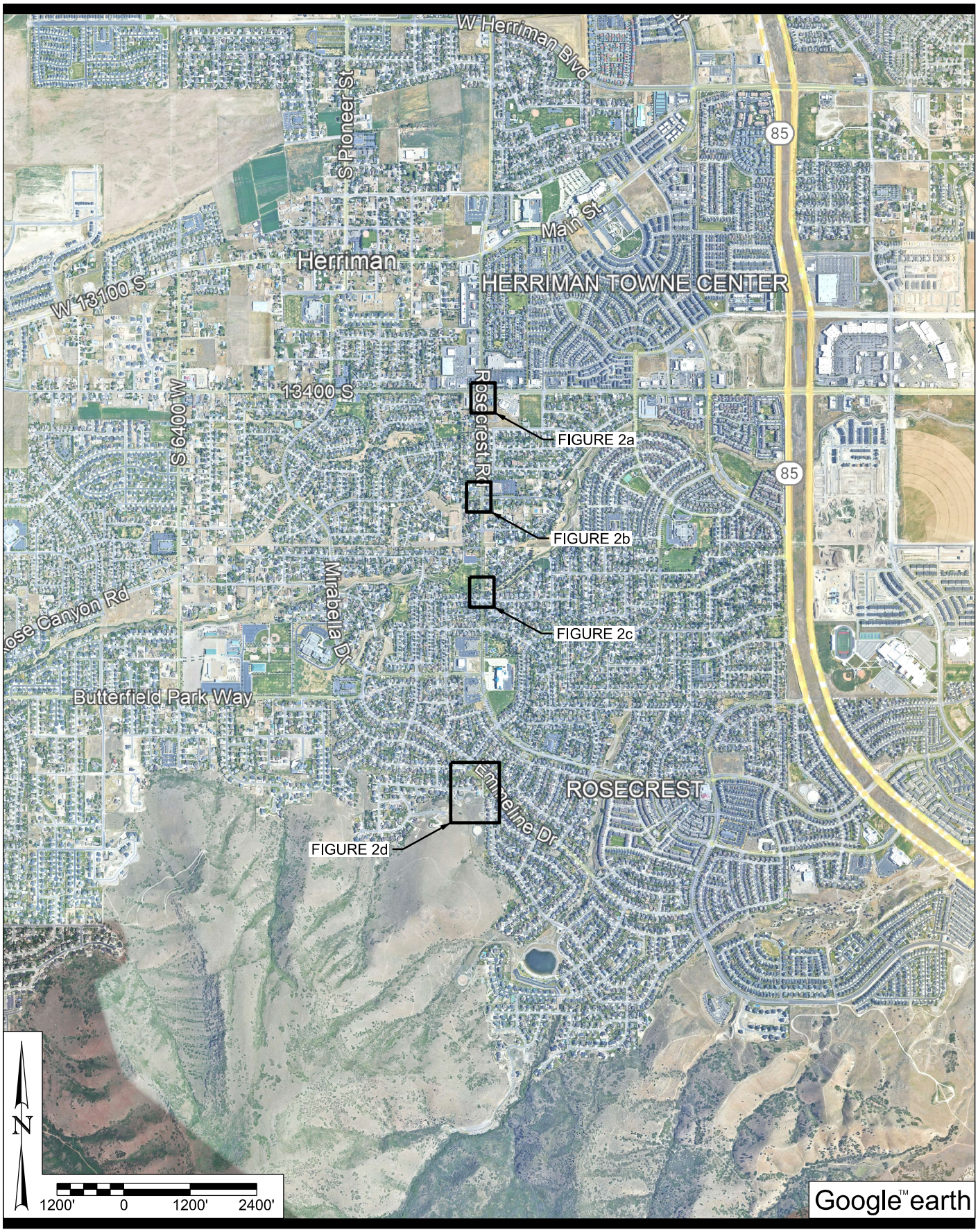
Soils at the bottoms of excavations may be too soft to provide an adequate working surface in some areas. Stabilization methods will depend upon conditions encountered. Moderately soft areas may be stabilized by over-excavating to a depth of about twelve inches, placing a 4-ounce non-woven geotextile separation fabric and a geogrid (or alternatively a higher-strength woven geotextile), and backfilling with well-graded sandy gravel fill compacted to least 90% of the maximum laboratory density determined using ASTM D 1557. Very soft areas may be stabilized by pressing 3" to 8" angular to sub-angular cobble rock or broken concrete into the subgrade in lifts no thicker than 12 inches at a time. If the subgrade is not stable after pressing in two 12-inch lifts of cobbles or broken concrete, we recommend the subgrade be left undisturbed for 24 to 48 hours to allow soil pore water pressures to dissipate before attempting further stabilization. Where cobbles are used for subgrade stabilization, excess rock that cannot be tamped into the subgrade should be removed to avoid leaving voids between cobbles. If voids are left between cobbles, migration of soil particles into the voids over time could result in settlement of the pipeline, trench backfill, and surface elements such as pavements.

6 LIMITATIONS AND CLOSURE

The findings and recommendations presented in this report are the results of geotechnical explorations and analyses conducted for design of the project. It should be recognized that soil materials are inherently heterogeneous and that conditions may exist at the site which could not be defined during the explorations described herein.

If conditions are encountered during construction which differ from those presented in this report, it is requested that RB&G Engineering be informed in order that appropriate action may be taken.

The information contained in this report is provided for the specific location and purpose identified herein, and is not intended or suitable for reuse by any other person or entity, whether for the specified use, or for any other use. Any such unauthorized reuse, by any other party, is at that party's sole risk, and RB&G Engineering, Inc. does not accept any liability or responsibility for its use.

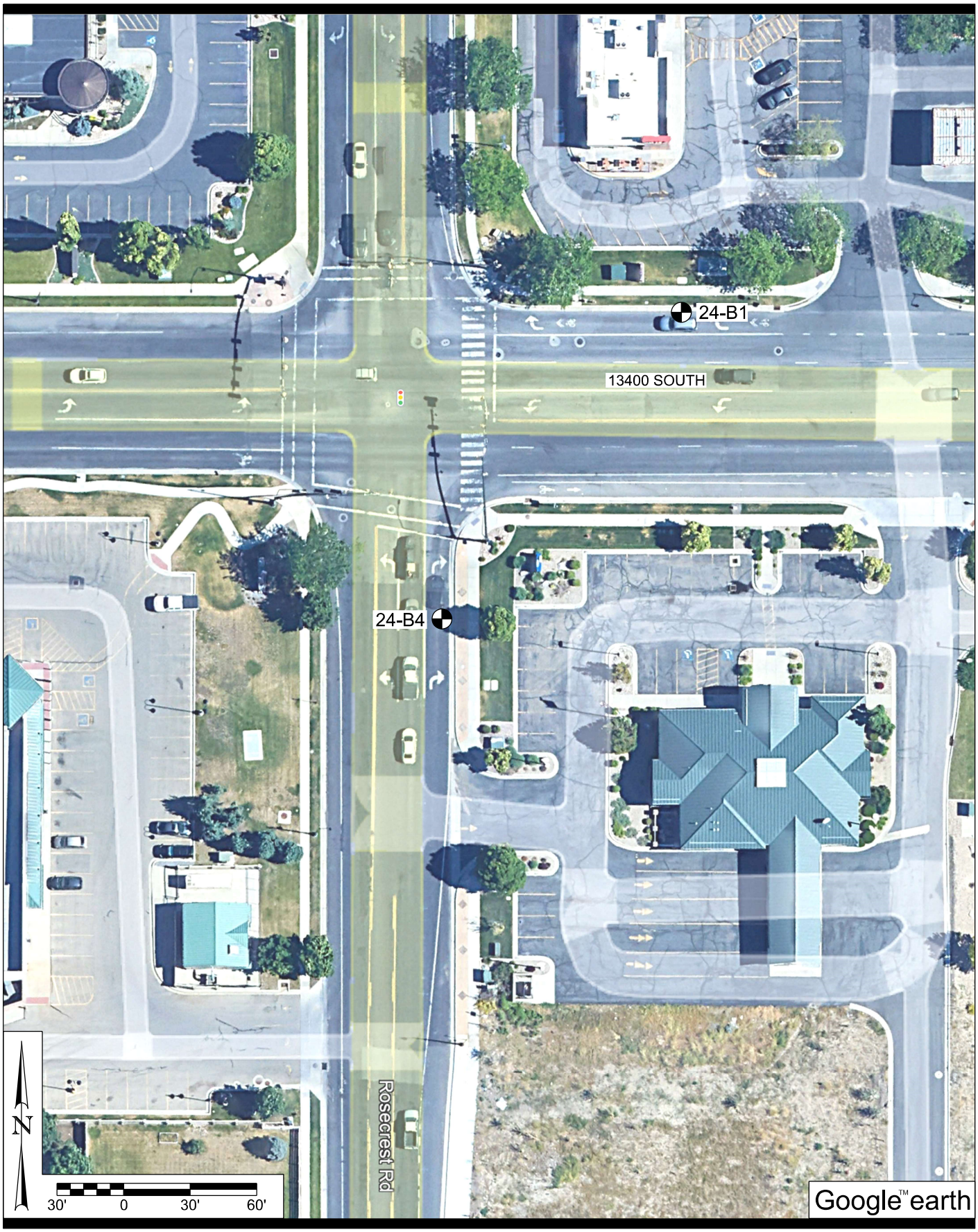


RB&G ENGINEERING, INC.

Figure 1 VICINITY MAP

JVWCD Rosecrest Pipeline Capacity Upgrades

Herriman, Salt Lake County, Utah

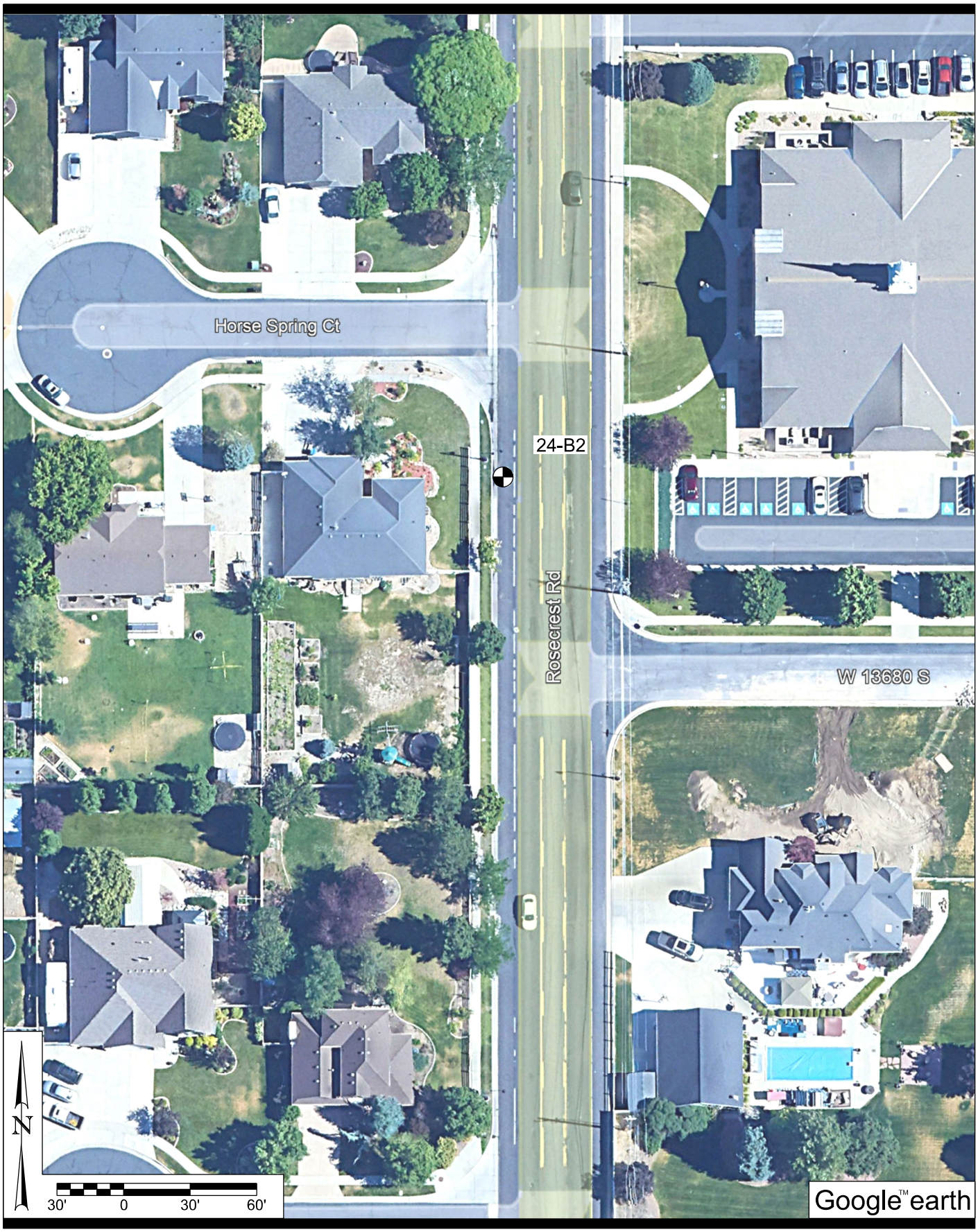


RB&G ENGINEERING, INC.

Figure 2a SITE PLAN & TEST HOLE LOCATIONS

JVWCD Rosecrest Pipeline Capacity Upgrades

Herriman, Salt Lake County, Utah

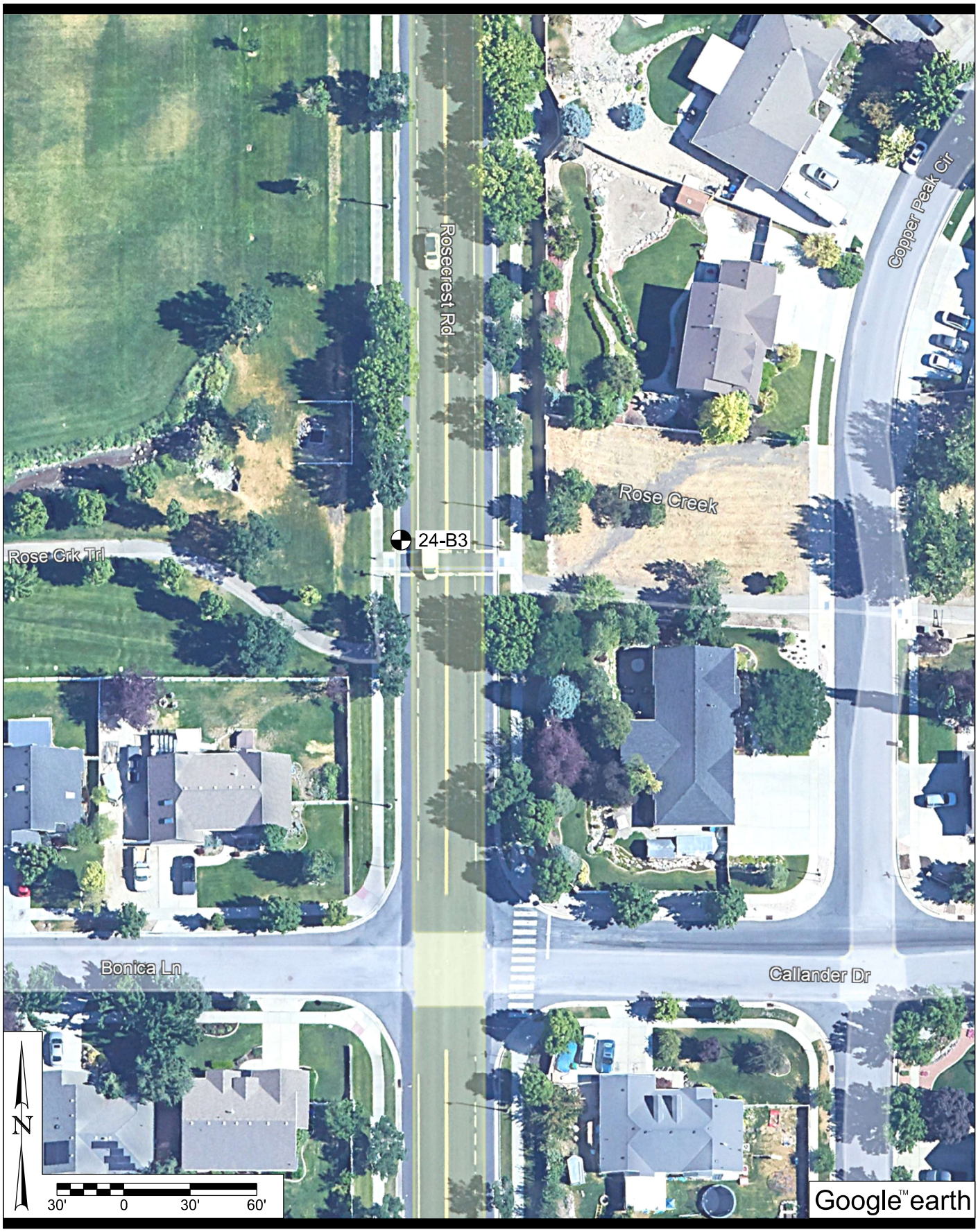


RB&G ENGINEERING, INC.

Figure 2b SITE PLAN & TEST HOLE LOCATION

JVWCD Rosecrest Pipeline Capacity Upgrades

Herriman, Salt Lake County, Utah

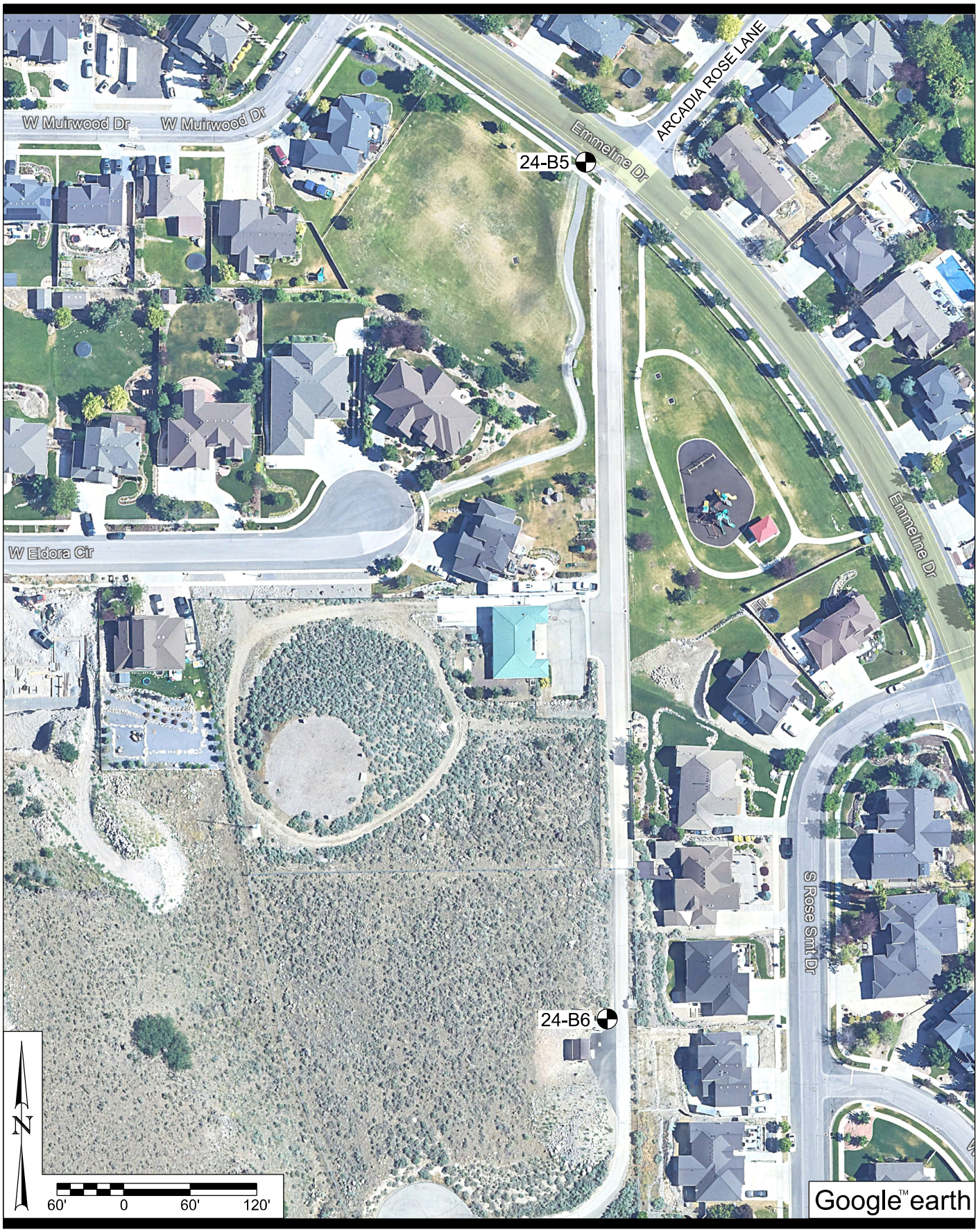


RB&G ENGINEERING, INC.

Figure 2c SITE PLAN & TEST HOLE LOCATION

JVWCD Rosecrest Pipeline Capacity Upgrades

Herriman, Salt Lake County, Utah



RB&G ENGINEERING, INC.

Figure 2d SITE PLAN & TEST HOLE LOCATIONS

JVWCD Rosecrest Pipeline Capacity Upgrades

Herriman, Salt Lake County, Utah

DRILL HOLE LOG

BORING NO. 24-B1

SHEET 1 OF 1

PROJECT: JVWCD ROSECREST PIPELINE CAPACITY UPGRADES

CLIENT: BOWEN COLLINS & ASSOCIATES

PROJECT NUMBER: 202301-040-24-2

LOCATION: N: 7354197, E: 1494705 / LAT: 40.507984° N, LONG: 112.024020 W

DATE STARTED: 12/5/24

DRILLING METHOD: 20-CME-55 / HQ CASING ADVANCER

DATE COMPLETED: 12/5/24

DRILLER: S.W., S.J.

GROUND ELEVATION: 4892.8'

DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

LOGGED BY: A.W., M.N.H, J.B.

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
							7.5" ASPHALT								
				14	14,13,7,(44)	GP-GM GC	lt. brown, wet GRAVEL W/SILT & SAND (fill) dk. brown, moist, med. dense CLAYEY GRAVEL W/SAND								
4890				15	2,3,5,(18) *T 0.40*	CL-ML	brown, moist, firm								Chem.
	5						SILTY CLAY W/SAND								
				15	Pushed	CL-ML	brown, very moist, soft	101.2	25.1	27	7	0	18	82	Chem. CT UC 564 psf
4885															
				13	4,8,13,(38)	CL GM	SANDY LEAN CLAY brown, moist brown, very moist, med. dense SILTY GRAVEL W/SAND								
	10														
4880				12	11,18,24,(62)	GC-GM	brown, very moist, dense SILTY CLAYEY GRAVEL W/SAND clay lenses, possible cobbles								
	15			13	20,24,29,(70)	GP-GC	brown, very moist, dense GRAVEL W/CLAY & SAND possible cobbles		9.8	27	9	59	30	11	
4875				13	18,18,52,(85)	GC-GM	brown, very moist, very dense SILTY CLAYEY GRAVEL W/SAND possible cobbles								
	20			14	14,23,39,(70)	GC-GM	brown, moist, very dense								
4870					*T 0.28*	CL-ML	brown, moist, firm SANDY SILTY CLAY W/GRAVEL								
	25			14	13,29,34,(67)	GM	brown, very moist, dense SILTY GRAVEL W/SAND clay lenses & seams, possible cobbles								
						GC	brown, wet, very loose CLAYEY GRAVEL W/SAND								
4865				13	8,3,4,(7) *T 0.20*	CL GC	brown, moist, soft SANDY LEAN CLAY brown, wet, very loose CLAYEY GRAVEL W/SAND		24.5	28	11	2	45	53	
				14	8,8,4,(12)	SC-SM	brown, very moist, med. dense SILTY CLAYEY SAND W/GRAVEL		16.0	22	4	27	46	27	
	30			9	5,6,9,(15)	GM	brown, very moist, very loose SILTY GRAVEL W/SAND plasstic fines								
4860							BOTTOM OF HOLE								

DH_LOG_V8-2014-1 ROSECREST_PIPELINE.GPJ US EVAL.GDT 3/12/25

RB&G ENGINEERING, INC.

LEGEND:

- 2" OD Split Spoon (SPT)
- 2.5" OD Split Spoon
- 3" OD Split Spoon

Split Spoon Sample: 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; *T 0.45* ← Torvane (tsf); *PP 2.0* ← Pocket Penetrometer (tsf); * With Liners

Thin-Walled Tube Sample: Pushed; *T 0.45* ← Torvane (tsf); *PP 2.0* ← Pocket Penetrometer (tsf)

OTHER TESTS

UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride
Hyd. = Hydrometer
DC = Dispersive Clay
SS = Soluble Salts

DRILL HOLE LOG

BORING NO. 24-B2

SHEET 1 OF 1

PROJECT: JVWCD ROSECREST PIPELINE CAPACITY UPGRADES

CLIENT: BOWEN COLLINS & ASSOCIATES

PROJECT NUMBER: 202301-040-24-2

LOCATION: N: 7352389, E: 1494552 / LAT: 40.503019° N, LONG: 112.024532 W

DATE STARTED: 12/16/24

DRILLING METHOD: 08-CME-55

DATE COMPLETED: 12/17/24

DRILLER: S.W., J.H.

GROUND ELEVATION: 4932.4'

DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

LOGGED BY: M.S.H., J.B.

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
							6.5" ASPHALT								
				15	10,21,21,(85)	GC	lt. brown to brown, very moist, very dense — CLAYEY GRAVEL W/SAND (fill)								
4930				14	8,16,12,(57)	SM	lt. brown, moist, very dense — SILTY SAND								Chem.
	5			12	13,14,18,(59)	GP-GM	lt. brown, very moist, dense — GRAVEL W/SILT & SAND possible cobbles		8.7		NP	59	36	5	
4925						GP-GM	lt. brown, very moist								
	10			15	11,8,3,(17) *T 0.85*	CL	gray-lt. brown, moist, stiff — GRAVELLY LEAN CLAY W/SAND								
				10	Pushed	GC	lt. brown, moist — CLAYEY GRAVEL W/SAND	104.4	20.4	32	16	36	18	46	DS
4920				12	3,3,2,(7) *T 0.30*	CL	lt. brown, moist, firm — LEAN CLAY W/GRAVEL silty sand seams								
	15			14	Pushed *T 0.22*	CL	lt. brown, moist, soft	96.4	25.8	30	11	27	17	56	CT
4915						ML	lt. brown-white, very moist — SILT W/SAND plastic fines								
				14	1,6,3,(11) *T 0.89*	CL	red-brown to lt. brown-white, very moist, stiff — LEAN CLAY W/SAND								
	20			15	4,6,6,(13) *T 0.34*	CL-ML	lt. brown, wet, firm — SANDY SILTY CLAY trace gravels		21.8	22	4	14	30	56	
4910							BOTTOM OF HOLE								

DH_LOG_V8-2014-1 ROSECREST_PIPELINE.GPJ US EVAL.GDT 3/12/25

RB&G ENGINEERING, INC.

LEGEND:

- 2" OD Split Spoon (SPT)
- 2.5" OD Split Spoon
- 3" OD Split Spoon

Split Spoon Sample: 2,3,2,(6) ← Blow Count per 6"; $(N_1)_{60}$ Value; *T 0.45* ← Torvane (tsf); *PP 2.0* ← Pocket Penetrometer (tsf); With Liners

Thin-Walled Tube Sample: Pushed; *T 0.45* ← Torvane (tsf); *PP 2.0* ← Pocket Penetrometer (tsf)

OTHER TESTS

UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride
Hyd. = Hydrometer
DC = Dispersive Clay
SS = Soluble Salts

DRILL HOLE LOG

BORING NO. 24-B3

SHEET 1 OF 1

PROJECT: JVWCD ROSECREST PIPELINE CAPACITY UPGRADES

CLIENT: BOWEN COLLINS & ASSOCIATES

PROJECT NUMBER: 202301-040-24-2

LOCATION: N: 7350697, E: 1494551 / LAT: 40.498374° N, LONG: 112.024500 W

DATE STARTED: 12/17/24

DRILLING METHOD: 08-CME-55

DATE COMPLETED: 12/18/24

DRILLER: S.W., J.H.

GROUND ELEVATION: 4931.9'

DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ 14.6'

LOGGED BY: M.S.H., J.B.

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
							6" ASPHALT								
4930				16	17,25,25,(99+)	SP-SM/ GP-GM	lt. brown, moist, very dense — SAND W/SILT & GRAVEL TO GRAVEL W/SILT & SAND (fill)								
						SP-SM	lt. brown, moist, very dense — SAND W/SILT & GRAVEL								
				17	7,12,21,(67)	ML	gray, very moist, very stiff — SANDY SILT plastic fines		19.1	22	1	6	28	66	
	5														
4925				18	18,26,27,(99+)	SM,SP-SM	gray, very moist, very dense — INTERBEDDED LAYERS OF SILTY SAND & SAND W/SILT & GRAVEL								Chem.
				10	13,29,16,(69)	CL-ML	gray, moist, hard — SANDY SILTY CLAY								
	10														
4920				4	Pushed	ML	gray, very moist — SANDY SILT								
				15	10,14,10,(34)	ML	gray, very moist, dense		18.4		NP	3	27	70	
	15														
4915				14	16,13,23,(45)	ML	brown, wet, hard — SANDY SILT plastic fines, trace gravels								
				10	4,4,3,(9)	ML	brown, wet, firm		16.3	19	2	13	27	60	
	20						BOTTOM OF HOLE								
4910															

DH_LOG_V8-2014-1 ROSECREST_PIPELINE.GPJ US EVAL.GDT 3/12/25

RB&G ENGINEERING, INC.

LEGEND:

- 2" OD Split Spoon (SPT)
- 2.5" OD Split Spoon
- 3" OD Split Spoon
- Split Spoon Sample: 2,3,2,(6) ← Blow Count per 6"; $(N_1)_{60}$ Value
- T 0.45 ← Torvane (tsf)
- PP 2.0 ← Pocket Penetrometer (tsf)
- With Liners
- Thin-Walled Tube Sample: Pushed
- T 0.45 ← Torvane (tsf)
- PP 2.0 ← Pocket Penetrometer (tsf)

OTHER TESTS

UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride
Hyd. = Hydrometer
DC = Dispersive Clay
SS = Soluble Salts

DRILL HOLE LOG

BORING NO. 24-B4

SHEET 1 OF 1

PROJECT: JVWCD ROSECREST PIPELINE CAPACITY UPGRADES

CLIENT: BOWEN COLLINS & ASSOCIATES

PROJECT NUMBER: 202301-040-24-2

LOCATION: N: 7354062, E: 1494607 / LAT: 40.507612° N, LONG: 112.024369 W

DATE STARTED: 12/4/24

DRILLING METHOD: 20-CME-55 / HQ CASING ADVANCER

DATE COMPLETED: 12/4/24

DRILLER: S.W., S.J.

GROUND ELEVATION: 4896.7'

DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

LOGGED BY: A.W., J.B.

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
							6" ASPHALT								
4895				13	10,13,11,(53)	GM	lt. brown, wet, dense — SILTY GRAVEL W/SAND (fill)								
				8	4,19,17,(79)	GM	brown, wet, very dense — SILTY GRAVEL W/SAND								
	5														
4890				11	3,3,2,(10)	CL	brown, very moist, firm — LEAN CLAY W/SAND		23.0	25	9	7	14	79	
				8	14,15,18,(59)	GP	brown, wet, dense								
	10														
4885				8	11,15,7,(32)	GP	brown, wet, med. dense — GRAVEL W/SAND possible cobbles								Chem.
	15														
				8	26,28,28,(74)	GP	brown, wet, dense								
4880															
				8	20,27,38,(79)	GC-GM	brown, wet, very dense — SILTY CLAYEY GRAVEL W/SAND possible cobbles								
	20														
4875				16	20,39,46,(96)	GC-GM	brown, very moist, very dense		11.5	24	5	46	41	13	
				12	25,24,20,(47)	GC-GM	brown, very moist, med. dense — SILTY CLAYEY GRAVEL W/SAND sandy clay lenses, possible cobbles								
	25														
4870				17	2,2,3,(5) *T 0.16*	CL-ML	brown, wet, soft — SANDY SILTY CLAY		25.7	24	7	2	36	62	
	30														
				16	8,14,16,(29)	GC-GM	brown, very moist, med. dense — SILTY CLAYEY GRAVEL W/SAND possible cobbles								
4865							BOTTOM OF HOLE								

DH_LOG_V8-2014-1 ROSECREST_PIPELINE.GPJ US EVAL.GDT 3/12/25

RB&G ENGINEERING, INC.

LEGEND:

- 2" OD Split Spoon (SPT)
- 2.5" OD Split Spoon
- 3" OD Split Spoon

Split Spoon Sample: 2,3,2,(6) ← Blow Count per 6"; $(N_1)_{60}$ Value; *T 0.45* ← Torvane (tsf); *PP 2.0* ← Pocket Penetrometer (tsf); With Liners

Thin-Walled Tube Sample: Pushed; *T 0.45* ← Torvane (tsf); *PP 2.0* ← Pocket Penetrometer (tsf)

OTHER TESTS

UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride
Hyd. = Hydrometer
DC = Dispersive Clay
SS = Soluble Salts

DRILL HOLE LOG

BORING NO. 24-B5

SHEET 1 OF 1

PROJECT: JVWCD ROSECREST PIPELINE CAPACITY UPGRADES

CLIENT: BOWEN COLLINS & ASSOCIATES

PROJECT NUMBER: 202301-040-24-2

LOCATION: N: 7347572, E: 1494532 / LAT: 40.489796° N, LONG: 112.024502 W

DATE STARTED: 12/18/24

DRILLING METHOD: 08-CME-55

DATE COMPLETED: 12/19/24

DRILLER: S.W., J.H.

GROUND ELEVATION: 5056.6'

DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

LOGGED BY: M.S.H., J.B.

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
							6" ASPHALT								
5055				10	12,4,6,(20)	SM	brown, moist, med. dense — SILTY SAND W/GRAVEL, possible cobbles, (fill)								
				10	13,62/5"	SP-SM	brown, very moist, very dense — SAND W/SILT & GRAVEL, possible cobbles, (fill)		12.1		NP	22	68	10	
	5														
5050				14	26,46,38,(99+)	SM	brown-red, very moist, very dense — SILTY SAND, gravel layers, possible cobbles								Chem.
				10	27,60/3"	GM	brown, very moist, very dense — SILTY GRAVEL W/SAND, possible cobbles		14.1		NP	43	38	19	
	10														
5045				3**	19,25,30,(74)	GP	red-black, wet, dense								
	15			0	60/1"	-	no recovery — GRAVELS, possible cobbles								
5040				1**	60/2"	GP	red w/black, wet, very dense								
	20					GP	red w/black, moist								
				10	36,60/4"	GC-GM	red w/black, very moist, very dense — SILTY CLAYEY GRAVEL W/SAND, possible cobbles								
5035							BOTTOM OF HOLE								
							**poor samples								

DH_LOG_V8-2014-1 ROSECREST_PIPELINE.GPJ US EVAL.GDT 3/12/25

RB&G ENGINEERING, INC.

LEGEND:

- 2" OD Split Spoon (SPT)
- 2.5" OD Split Spoon
- 3" OD Split Spoon
- Split Spoon Sample
- Thin-Walled Tube Sample
- 2,3,2,(6) ← Blow Count per 6"
- $(N_1)_{60}$ Value
- *T 0.45* ← Torvane (tsf)
- *PP 2.0* ← Pocket Penetrometer (tsf)
- With Liners
- Pushed
- *T 0.45* ← Torvane (tsf)
- *PP 2.0* ← Pocket Penetrometer (tsf)

OTHER TESTS

UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride
Hyd. = Hydrometer
DC = Dispersive Clay
SS = Soluble Salts

DRILL HOLE LOG

BORING NO. 24-B6

SHEET 1 OF 1

PROJECT: JVWCD ROSECREST PIPELINE CAPACITY UPGRADES

CLIENT: BOWEN COLLINS & ASSOCIATES

PROJECT NUMBER: 202301-040-24-2

LOCATION: N: 7346820, E: 1494558 / LAT: 40.487733° N, LONG: 112.024392 W

DATE STARTED: 12/3/24

DRILLING METHOD: 20-CME-55 / HWT CASING ADV. TO 10.5', HQ CASING TO 15'

DATE COMPLETED: 12/3/24

DRILLER: S.W., S.J.

GROUND ELEVATION: 5121.2'

DEPTH TO WATER - INITIAL: ▽ DRY' **AFTER 24 HOURS:** ▼ N.M.

LOGGED BY: A.W., M.N.H, J.B.

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
5120				18	7,28,51,(99+)	SP-SM	brown, moist, very dense — SAND W/SILT & GRAVEL		11.4		NP	41	47	12	Chem.
				1**	50/2"	GP	brown, wet, very dense								
	5														
5115				1**	50/2"	GP	brown, wet, very dense — GRAVELS possible cobbles								
				1**	50/2"	GP	brown, wet, very dense								
	10														
5110				3**	50/3"	GP	brown to dk. brown, wet, very dense — GRAVEL W/SAND possible cobbles								
	15			4**	107/6"	GP	dk. gray, wet, very dense								
5105							BOTTOM OF HOLE **poor samples								

DH_LOG_V8-2014-1 ROSECREST_PIPELINE.GPJ US EVAL.GDT 3/12/25

RB&G ENGINEERING, INC.

LEGEND:

- 2" OD Split Spoon (SPT)
- 2.5" OD Split Spoon
- 3" OD Split Spoon
- Split Spoon Sample
- Thin-Walled Tube Sample
- Blow Count per 6" 2,3,2,(6)
- $(N_1)_{60}$ Value
- *T 0.45* Torvane (tsf)
- *PP 2.0* Pocket Penetrometer (tsf)
- With Liners
- Pushed *T 0.45* Torvane (tsf)
- Pushed *PP 2.0* Pocket Penetrometer (tsf)

OTHER TESTS

UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride
Hyd. = Hydrometer
DC = Dispersive Clay
SS = Soluble Salts

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Table 1

SUMMARY OF TEST DATA

PROJECT JVWCD Rosecrest Pipeline PROJECT NO. 202301-040 Task 24-2

HOLE NO.	DEPTH BELOW GROUND SURFACE (ft)	IN-PLACE		UNCONFINED COMPRESSIVE STRENGTH (psf)	ATTERBERG LIMITS			MECHANICAL ANALYSIS			PERCENT FINER THAN 0.005 mm	UNIFIED SOIL CLASSIFICATION SYSTEM
		DRY UNIT WEIGHT (pcf)	MOISTURE (%)		LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT & CLAY		
24-B1	6-7.5	101.2	25.1	564	27	20	7	0	18	82		CL-ML
	15-16.5		9.8		27	18	9	59	30	11		GP-GC
	27-28.5		24.5		28	17	11	2	45	53		CL
	28.5-30		16.0		22	18	4	27	46	27		SC-SM
24-B2	6-7.5		8.7				NP	59	36	5		GP-GM
	10.5-12	104.4	20.4		32	16	16	36	18	46		GC
	15-16.5	96.4	25.8		30	19	11	27	17	56		CL
	21-22.5		21.8		22	18	4	14	30	56		CL-ML
24-B3	3-4.5		19.1		22	21	1	6	28	66		ML
	12.3-13.8		18.4				NP	3	27	70		ML
	18.5-20		16.3		19	17	2	13	27	60		ML
24-B4	6-7.5		23.0		25	16	9	7	14	79		CL
	21-22.5		11.5		24	19	5	46	41	13		GC-GM
	27-28.5		25.7		24	17	7	2	36	62		CL-ML
24-B5	3-3.9		12.1				NP	22	68	10		SP-SM
	9-9.8		14.1				NP	43	38	19		GM
24-B6	0-1.5		11.4				NP	41	47	12		SP-SM

HOLE NO.	DEPTH BELOW GROUND SURFACE (ft)	pH	RESISTIVITY (ohm-cm)	SULFATE (mg/kg)	CHLORIDE (mg/kg)	SOLUBLE SOLIDS
24-B1	3-4.5	8.2	450	40	433	2.15
	6-7.5	8.1	510	51	361	2.19
24-B2	3-4.5	8.6	2,800	< 11	77	0.33
24-B3	6-7.5	8.1	2,000	30	160	0.13
24-B4	12-13.5	7.6	1,100	40	129	0.32
24-B5	6-7.5	8.4	1,400	29	106	0.55
24-B6	0-1.5	8.7	3,300	135	66	0.49

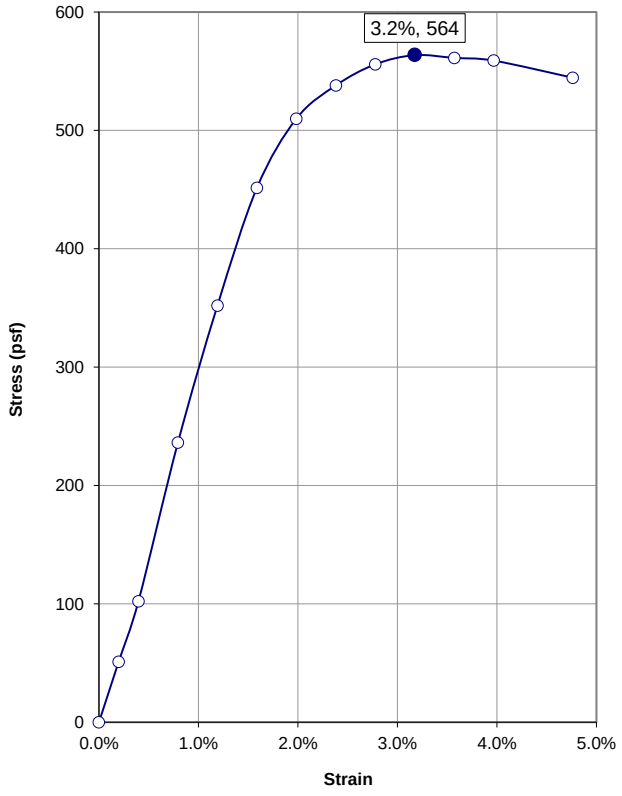
NP=Non-Plastic

RB&G ENGINEERING, INC.

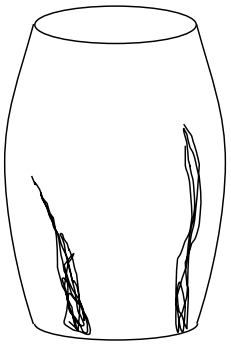
UNCONFINED COMPRESSION TEST ON COHESIVE SOILS

Project	JVWCD Rosecrest Pipeline	**Boring No.**	24-B1
Project No.	202301-040-24-2	**Sample**	1
Location	See Site Plan	**Depth / Elev. (ft)**	6-7.5'
Date	Saturday, December 27, 2025	**Sample Description**	Silty Clay w/ Sand CL-ML
Tested By	Z Chaffin	**Sample Type**	Undisturbed (shelby)

Apparatus No.	UC-1	**Proving Ring No.**	5552



Total Strain	Stress (psf)	Sketch of Specimen After Failure
0.0%	0	
0.2%	51	
0.4%	102	
0.8%	236	
1.2%	352	
1.6%	451	
2.0%	510	
2.4%	538	
2.8%	556	
3.2%	564	
3.6%	561	
4.0%	559	
4.8%	545	



Initial Sample Data

Initial height of specimen	L_o	5.04	(in)	**Liquid limit**	LL	27
Initial diameter of specimen	D_o	2.6	(in)	**Plastic index**	PI	7
Height-to-diameter ratio	L_o / D_o	1.94		**Moisture content***	w	25.1%
Dry unit weight	γ_d	98.1	(pcf)			

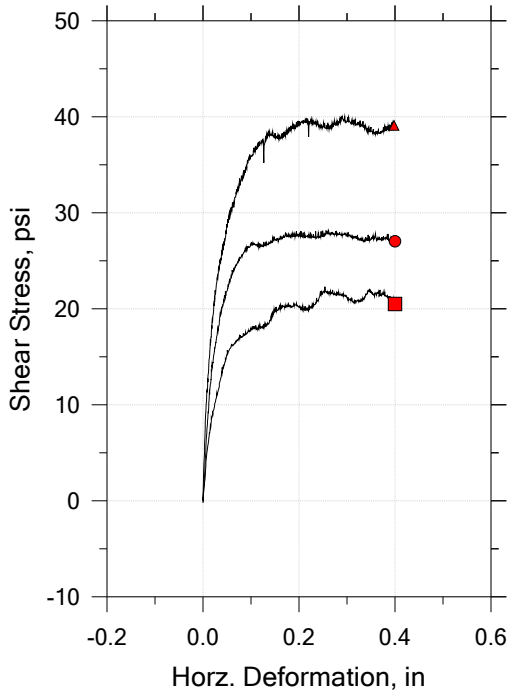
Test Results

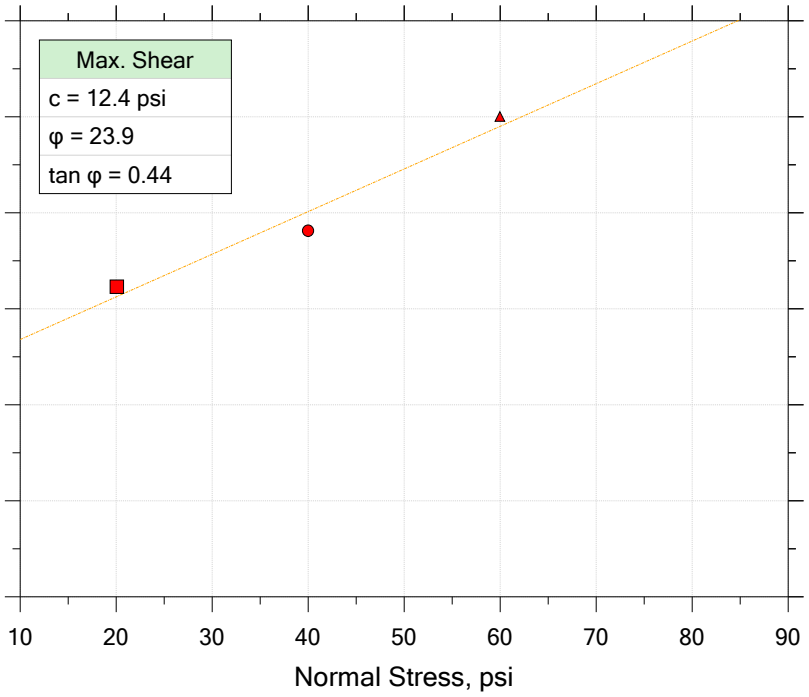
Unconfined compressive strength	q_u	564	(psf)
Shear strength	τ_f	282	(psf)
Average strain rate to failure		1%	
Strain at failure		3.2%	

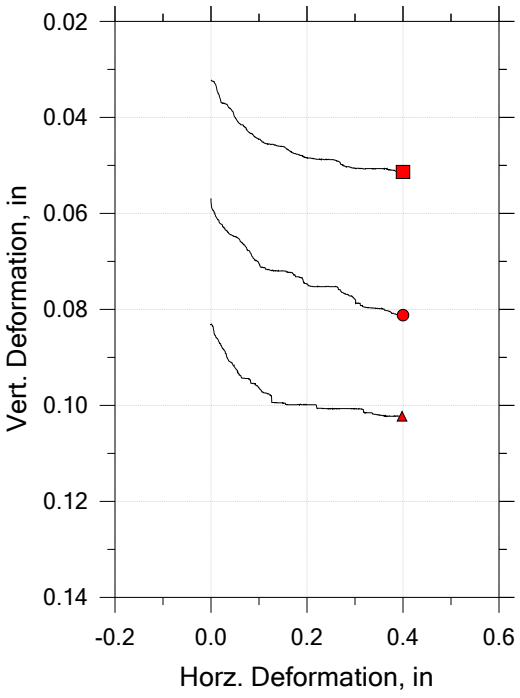
Remarks

*Moisture content obtained from cuttings and or excess material

Direct Shear Test





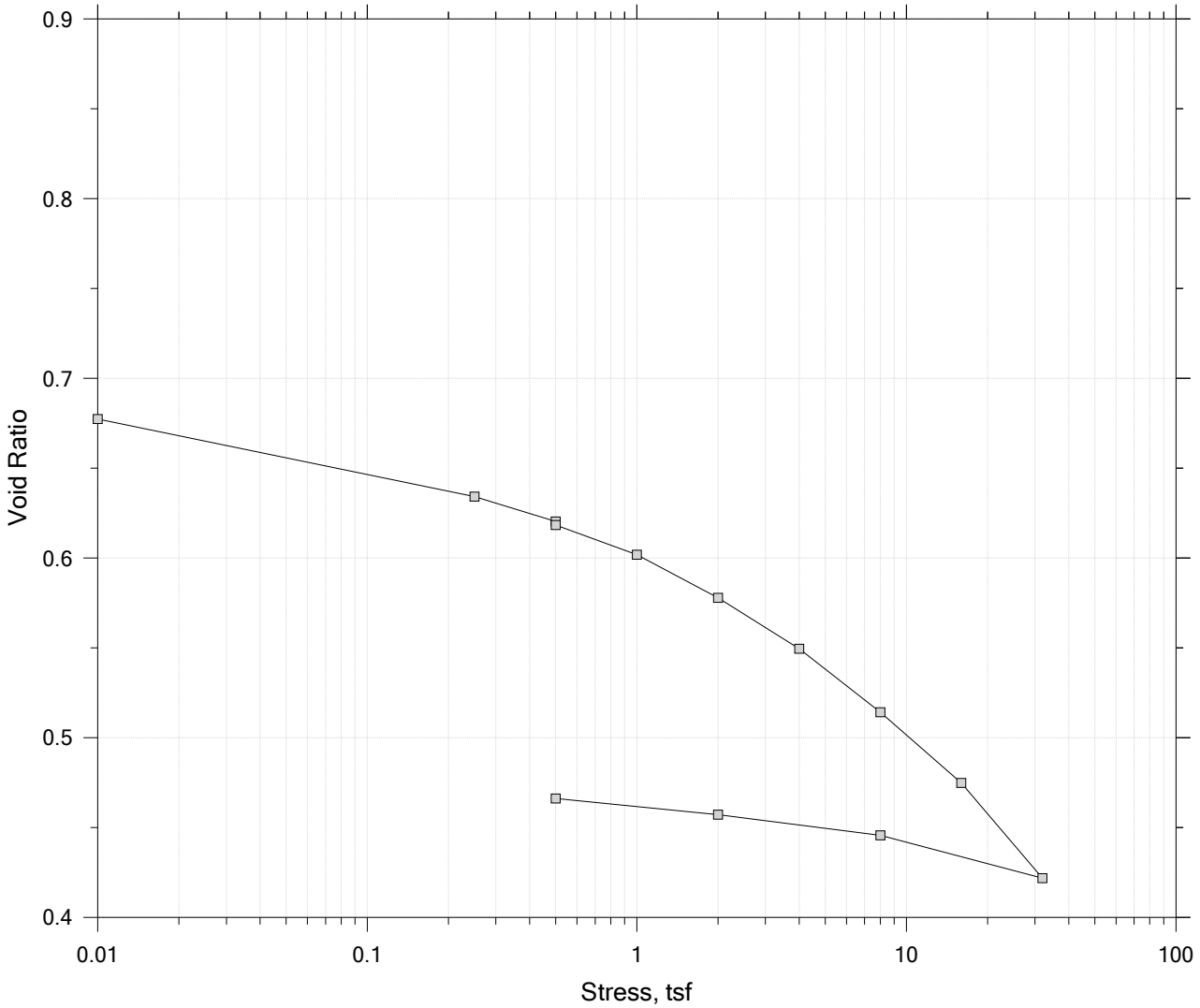


Symbol		■	●	▲	
Test No.		20 psi	40 psi	60 psi	
Sample No.		1	1	1	
Shape		Circular	Circular	Circular	
Initial	Dimension, in	2.37	2.37	2.36	
	Area, in²	4.4115	4.4115	4.3744	
	Height, in	0.923	0.908	0.929	
	Moisture Content	20.65	20.42	20.00	
	Dry Density, pcf	102.0	103.1	108.2	
	Saturation, %	85.41	86.81	96.73	
	Void Ratio	0.65282	0.63496	0.55835	
Consol. Height, in		0.89072	0.85113	0.84588	
Consol. Void Ratio		0.59502	0.53256	0.41892	
Final	Moisture Content, %	20.65	20.42	20.00	
	Dry Density, pcf	108.0	113.2	121.5	
	Saturation, %	99.42	112.79	139.64	
	Void Ratio	0.56083	0.48871	0.38678	
Normal Stress, psi		20.065	39.988	59.99	
Max. Shear Stress, psi		22.3	28.135	40.028	
Ult. Shear Stress, psi		20.508	27.04	39.111	
Time to Failure, min		405	410	471	
Disp. Rate, %/min		0.00063	0.00063	0.00063	

Project Name: JVWCD Rosecrest Pipeline	Location: see site plan	Project Number: 202301-040-24-2
Boring Number: 24-B2	Tester: LP	Checker:
Sample Number: 1	Test Date: 12/30/2024	Depth: 10.5-12'
Test Number: 20 psi	Preparation: Shelby Tube	Elevation: NA
Client:	Classification:	Group Symbol:
Description: Clayey Gravel w/ Sand GC		
Remarks:		

Consolidation Test

Summary Report

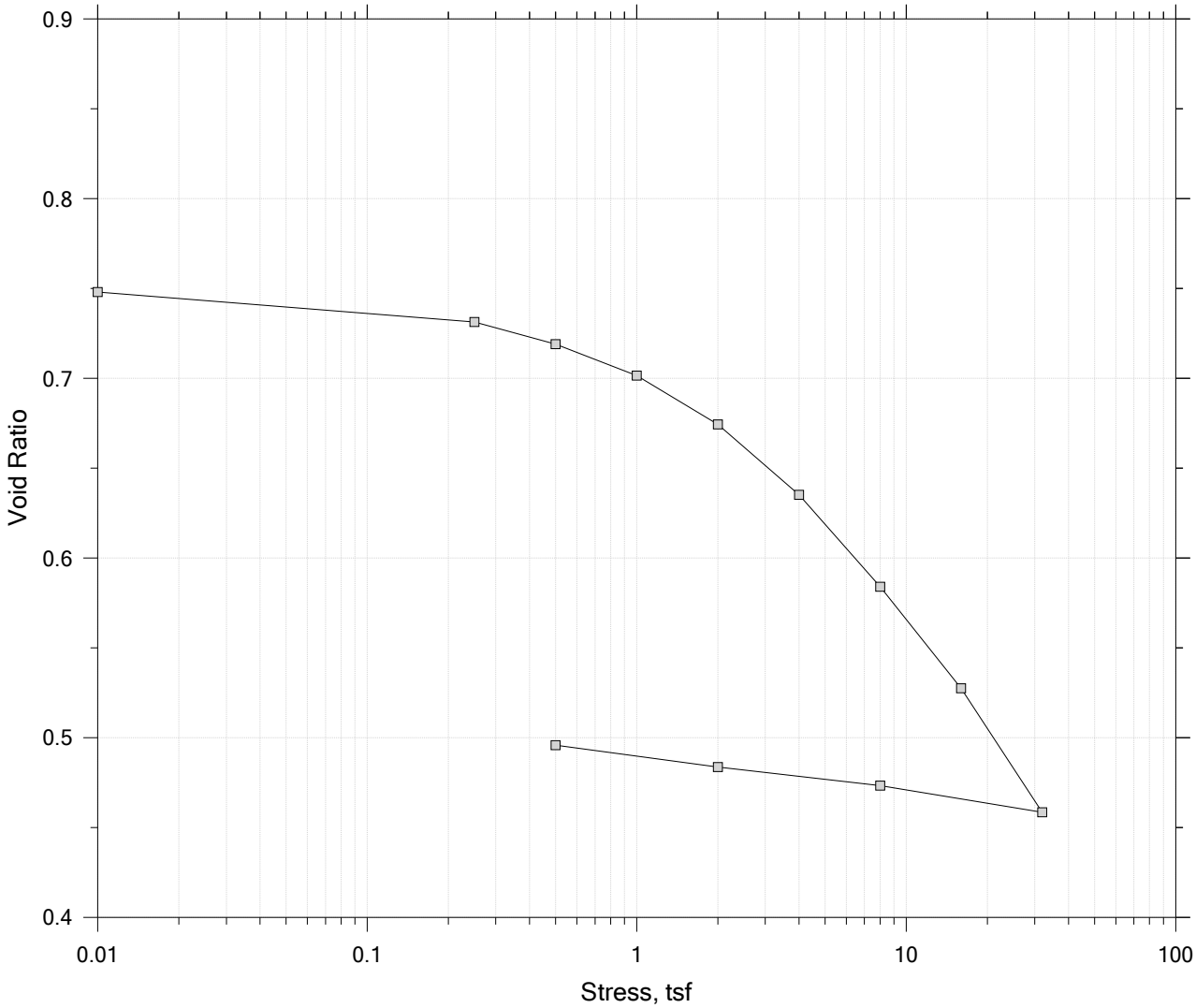


					Before Test	After Test
Current Vertical Effective Stress, tsf: ---				Water Content, %	25.05	18.50
Preconsolidation Stress, tsf: ---				Dry Unit Weight, pcf	101.17	114.96
Compression Ratio: ---				Saturation, %	101.53	107.14
Specimen Diameter, in: 2.37		Specimen Height, in: 0.924		Void Ratio	0.67	0.47
LL: 27	PL: 20	PI: 7	GS: 2.70	Back Pressure, tsf	0.37555	0.3767

	Project Name: Rosecrest Pipeline	Location: See site plan	Project Number: 202301-040-24-2
	Boring Number: 24-B1	Tester: LP	Checker:
	Sample Number: 1	Test Date: 12/24/2024	Depth: 6-7.5'
	Test Number: 1	Preparation: Shelby Tube	Elevation:
	Client:	Classification:	Group Symbol:
	Description: Silty Clay w/ Sand CL-ML		
	Remarks: Load Frame #72. check collapse swell		
	Displacement at End of Increment		

Consolidation Test

Summary Report



					Before Test	After Test
Current Vertical Effective Stress, tsf: ---				Water Content, %	25.80	19.02
Preconsolidation Stress, tsf: ---				Dry Unit Weight, pcf	96.381	112.69
Compression Ratio: ---				Saturation, %	93.03	103.62
Specimen Diameter, in: 2.37		Specimen Height, in: 0.957		Void Ratio	0.75	0.50
LL: 30	PL: 19	PI: 11	GS: 2.70	Back Pressure, tsf	0.001152	0.001152

	Project Name: Rosecrest Pipeline	Location: See site plan	Project Number: 202301-040-24-2
	Boring Number: 24-B2	Tester: LP	Checker:
	Sample Number: 1	Test Date: 12/24/2024	Depth: 15-16.5'
	Test Number: 1	Preparation: Shelby Tube	Elevation:
	Client:	Classification:	Group Symbol:
	Description: Gravelly Lean Clay w/ Sand CL		
	Remarks: Load frame #71.		
	Displacement at End of Increment		

APPENDIX B

HERRIMAN CITY INSPECTION REPORTS

ROSECREST ROADWAY ADA RAMPS

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Herriman Roads
Find address or place
Replace
12
Replace
11
10
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9
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8
7
Replace
Replace
6
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5
Replace 10' high back C&G
Replace
4
Replace
2
Replace
3
Replace
1
Replace
-112.014 40.494 Degrees
300ft

Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY: Eric Didericksen		**DATE:** 8/25/2025	
PROJECT NAME: Rosecrest Inspection		**JOB NUMBER:** 1	
Street Names: Rosecrest Rd & Crown Rose Dr		**Orientation:** NW NE SE SW MID	
Ramp Area		**CRITERION**	**PASS**	**FAIL**
(R) Running Slope		**≤ 8.33%**		10.00%
Cross Slope		**≤ 2%**	1.00	
Clear Space/Gutter Area				
(C) Min 4' x 4'		**Yes**	yes	
Running Slope (counter slope)		**≤ 5%**		8.00%
Cross Slope		**≤ 2%**	1.90%	
Tripping Hazards				
Tripping Hazard at Flow-line		**No**		yes
Tripping Hazard at Lip of Gutter		**No**	no	
Tripping Hazard at Back of Curb		**No**		yes
Curb Ramp Opening				
Minimum Width		**4 Feet**	yes	
Detectable Warning Surface Spans Entire Opening		**Yes**		no
Detectable Warning Surface Color		**Dark Gray**		no
Landing/Turning Space				
(T) Minimum Width by Minimum Length		**4' X 4'**	x	
Running Slope		**≤ 2%**		3.55%
Cross Slope		**≤ 2%**		1.80%
Flare				
(F) Within Pedestrian Walk Way		**≤ 10%**	9.10%	
In Parkstrip		**≤ 25% or ≥ 2' Wide**		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

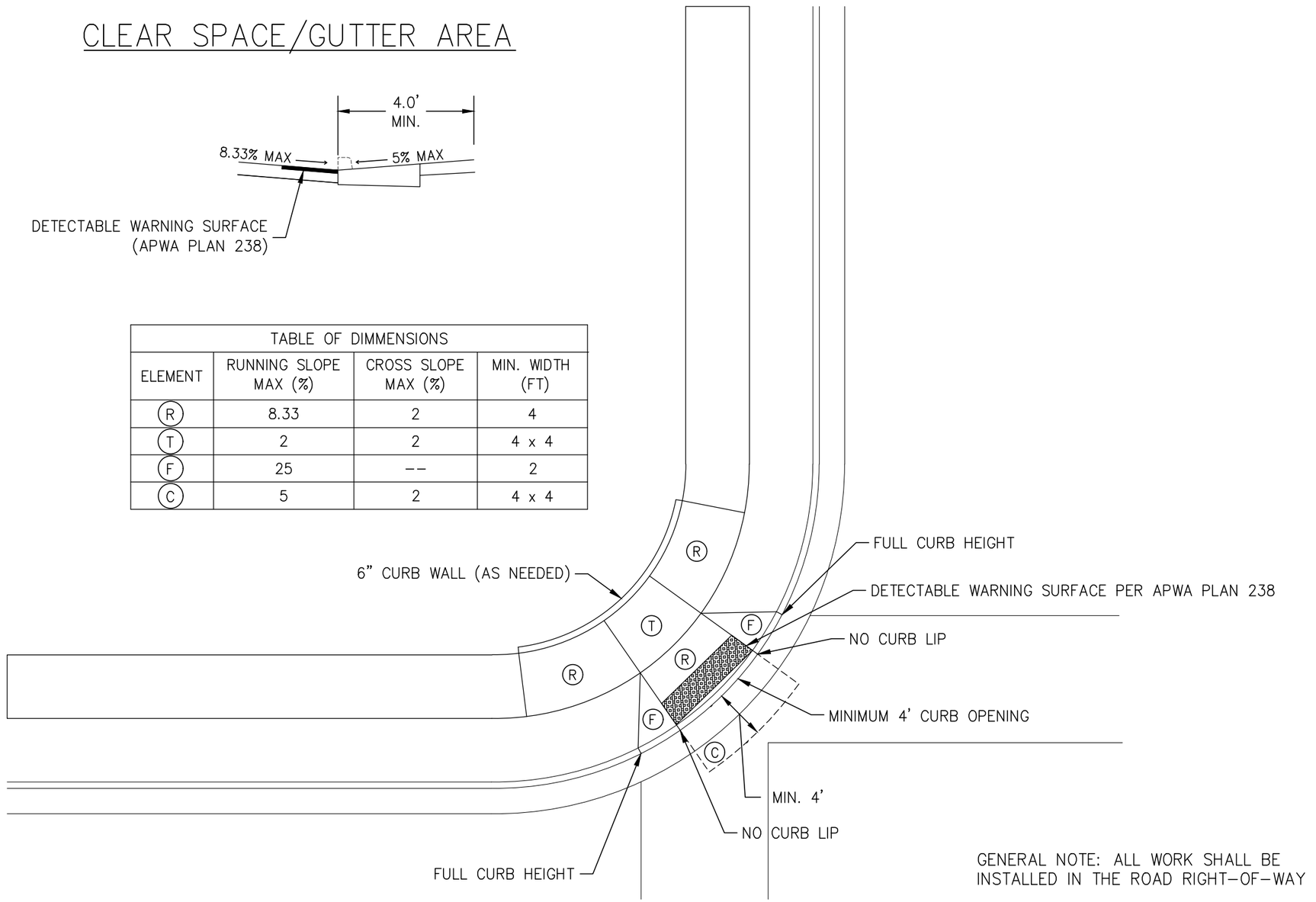
CONTRACTOR SIGNATURE **DATE**

CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

CALL BLUESTAKES @ 1-800-662-4111 AT LEAST 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

HERRIMAN CITY

HERRIMAN CITY
ENGINEERING DEPARTMENT
ADA Curb Ramps

APEX BIDIRECTIONAL RAMP

D1

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Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY:	Eric Didericksen	**DATE:**	8-25-2025
PROJECT NAME:	Rosecrest Inspection	**JOB NUMBER:**	2

Street Names:	Rosecrest Rd & Crown Rose Dr.	**Orientation:**	**(NW)** NE SE SW MID

	CRITERION	**PASS**	**FAIL**
Ramp Area			
(R) Running Slope	**≤ 8.33%**	8.00%	
Cross Slope	**≤ 2%**		6.45%
Clear Space/Gutter Area			
(C) Min 4' x 4'	**Yes**	Yes	
Running Slope (counter slope)	**≤ 5%**		8.00%
Cross Slope	**≤ 2%**		6.60%
Tripping Hazards			
Tripping Hazard at Flow-line	**No**	no	
Tripping Hazard at Lip of Gutter	**No**	no	
Tripping Hazard at Back of Curb	**No**		Yes
Curb Ramp Opening			
Minimum Width	**4 Feet**	Yes	
Detectable Warning Surface Spans Entire Opening	**Yes**		no
Detectable Warning Surface Color	**Dark Gray**		no
Landing/Turning Space			
(T) Minimum Width by Minimum Length	**4' X 4'**		np
Running Slope	**≤ 2%**	1.35%	
Cross Slope	**≤ 2%**		5.40%
Flare			
(F) Within Pedestrian Walk Way	**≤ 10%**	15.00%	
In Parkstrip	**≤ 25% or ≥ 2' Wide**		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

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CONTRACTOR SIGNATURE **DATE**

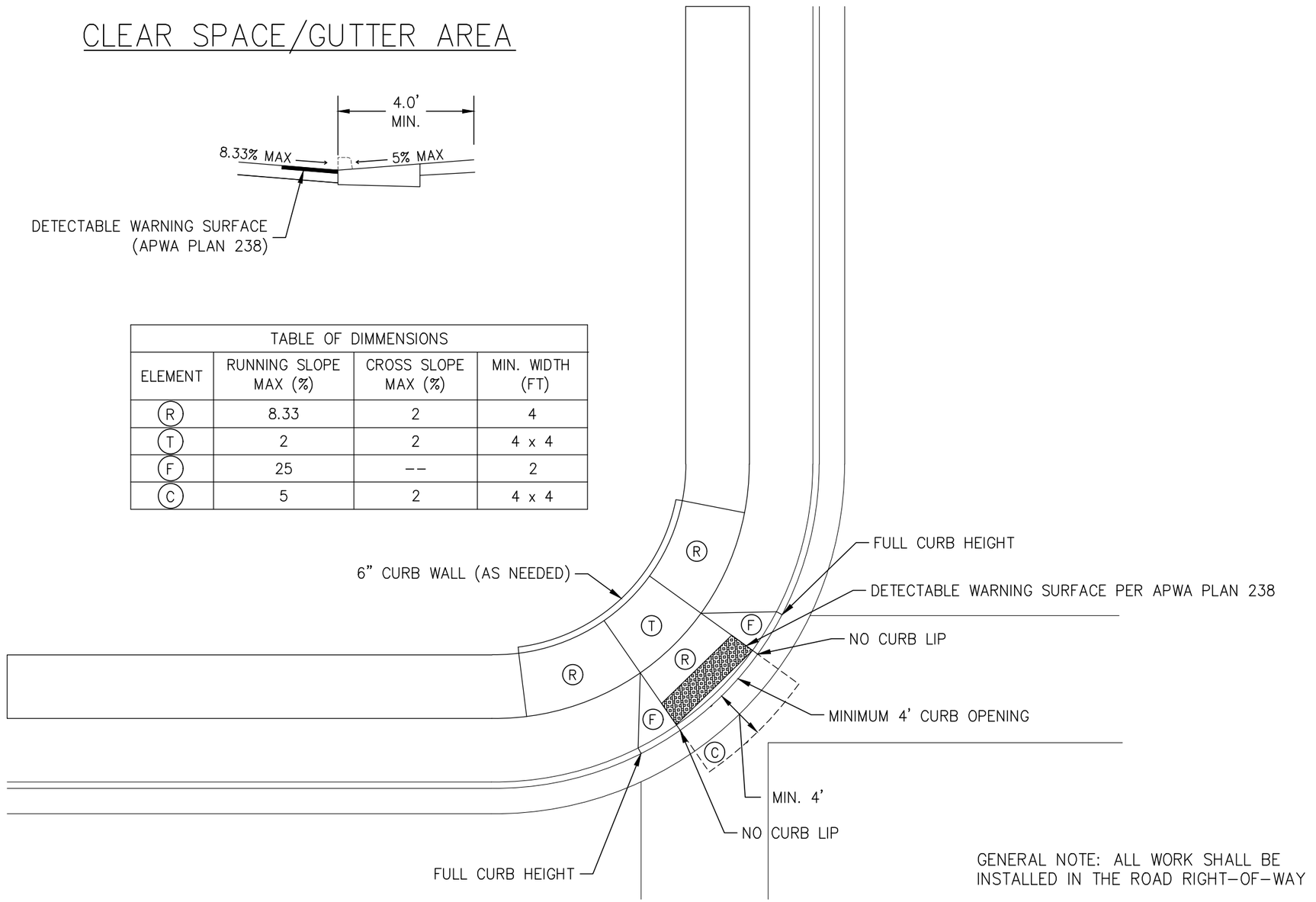
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CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

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HERRIMAN CITY

HERRIMAN CITY
ENGINEERING DEPARTMENT
ADA Curb Ramps

APEX BIDIRECTIONAL RAMP

D1

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Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY: Eric Didericksen		**DATE:** 8-25-2025	
PROJECT NAME: Rosecrest Inspection		**JOB NUMBER:** 3	
Street Names: Rosecrest Rd & Crown Rose Dr.		**Orientation:** NW NE (SE) SW MID	
Ramp Area	**CRITERION**	**PASS**	**FAIL**
R — Running Slope	≤ 8.33%		8.55%
Cross Slope	≤ 2%		4.80%
Clear Space/Gutter Area			
C — Min 4' x 4'	Yes	Yes	
Running Slope (counter slope)	≤ 5%		9.00%
Cross Slope	≤ 2%		4.15%
Tripping Hazards			
Tripping Hazard at Flow-line	No		yes
Tripping Hazard at Lip of Gutter	No		yes
Tripping Hazard at Back of Curb	No		yes
Curb Ramp Opening			
Minimum Width	4 Feet	yes	
Detectable Warning Surface Spans Entire Opening	Yes		no
Detectable Warning Surface Color	Dark Gray		no
Landing/Turning Space			
T — Minimum Width by Minimum Length	4' X 4'		
Running Slope	≤ 2%	2.00%	
Cross Slope	≤ 2%		6.35%
Flare			
F — Within Pedestrian Walk Way	≤ 10%	12.00%	
In Parkstrip	≤ 25% or ≥ 2' Wide		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

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CONTRACTOR SIGNATURE **DATE**

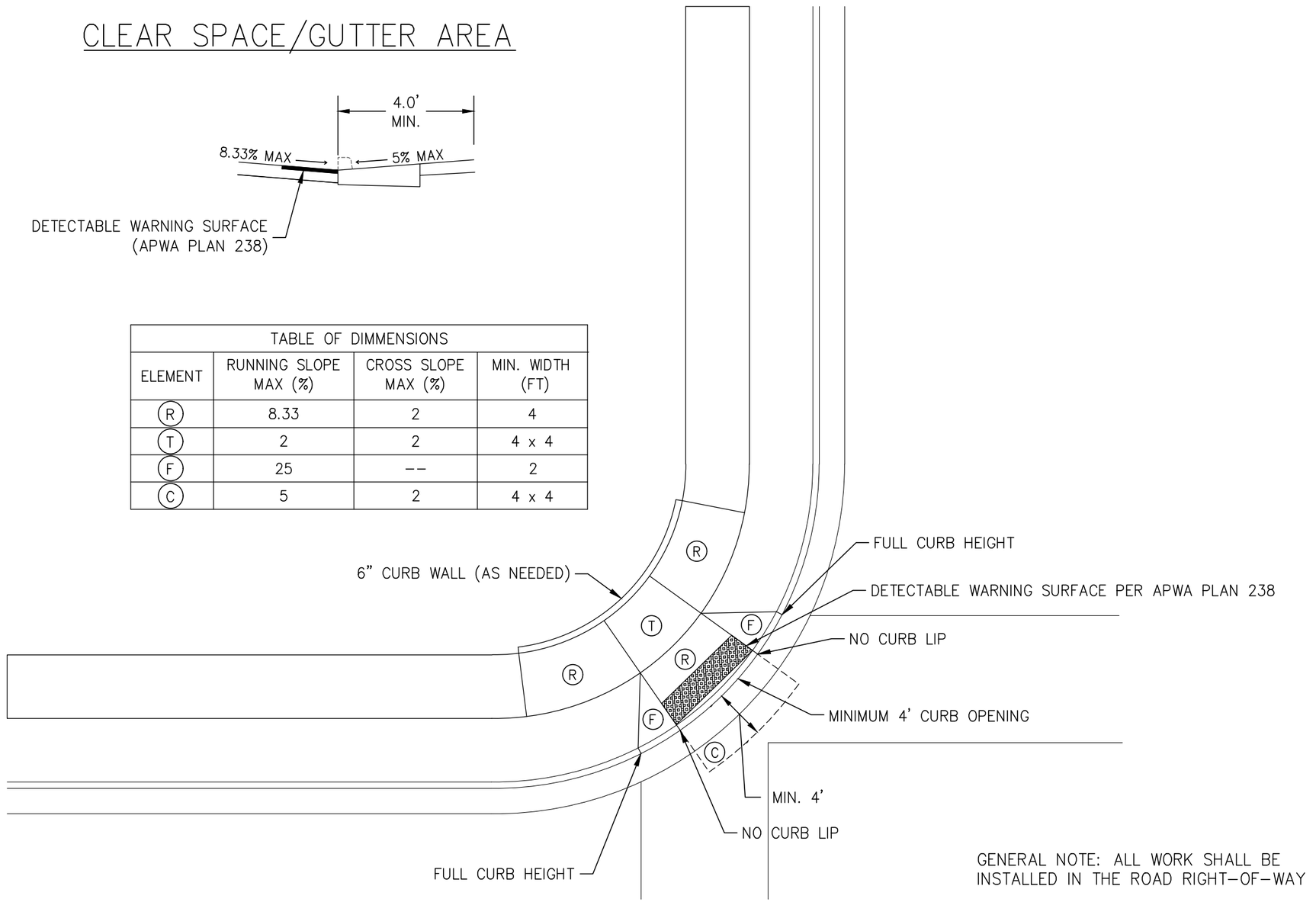
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CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

CALL BLUESTAKES @ 1-800-662-4111 AT LEAST 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

HERRIMAN CITY

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ENGINEERING DEPARTMENT
ADA Curb Ramps

APEX BIDIRECTIONAL RAMP

D1

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Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY: Eric Didericksen		**DATE:** 8-25-2025	
PROJECT NAME: Rosecrest Inspection		**JOB NUMBER:** 4	
Street Names: Rosecrest Rd. Crown Rose Dr.		**Orientation:** NW NE SE SW MID	
Ramp Area	**CRITERION**	**PASS**	**FAIL**
R — Running Slope	**≤ 8.33%**	4.35%	
Cross Slope	**≤ 2%**	.05%	
Clear Space/Gutter Area			
C — Min 4' x 4'	**Yes**	Yes	
Running Slope (counter slope)	**≤ 5%**		10.00%
Cross Slope	**≤ 2%**		.75%
Tripping Hazards			
Tripping Hazard at Flow-line	**No**	no	
Tripping Hazard at Lip of Gutter	**No**		Yes
Tripping Hazard at Back of Curb	**No**		Yes
Curb Ramp Opening			
Minimum Width	**4 Feet**	Yes	
Detectable Warning Surface Spans Entire Opening	**Yes**		No
Detectable Warning Surface Color	**Dark Gray**		no
Landing/Turning Space			
T — Minimum Width by Minimum Length	**4' X 4'**		
Running Slope	**≤ 2%**	.50%	
Cross Slope	**≤ 2%**	.05%	
Flare			
F — Within Pedestrian Walk Way	**≤ 10%**	10.40%	
In Parkstrip	**≤ 25% or ≥ 2' Wide**		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

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CONTRACTOR SIGNATURE **DATE**

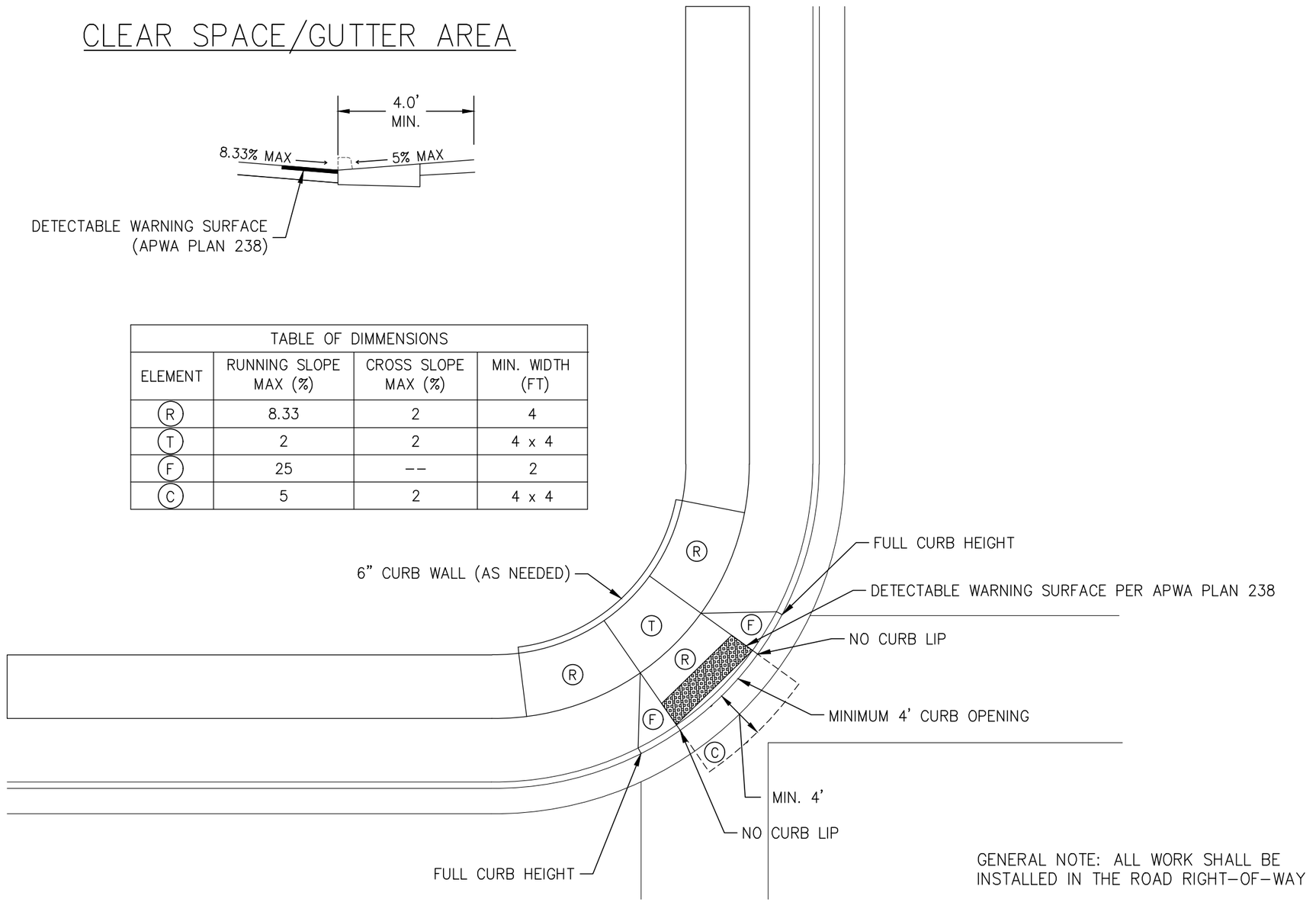
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CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

CALL BLUESTAKES @ 1-800-662-4111 AT LEAST 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

HERRIMAN CITY

HERRIMAN CITY
ENGINEERING DEPARTMENT
ADA Curb Ramps

APEX BIDIRECTIONAL RAMP

D1

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Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY: Eric Didericksen **DATE:** 8-25-2025

PROJECT NAME: Rosecrest Inspection **JOB NUMBER:** 5

Street Names: Rosecrest Rd. Mirabella Dr. **Orientation:** NW NE SE (SW) MID

	CRITERION	PASS	FAIL
Ramp Area			
R — Running Slope	≤ 8.33%	5.05%	
R — Cross Slope	≤ 2%		2.75%
Clear Space/Gutter Area			
C — Min 4' x 4'	Yes	Yes	
C — Running Slope (counter slope)	≤ 5%	5%	
C — Cross Slope	≤ 2%		2.95%
Tripping Hazards			
Tripping Hazard at Flow-line	No	no	
Tripping Hazard at Lip of Gutter	No		yes
Tripping Hazard at Back of Curb	No		yes
Curb Ramp Opening			
Minimum Width	4 Feet	yes	
Detectable Warning Surface Spans Entire Opening	Yes		no
Detectable Warning Surface Color	Dark Gray	yes	
Landing/Turning Space			
T — Minimum Width by Minimum Length	4' X 4'		
T — Running Slope	≤ 2%		4.70
T — Cross Slope	≤ 2%		3.75%
Flare			
F — Within Pedestrian Walk Way	≤ 10%	8.70%	
F — In Parkstrip	≤ 25% or ≥ 2' Wide		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

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CONTRACTOR SIGNATURE **DATE**

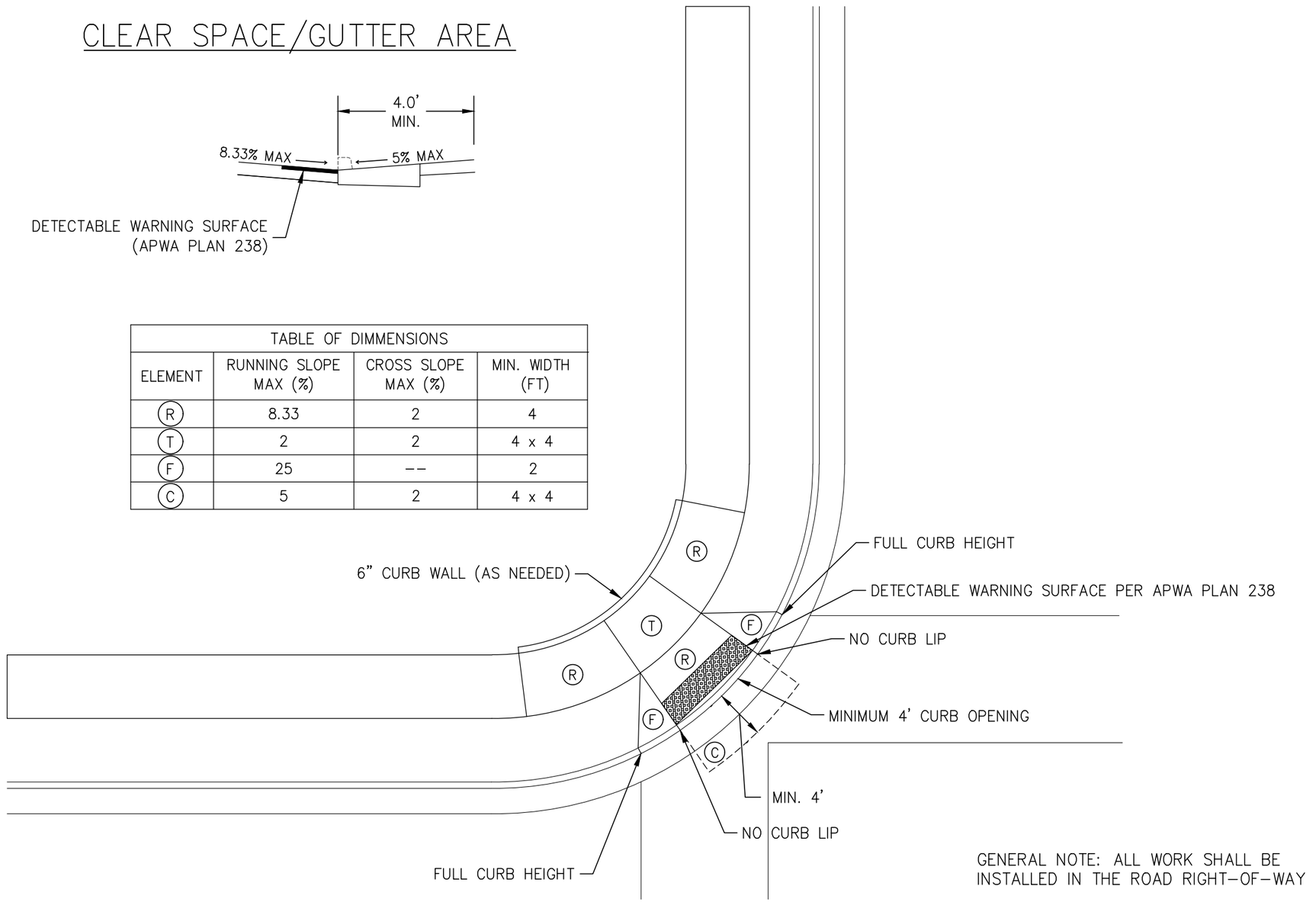
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CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

CALL BLUESTAKES @ 1-800-662-4111 AT LEAST 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

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ADA Curb Ramps

APEX BIDIRECTIONAL RAMP

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Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY: Eric Didericksen **DATE:** 8-25-2025

PROJECT NAME: Rosecrest Inspection **JOB NUMBER:** 6

Street Names: Rosecrest Rd. Mirabella Dr. **Orientation:** NW NE SE SW MID

	CRITERION	PASS	FAIL
Ramp Area			
R — Running Slope	≤ 8.33%	6.55%	
R — Cross Slope	≤ 2%		3.45%
Clear Space/Gutter Area			
C — Min 4' x 4'	Yes	Yes	
C — Running Slope (counter slope)	≤ 5%		
C — Cross Slope	≤ 2%		3.05%
Tripping Hazards			
Tripping Hazard at Flow-line	No	no	
Tripping Hazard at Lip of Gutter	No		yes
Tripping Hazard at Back of Curb	No		yes
Curb Ramp Opening			
Minimum Width	4 Feet	yes	
Detectable Warning Surface Spans Entire Opening	Yes		no
Detectable Warning Surface Color	Dark Gray		no
Landing/Turning Space			
T — Minimum Width by Minimum Length	4' X 4'		
T — Running Slope	≤ 2%		8.45%
T — Cross Slope	≤ 2%		3.75%
Flare			
F — Within Pedestrian Walk Way	≤ 10%	10.30%	
F — In Parkstrip	≤ 25% or ≥ 2' Wide		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

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CONTRACTOR SIGNATURE **DATE**

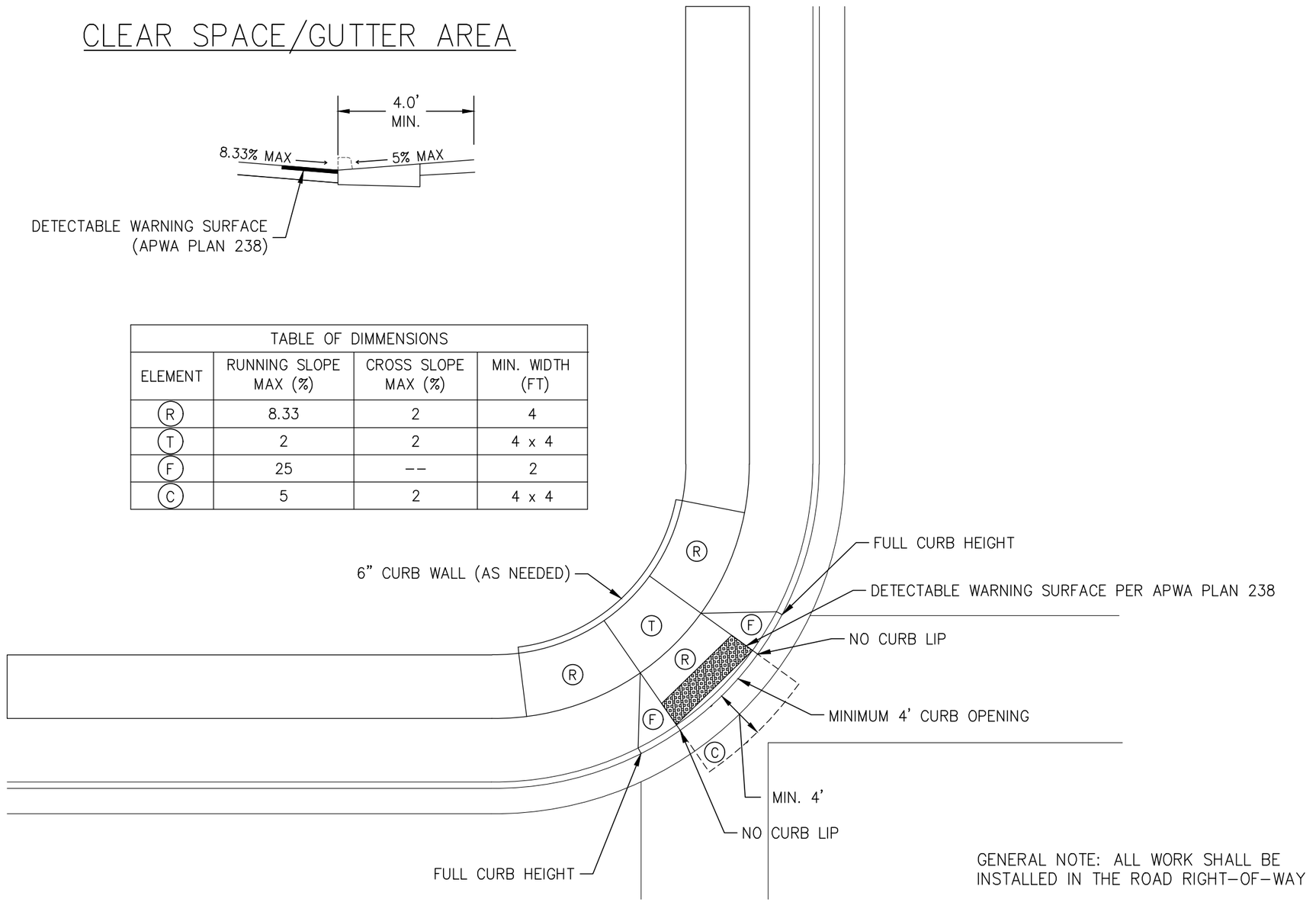
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CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

CALL BLUESTAKES @ 1-800-662-4111 AT LEAST 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

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ENGINEERING DEPARTMENT
ADA Curb Ramps

APEX BIDIRECTIONAL RAMP

D1

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Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY: Eric Didericksen		**DATE:** 8-26-2025	
PROJECT NAME: Rosecrest Inspection		**JOB NUMBER:** 7	
Street Names: Rosecrest Splash Pad		**Orientation:** NW NE (SE) SW MID	
Ramp Area		**CRITERION**	**PASS**	**FAIL**
(R)	Running Slope	≤ 8.33%		10.15%
	Cross Slope	≤ 2%	1.45%	
Clear Space/Gutter Area				
(C)	Min 4' x 4'	Yes	Yes	
	Running Slope (counter slope)	≤ 5%	3.20%	
	Cross Slope	≤ 2%	1.30%	
Tripping Hazards				
	Tripping Hazard at Flow-line	No	no	
	Tripping Hazard at Lip of Gutter	No	no	
	Tripping Hazard at Back of Curb	No		yes
Curb Ramp Opening				
	Minimum Width	4 Feet	yes	
	Detectable Warning Surface Spans Entire Opening	Yes		no
	Detectable Warning Surface Color	Dark Gray		no
Landing/Turning Space				
(T)	Minimum Width by Minimum Length directional	4' X 4'		
	Running Slope	≤ 2%		
	Cross Slope	≤ 2%		
Flare				
(F)	Within Pedestrian Walk Way	≤ 10%		
	In Parkstrip	≤ 25% or ≥ 2' Wide		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

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CONTRACTOR SIGNATURE **DATE**

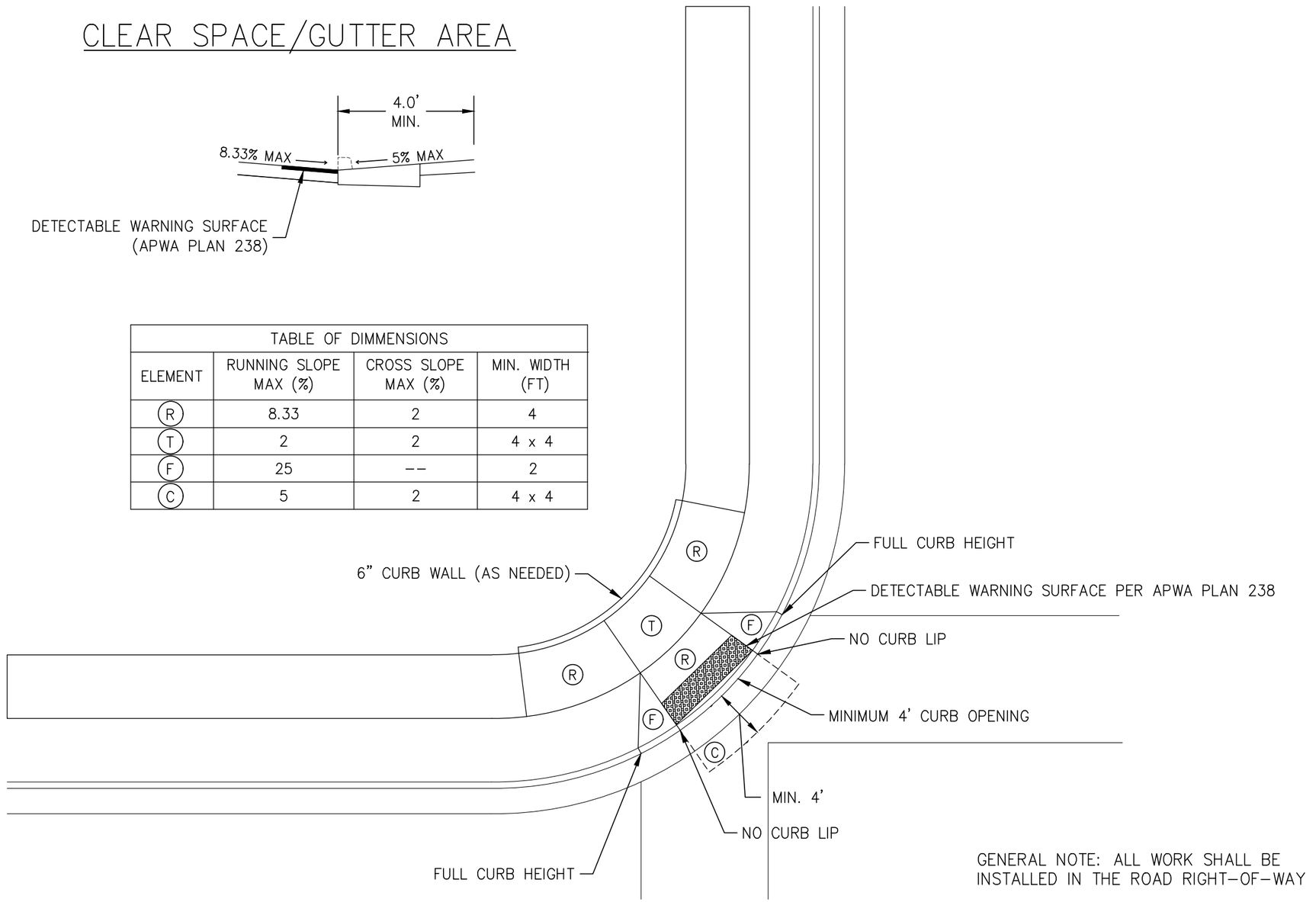
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CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

CALL BLUESTAKES @ 1-800-662-4111 AT LEAST 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

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ADA Curb Ramps

APEX BIDIRECTIONAL RAMP

D1

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Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY: Eric Didericksen **DATE:** 8-26-2025

PROJECT NAME: Rosecrest Inspection **JOB NUMBER:** 8

Street Names: Rosecrest Rd Splash Pad **Orientation:** NW (NE) SE SW MID

	CRITERION	PASS	FAIL
Ramp Area			
R Running Slope	≤ 8.33%	1.90%	
R Cross Slope	≤ 2%	1.70%	
Clear Space/Gutter Area			
C Min 4' x 4'	Yes	yes	
C Running Slope (counter slope)	≤ 5%	5.5%	
C Cross Slope	≤ 2%	.25%	
Tripping Hazards			
Tripping Hazard at Flow-line	No	no	
Tripping Hazard at Lip of Gutter	No	no	
Tripping Hazard at Back of Curb	No		yes
Curb Ramp Opening			
Minimum Width	4 Feet	yes	
Detectable Warning Surface Spans Entire Opening	Yes		no
Detectable Warning Surface Color	Dark Gray		no
Landing/Turning Space			
T Minimum Width by Minimum Length directional	4' X 4'		
T Running Slope	≤ 2%		
T Cross Slope	≤ 2%		
Flare			
F Within Pedestrian Walk Way	≤ 10%		
F In Parkstrip	≤ 25% or ≥ 2' Wide		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

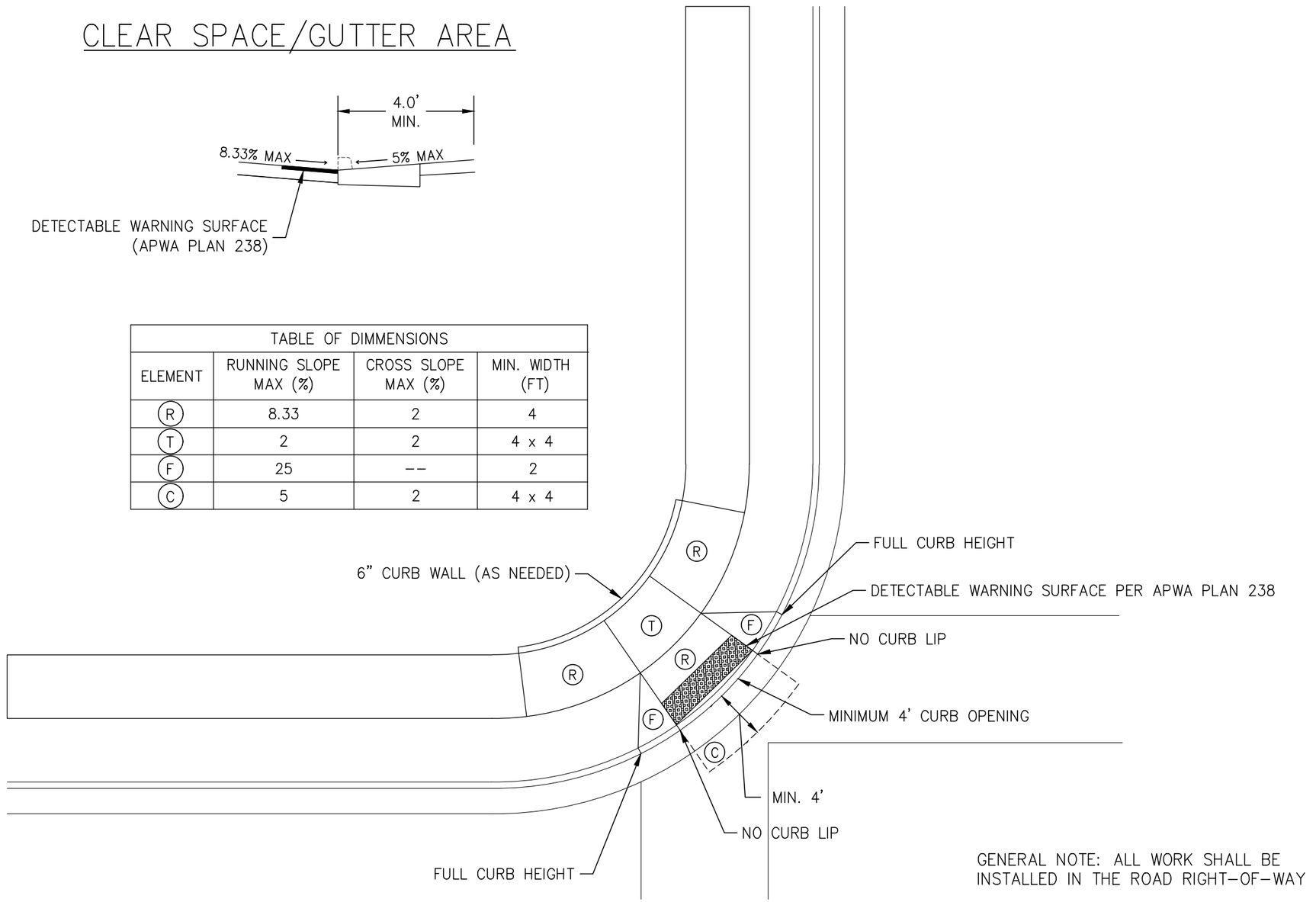
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CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

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APEX BIDIRECTIONAL RAMP

D1

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Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY: Eric Didericksen **DATE:** 8-26-2025
PROJECT NAME: Rosecrest Inspection **JOB NUMBER:** 9

Street Names: Rosecrest Rd. Prospero Ln **Orientation:** NW NE (SE) SW MID

	CRITERION	PASS	FAIL
Ramp Area			
(R) Running Slope	≤ 8.33%	5.20%	
Cross Slope	≤ 2%	2.05%	
Clear Space/Gutter Area			
(C) Min 4' x 4'	Yes	yes	
Running Slope (counter slope)	≤ 5%	3.30%	
Cross Slope	≤ 2%	0.30	
Tripping Hazards			
Tripping Hazard at Flow-line	No	no	
Tripping Hazard at Lip of Gutter	No		yes
Tripping Hazard at Back of Curb	No		yes
Curb Ramp Opening			
Minimum Width	4 Feet	yes	
Detectable Warning Surface Spans Entire Opening	Yes		no
Detectable Warning Surface Color	Dark Gray		no
Landing/Turning Space			
(T) Minimum Width by Minimum Length	4' X 4'		
Running Slope	≤ 2%		5.65%
Cross Slope	≤ 2%		3.45%
Flare			
(F) Within Pedestrian Walk Way	≤ 10%	6.95%	
In Parkstrip	≤ 25% or ≥ 2' Wide		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

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CONTRACTOR SIGNATURE **DATE**

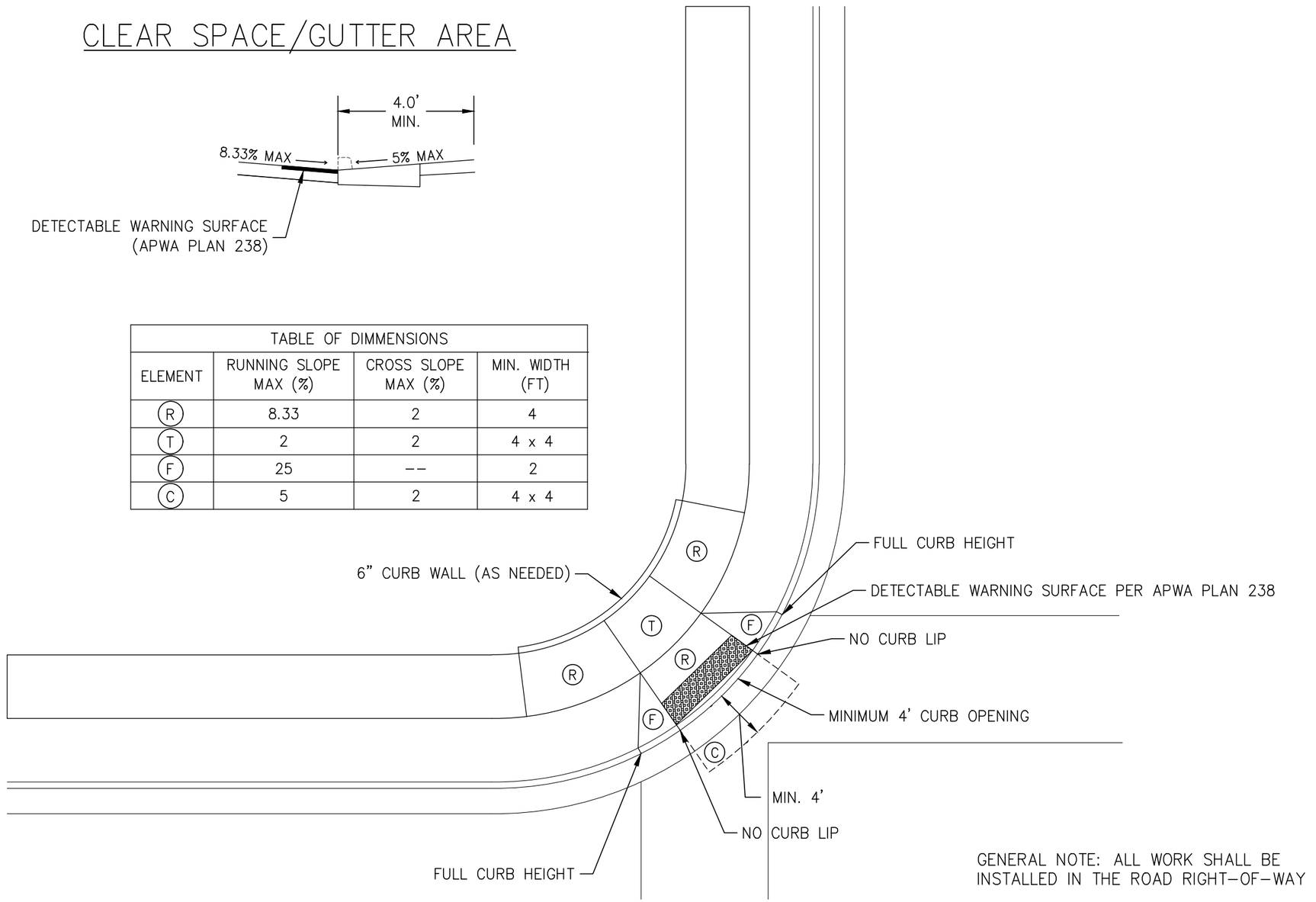
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CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

CALL BLUESTAKES @ 1-800-662-4111 AT LEAST 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

HERRIMAN CITY

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ENGINEERING DEPARTMENT
ADA Curb Ramps

APEX BIDIRECTIONAL RAMP

D1

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Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY: Eric Didericksen **DATE:** 8-26-2025
PROJECT NAME: Rosecrest Inspection **JOB NUMBER:** 10

Street Names: Rosecrest Rd Prospero Ln. **Orientation:** NW NE SE SW MID

	CRITERION	PASS	FAIL
Ramp Area			
R — Running Slope	≤ 8.33%	6.00%	
R — Cross Slope	≤ 2%		2.15%
Clear Space/Gutter Area			
C — Min 4' x 4'	Yes	yes	
C — Running Slope (counter slope)	≤ 5%	3%	
C — Cross Slope	≤ 2%		2.60%
Tripping Hazards			
Tripping Hazard at Flow-line	No	no	
Tripping Hazard at Lip of Gutter	No		yes
Tripping Hazard at Back of Curb	No		yes
Curb Ramp Opening			
Minimum Width	4 Feet	yes	
Detectable Warning Surface Spans Entire Opening	Yes		no
Detectable Warning Surface Color	Dark Gray		no
Landing/Turning Space			
T — Minimum Width by Minimum Length	4' X 4'		
T — Running Slope	≤ 2%		5.40%
T — Cross Slope	≤ 2%		3.55%
Flare			
F — Within Pedestrian Walk Way	≤ 10%	10.50%	
F — In Parkstrip	≤ 25% or ≥ 2' Wide		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

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CONTRACTOR SIGNATURE **DATE**

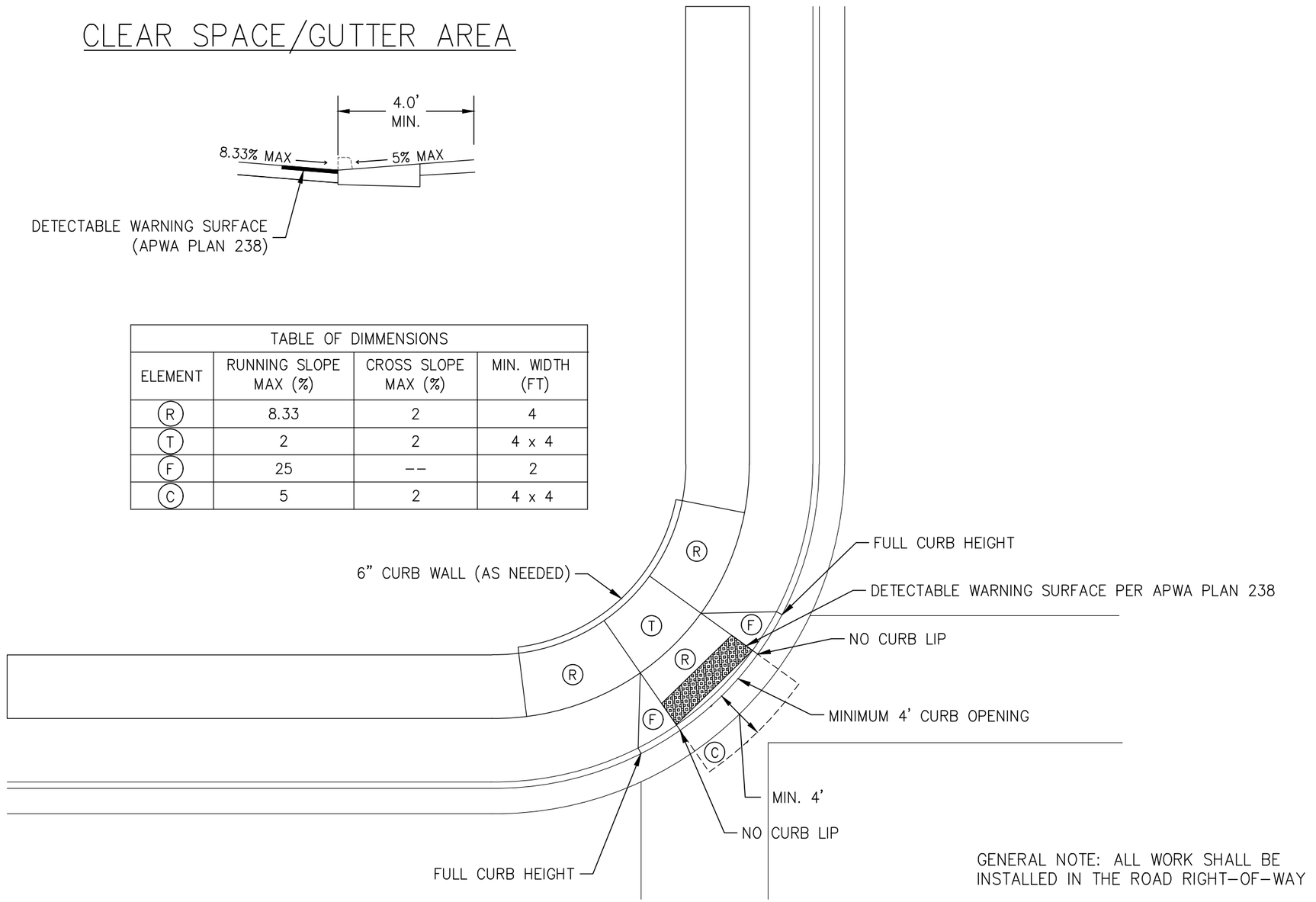
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CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

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HERRIMAN CITY

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ENGINEERING DEPARTMENT
ADA Curb Ramps

APEX BIDIRECTIONAL RAMP

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Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY: Eric Didericksen **DATE:** 8-26-2025
PROJECT NAME: Rosecrest Inspection **JOB NUMBER:** 11

Street Names: Rosecrest Rd Prospero Ln **Orientation:** NW NE SE SW MID

	CRITERION	PASS	FAIL
Ramp Area			
R Running Slope	≤ 8.33%	3.55%	
Cross Slope	≤ 2%		2.25%
Clear Space/Gutter Area			
C Min 4' x 4'	Yes	Yes	
Running Slope (counter slope)	≤ 5%	5.05%%	
Cross Slope	≤ 2%	1.20%	
Tripping Hazards			
Tripping Hazard at Flow-line	No	no	
Tripping Hazard at Lip of Gutter	No		yes
Tripping Hazard at Back of Curb	No		yes
Curb Ramp Opening			
Minimum Width	4 Feet	yes	
Detectable Warning Surface Spans Entire Opening	Yes		no
Detectable Warning Surface Color	Dark Gray		no
Landing/Turning Space			
T Minimum Width by Minimum Length	4' X 4'	yes	
Running Slope	≤ 2%		2.40%
Cross Slope	≤ 2%		2.50%
Flare			
F Within Pedestrian Walk Way	≤ 10%	6.80%	
In Parkstrip	≤ 25% or ≥ 2' Wide		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

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CONTRACTOR SIGNATURE **DATE**

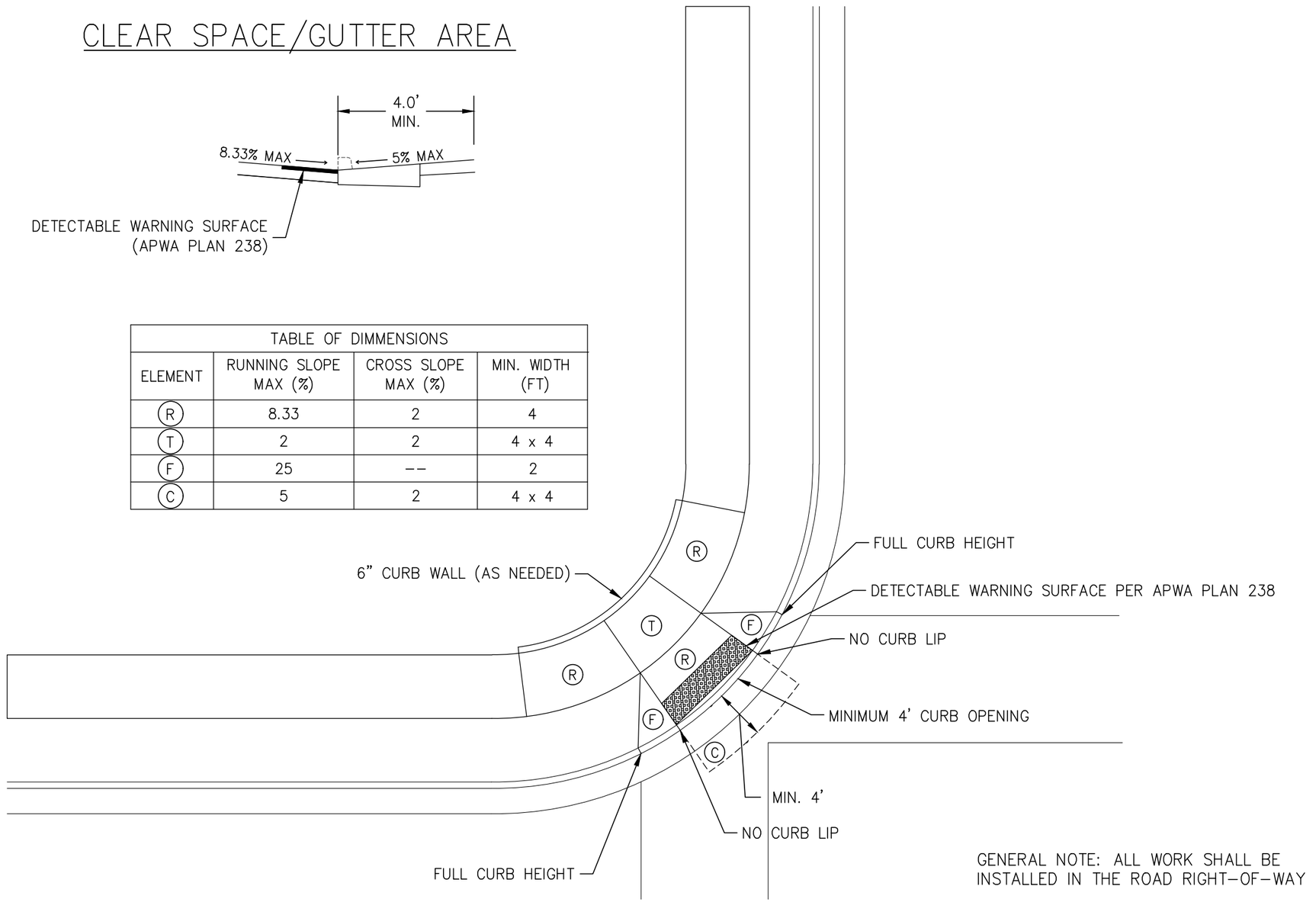
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CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

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ADA Curb Ramps

APEX BIDIRECTIONAL RAMP

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Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY:	Eric Didericksen	**DATE:**	8-26-2025
PROJECT NAME:	Rosecrest Inspection	**JOB NUMBER:**	12

Street Names:	Rosecrest Rd Prospero Ln	**Orientation:**	(NW) NE SE SW MID

	CRITERION	**PASS**	**FAIL**
Ramp Area			
R — Running Slope	≤ 8.33%	5.85%	
Cross Slope	≤ 2%		2.60%
Clear Space/Gutter Area			
C — Min 4' x 4'	Yes	yes	
Running Slope (counter slope)	≤ 5%		6.60%
Cross Slope	≤ 2%		2.36%
Tripping Hazards			
Tripping Hazard at Flow-line	No	no	
Tripping Hazard at Lip of Gutter	No		yes
Tripping Hazard at Back of Curb	No		yes
Curb Ramp Opening			
Minimum Width	4 Feet	yes	
Detectable Warning Surface Spans Entire Opening	Yes		no
Detectable Warning Surface Color	Dark Gray		no
Landing/Turning Space			
T — Minimum Width by Minimum Length	4' X 4'	yes	
Running Slope	≤ 2%		6.35%
Cross Slope	≤ 2%		3.75%
Flare			
F — Within Pedestrian Walk Way	≤ 10%		
In Parkstrip	≤ 25% or ≥ 2' Wide		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

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CONTRACTOR SIGNATURE **DATE**

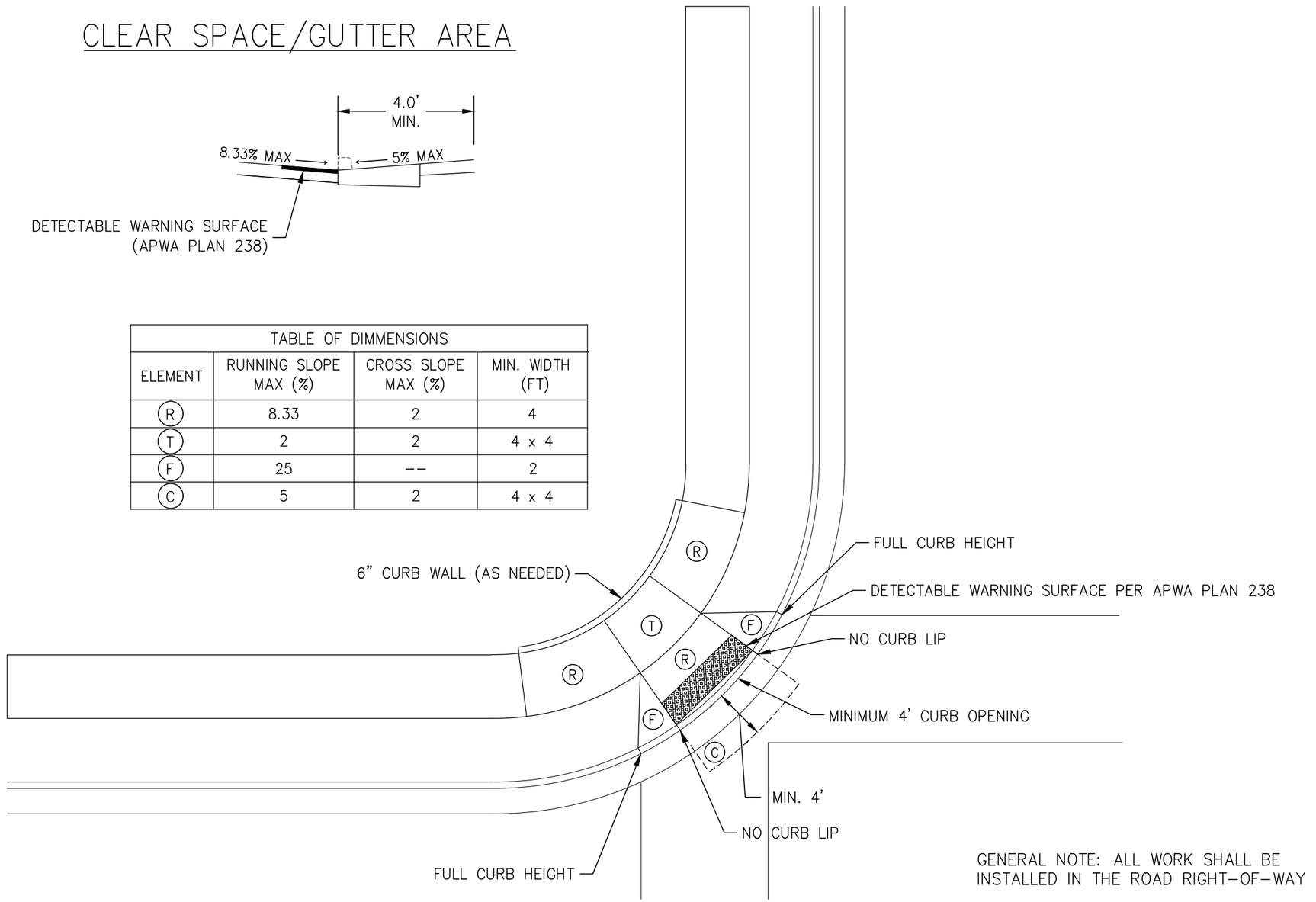
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CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

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APEX BIDIRECTIONAL RAMP

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Herriman Roads
Find address or place
Replace
40' waterway
10' highback
Replace
23
Replace
22
21
Replace
replace 40'
existing curb-cut
with high back
20
19
replace one
section of
sidewalk and
add truncated
domes
10' high back
gutter replacement
Replace
18
17
Replace
Replace
16
14
Replace
Replace
15
13
Replace
12
10
11
9
-112.016 40.502 Degrees
300ft

Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY: Eric Didericksen		**DATE:** 8-26-2025	
PROJECT NAME: Rosecrest Inspection		**JOB NUMBER:** 13	
Street Names: Rosecrest Rd. Callander Dr.		**Orientation:** NW NE (SE) SW MID	
Ramp Area	**CRITERION**	**PASS**	**FAIL**
(R) Running Slope	≤ 8.33%	6.60%	
Cross Slope	≤ 2%		3.05%
Clear Space/Gutter Area			
(C) Min 4' x 4'	Yes	yes	
Running Slope (counter slope)	≤ 5%	3.65%	
Cross Slope	≤ 2%	2.00%	
Tripping Hazards			
Tripping Hazard at Flow-line	No	no	
Tripping Hazard at Lip of Gutter	No		yes
Tripping Hazard at Back of Curb	No	no	
Curb Ramp Opening			
Minimum Width	4 Feet	yes	
Detectable Warning Surface Spans Entire Opening	Yes		no
Detectable Warning Surface Color	Dark Gray		no
Landing/Turning Space			
(T) Minimum Width by Minimum Length	4' X 4'	yes	
Running Slope	≤ 2%		4.85%
Cross Slope	≤ 2%		3.20%
Flare			
(F) Within Pedestrian Walk Way	≤ 10%		
In Parkstrip	≤ 25% or ≥ 2' Wide		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

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CONTRACTOR SIGNATURE **DATE**

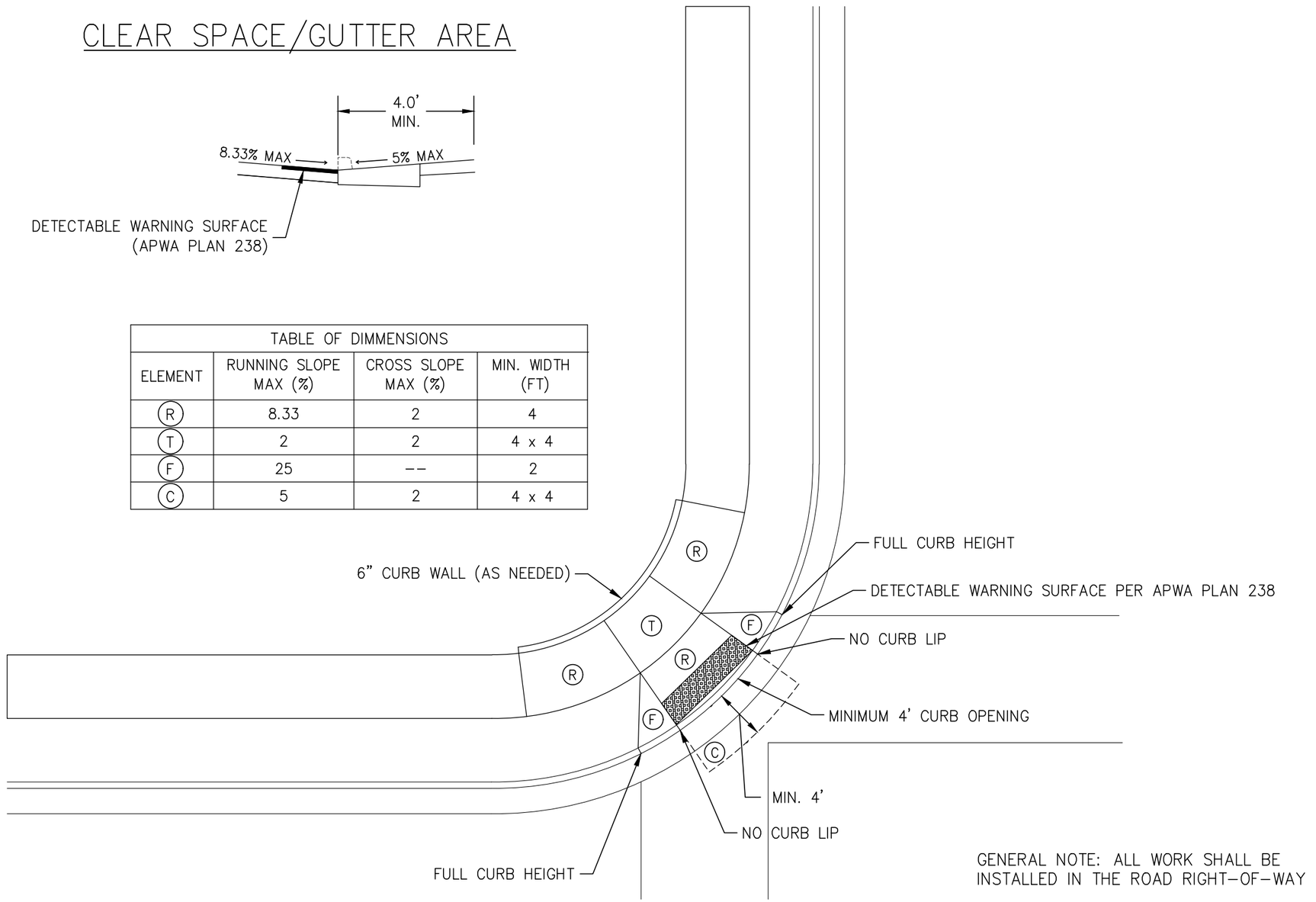
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CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

CALL BLUESTAKES @ 1-800-662-4111 AT LEAST 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

HERRIMAN CITY

HERRIMAN CITY
ENGINEERING DEPARTMENT
ADA Curb Ramps

APEX BIDIRECTIONAL RAMP

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Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY:	Eric Didericksen	**DATE:**	8-26-2025
PROJECT NAME:	Rosecrest Inspection	**JOB NUMBER:**	14

Street Names:	Rosecrest Rd. Callender Dr.	**Orientation:**	NW (NE) SE SW MID	
Ramp Area		**CRITERION**	**PASS**	**FAIL**
R	Running Slope	≤ 8.33%	3.05%	
	Cross Slope	≤ 2%	.75%	
Clear Space/Gutter Area				
C	Min 4' x 4'	Yes	yes	
	Running Slope (counter slope)	≤ 5%		9.00%
	Cross Slope	≤ 2%	0.25%	
Tripping Hazards				
	Tripping Hazard at Flow-line	No	no	
	Tripping Hazard at Lip of Gutter	No	no	
	Tripping Hazard at Back of Curb	No	no	
Curb Ramp Opening				
	Minimum Width	4 Feet	yes	
	Detectable Warning Surface Spans Entire Opening	Yes		no
	Detectable Warning Surface Color	Dark Gray		no
Landing/Turning Space				
T	Minimum Width by Minimum Length	4' X 4'	yes	
	Running Slope	≤ 2%		2.85%
	Cross Slope	≤ 2%		2.25%
Flare				
F	Within Pedestrian Walk Way	≤ 10%		
	In Parkstrip	≤ 25% or ≥ 2' Wide		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

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CONTRACTOR SIGNATURE **DATE**

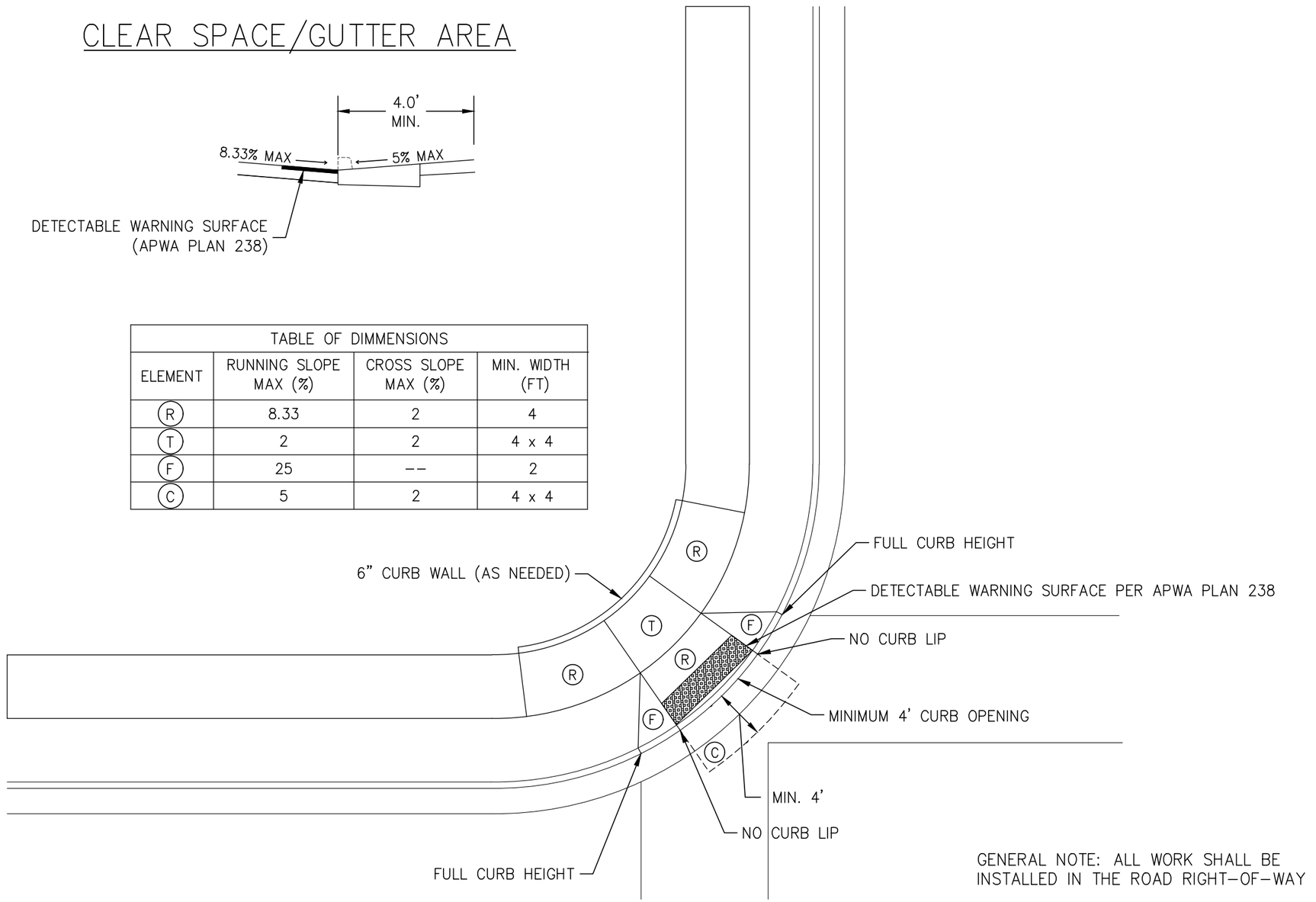
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CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

CALL BLUESTAKES @ 1-800-662-4111 AT LEAST 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

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ADA Curb Ramps

APEX BIDIRECTIONAL RAMP

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Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY: Eric Didericksen **DATE:** 8-26-2025
PROJECT NAME: Rosecrest Inspection **JOB NUMBER:** 15

Street Names: Rosecrest Rd. Callander Dr **Orientation:** NW NE SE SW MID

	CRITERION	PASS	FAIL
Ramp Area			
R Running Slope	≤ 8.33%	5.85%	
Cross Slope	≤ 2%		2.60%
Clear Space/Gutter Area			
C Min 4' x 4'	Yes	yes	
Running Slope (counter slope)	≤ 5%	5.05%	
Cross Slope	≤ 2%		3.65%
Tripping Hazards			
Tripping Hazard at Flow-line	No	no	
Tripping Hazard at Lip of Gutter	No		yes
Tripping Hazard at Back of Curb	No		yes
Curb Ramp Opening			
Minimum Width	4 Feet	yes	
Detectable Warning Surface Spans Entire Opening	Yes		no
Detectable Warning Surface Color	Dark Gray		no
Landing/Turning Space			
T Minimum Width by Minimum Length	4' X 4'	yes	
Running Slope	≤ 2%		2.50%
Cross Slope	≤ 2%		4.50%
Flare			
F Within Pedestrian Walk Way	≤ 10%		
In Parkstrip	≤ 25% or ≥ 2' Wide		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

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CONTRACTOR SIGNATURE **DATE**

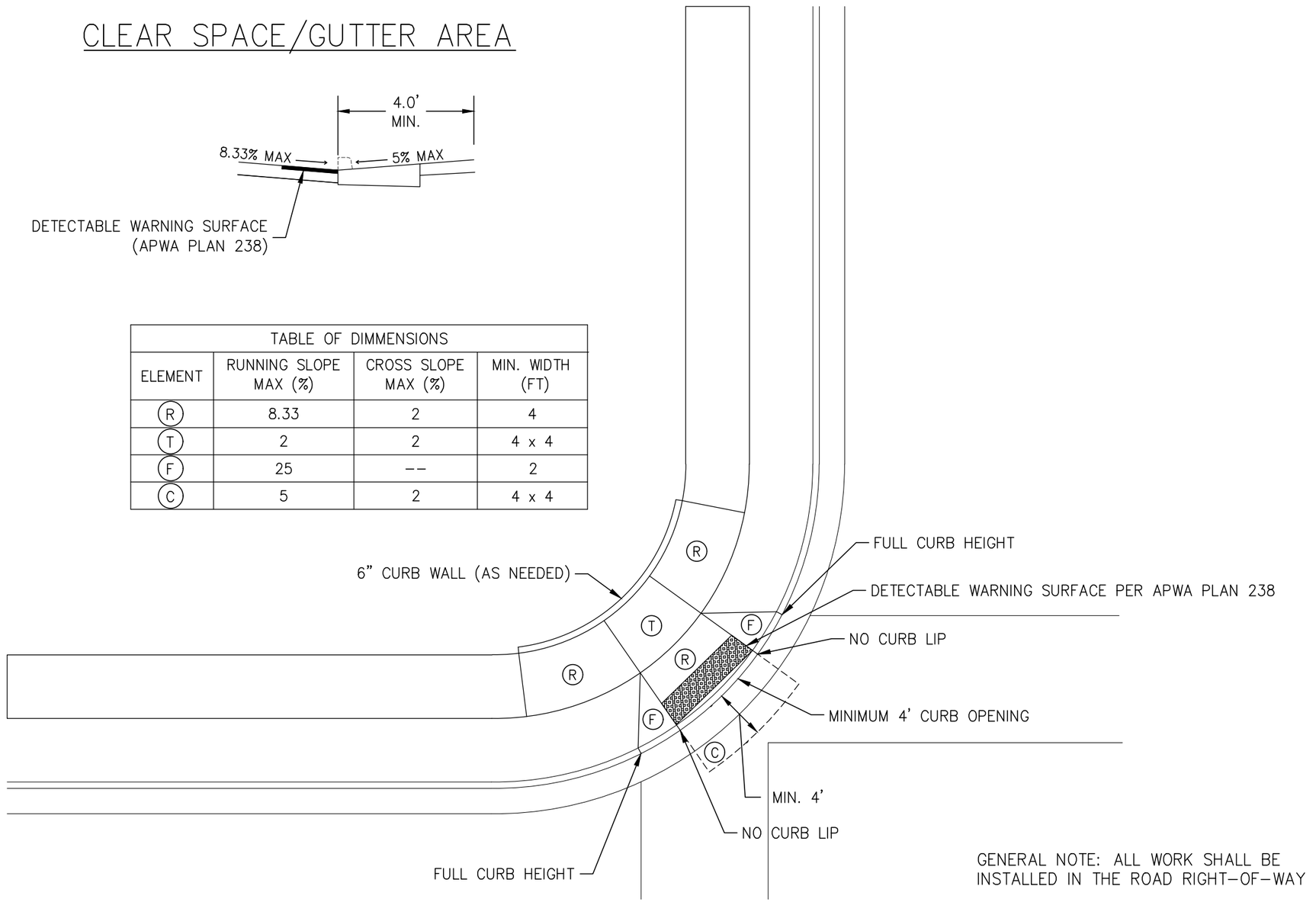
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CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

CALL BLUESTAKES @ 1-800-662-4111 AT LEAST 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

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ENGINEERING DEPARTMENT
ADA Curb Ramps

APEX BIDIRECTIONAL RAMP

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Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY: Eric Didericksen		**DATE:** 8-26-2025	
PROJECT NAME: Rosecrest Inspection		**JOB NUMBER:** 16	
Street Names: Rosecrest Rd. Callander Dr		**Orientation:** (NW) NE SE SW MID	
Ramp Area	**CRITERION**	**PASS**	**FAIL**
(R) Running Slope	**≤ 8.33%**	6.00%	
Cross Slope	**≤ 2%**	1.00%	
Clear Space/Gutter Area			
(C) Min 4' x 4'	**Yes**	yes	
Running Slope (counter slope)	**≤ 5%**		6.55%
Cross Slope	**≤ 2%**	1.00%	
Tripping Hazards			
Tripping Hazard at Flow-line	**No**	no	
Tripping Hazard at Lip of Gutter	**No**		yes
Tripping Hazard at Back of Curb	**No**		yes
Curb Ramp Opening			
Minimum Width	**4 Feet**	yes	
Detectable Warning Surface Spans Entire Opening	**Yes**		no
Detectable Warning Surface Color	**Dark Gray**		no
Landing/Turning Space			
(T) Minimum Width by Minimum Length	**4' X 4'**	yes	
Running Slope	**≤ 2%**		4.15%
Cross Slope	**≤ 2%**	1.20%	
Flare			
(F) Within Pedestrian Walk Way	**≤ 10%**		
In Parkstrip	**≤ 25% or ≥ 2' Wide**		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

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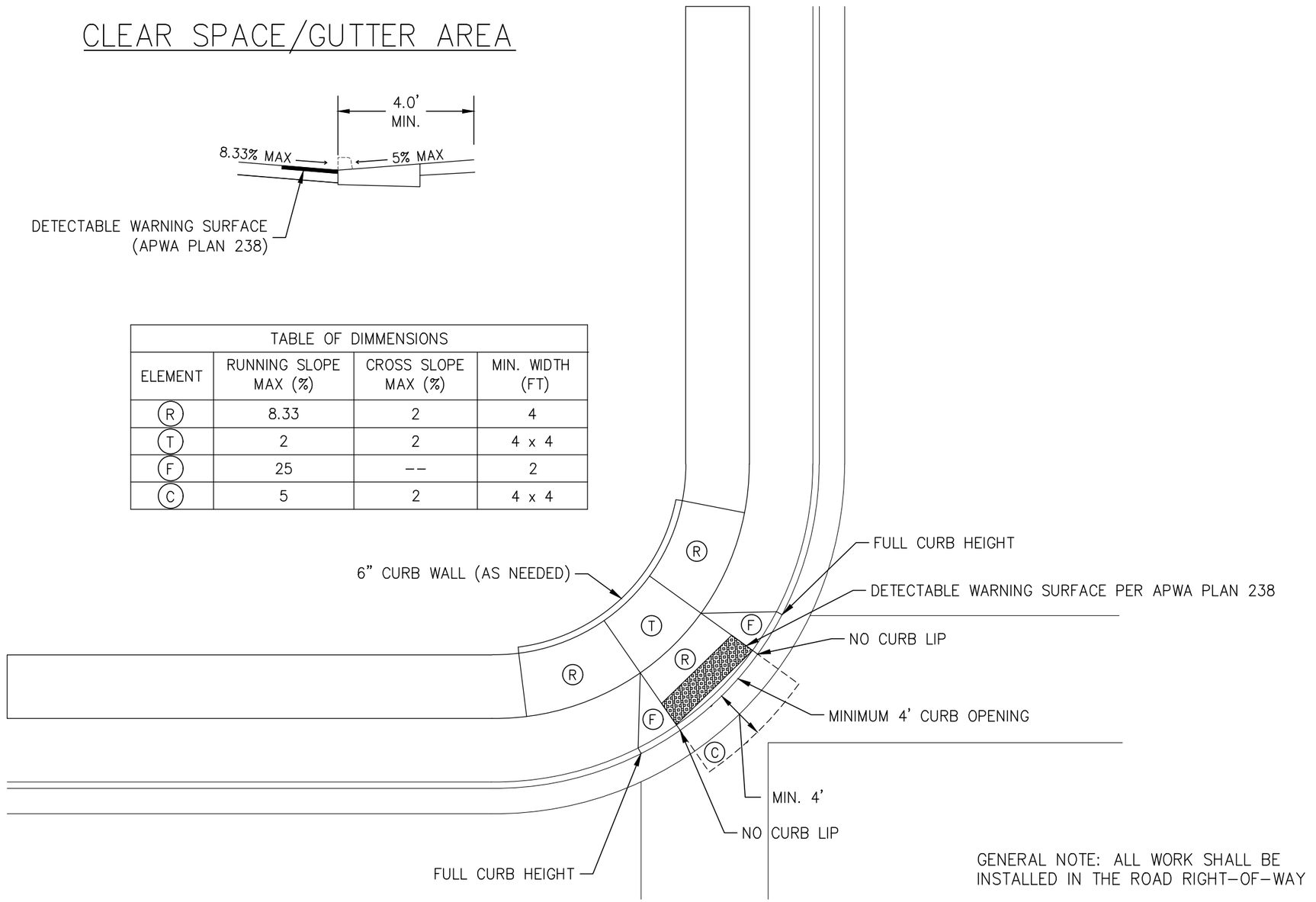
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CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

CALL BLUESTAKES @ 1-800-662-4111 AT LEAST 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

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ADA Curb Ramps

APEX BIDIRECTIONAL RAMP

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Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY: Eric Didericksen **DATE:** 8-27-2025

PROJECT NAME: Rosecrest Inspection **JOB NUMBER:** 17

Street Names: Rosecrest Rd. Midblock x-ing East **Orientation:** NW NE SE SW (MID)

	CRITERION	PASS	FAIL
Ramp Area			
R — Running Slope	≤ 8.33%		9.95%
Cross Slope	≤ 2%	1.55%	
Clear Space/Gutter Area			
C — Min 4' x 4'	Yes		
Running Slope (counter slope)	≤ 5%		6.60%
Cross Slope	≤ 2%	2.25%	
Tripping Hazards			
Tripping Hazard at Flow-line	No		yes
Tripping Hazard at Lip of Gutter	No		yes
Tripping Hazard at Back of Curb	No	no	
Curb Ramp Opening			
Minimum Width	4 Feet	yes	
Detectable Warning Surface Spans Entire Opening	Yes	yes	
Detectable Warning Surface Color	Dark Gray	yes	
Landing/Turning Space			
T — Minimum Width by Minimum Length	4' X 4'	yes	
Running Slope	≤ 2%	1.55%	
Cross Slope	≤ 2%	2.05%	
Flare			
F — Within Pedestrian Walk Way	≤ 10%		
In Parkstrip	≤ 25% or ≥ 2' Wide		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

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CONTRACTOR SIGNATURE **DATE**

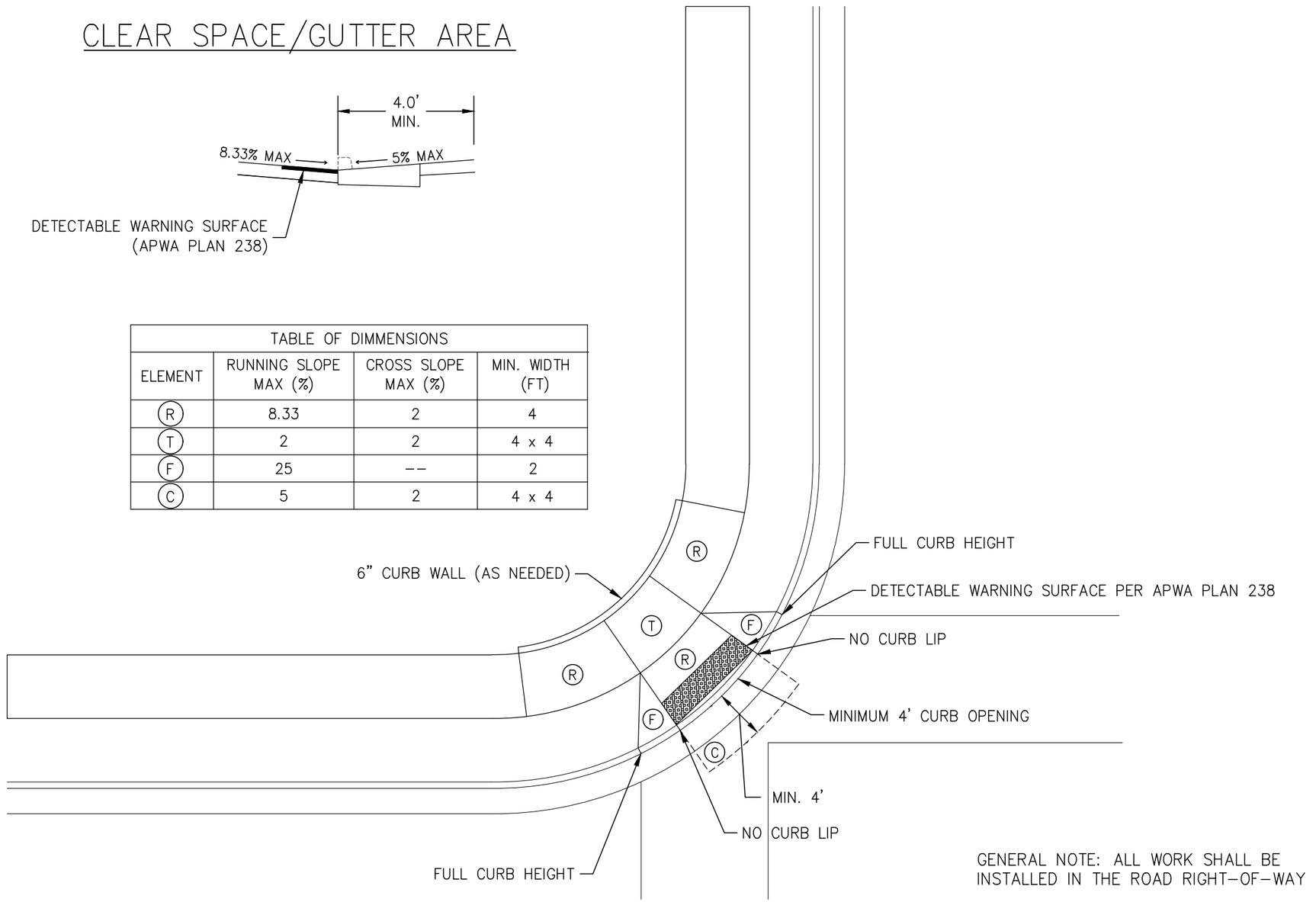
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CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

CALL BLUESTAKES @ 1-800-662-4111 AT LEAST 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

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APEX BIDIRECTIONAL RAMP

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Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY: Eric Didericksen **DATE:** 8-27-2025

PROJECT NAME: Rosecrest Inspection **JOB NUMBER:** 18

Street Names: Rosecrest Rd. Midblock x-ing West **Orientation:** NW NE SE SW (MID)

	CRITERION	PASS	FAIL
Ramp Area			
R — Running Slope	≤ 8.33%		9.50%
Cross Slope	≤ 2%	1.55%	
Clear Space/Gutter Area			
C — Min 4' x 4'	Yes		
Running Slope (counter slope)	≤ 5%		7.65%
Cross Slope	≤ 2%	2.25%	
Tripping Hazards			
Tripping Hazard at Flow-line	No		Yes
Tripping Hazard at Lip of Gutter	No		Yes
Tripping Hazard at Back of Curb	No	no	
Curb Ramp Opening			
Minimum Width	4 Feet	yes	
Detectable Warning Surface Spans Entire Opening	Yes	yes	
Detectable Warning Surface Color	Dark Gray	yes	
Landing/Turning Space			
T — Minimum Width by Minimum Length	4' X 4'	yes	
Running Slope	≤ 2%	1.10%	
Cross Slope	≤ 2%	2.05%	
Flare			
F — Within Pedestrian Walk Way	≤ 10%		
In Parkstrip	≤ 25% or ≥ 2' Wide		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

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CONTRACTOR SIGNATURE **DATE**

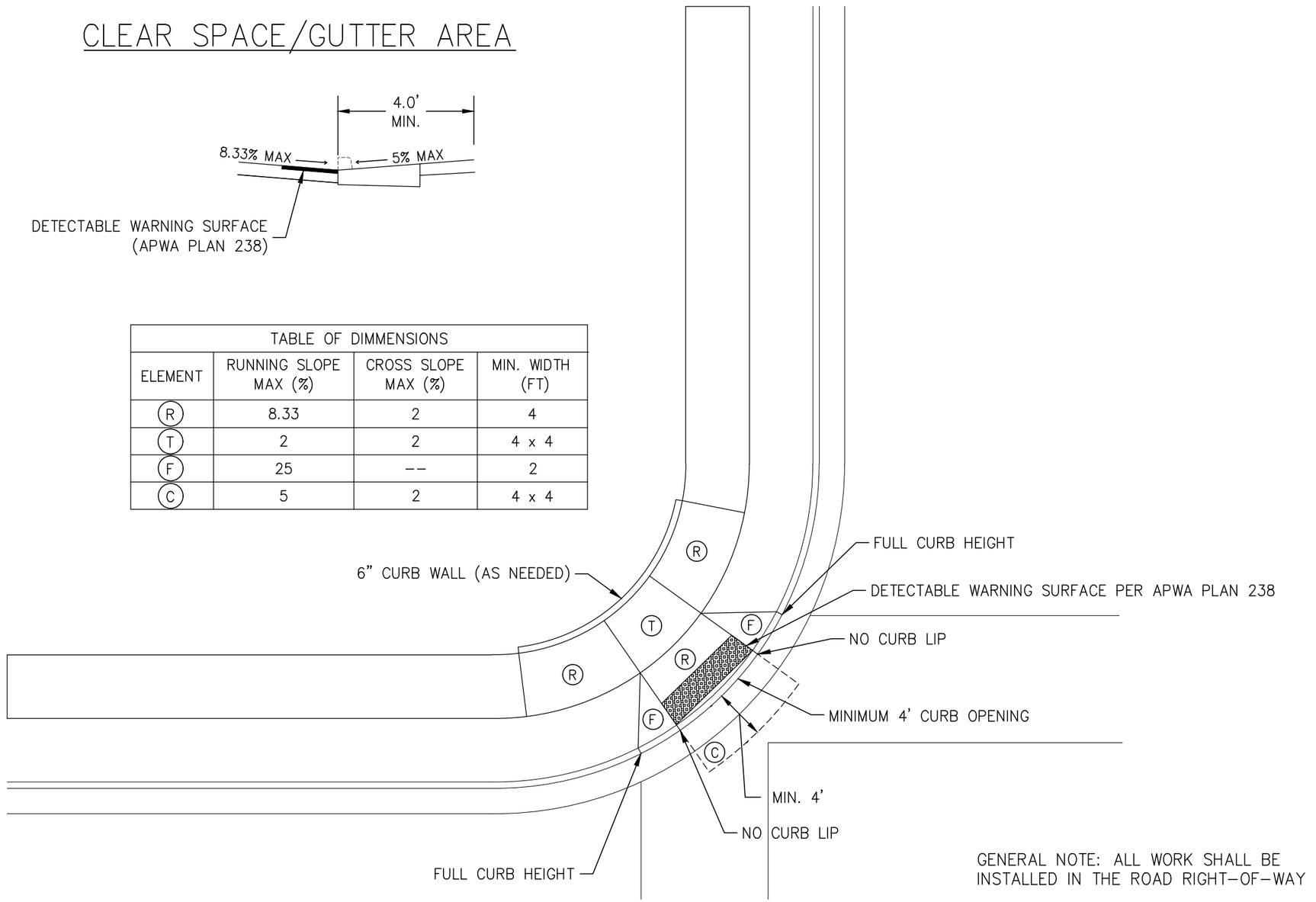
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CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

CALL BLUESTAKES @ 1-800-662-4111 AT LEAST 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

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Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY: Eric Didericksen		**DATE:** 8-27-2025	
PROJECT NAME: Rosecrest Inspection		**JOB NUMBER:** 19	
Street Names: Rosecrest Park Entrance		**Orientation:** NW NE SE **SW** MID	
Ramp Area	**CRITERION**	**PASS**	**FAIL**
(R) Running Slope	≤ 8.33%		
Cross Slope	≤ 2%		
Clear Space/Gutter Area			
(C) Min 4' x 4'	Yes		
Running Slope (counter slope)	≤ 5%		
Cross Slope	≤ 2%		
Tripping Hazards			
Tripping Hazard at Flow-line	No		
Tripping Hazard at Lip of Gutter	No		
Tripping Hazard at Back of Curb	No		
Curb Ramp Opening			
Minimum Width	4 Feet		
Detectable Warning Surface Spans Entire Opening	Yes		
Detectable Warning Surface Color	Dark Gray		
Landing/Turning Space			
(T) Minimum Width by Minimum Length	4' X 4'		
Running Slope	≤ 2%		
Cross Slope	≤ 2%		
Flare			
(F) Within Pedestrian Walk Way	≤ 10%		
In Parkstrip	≤ 25% or ≥ 2' Wide		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

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CONTRACTOR SIGNATURE **DATE**

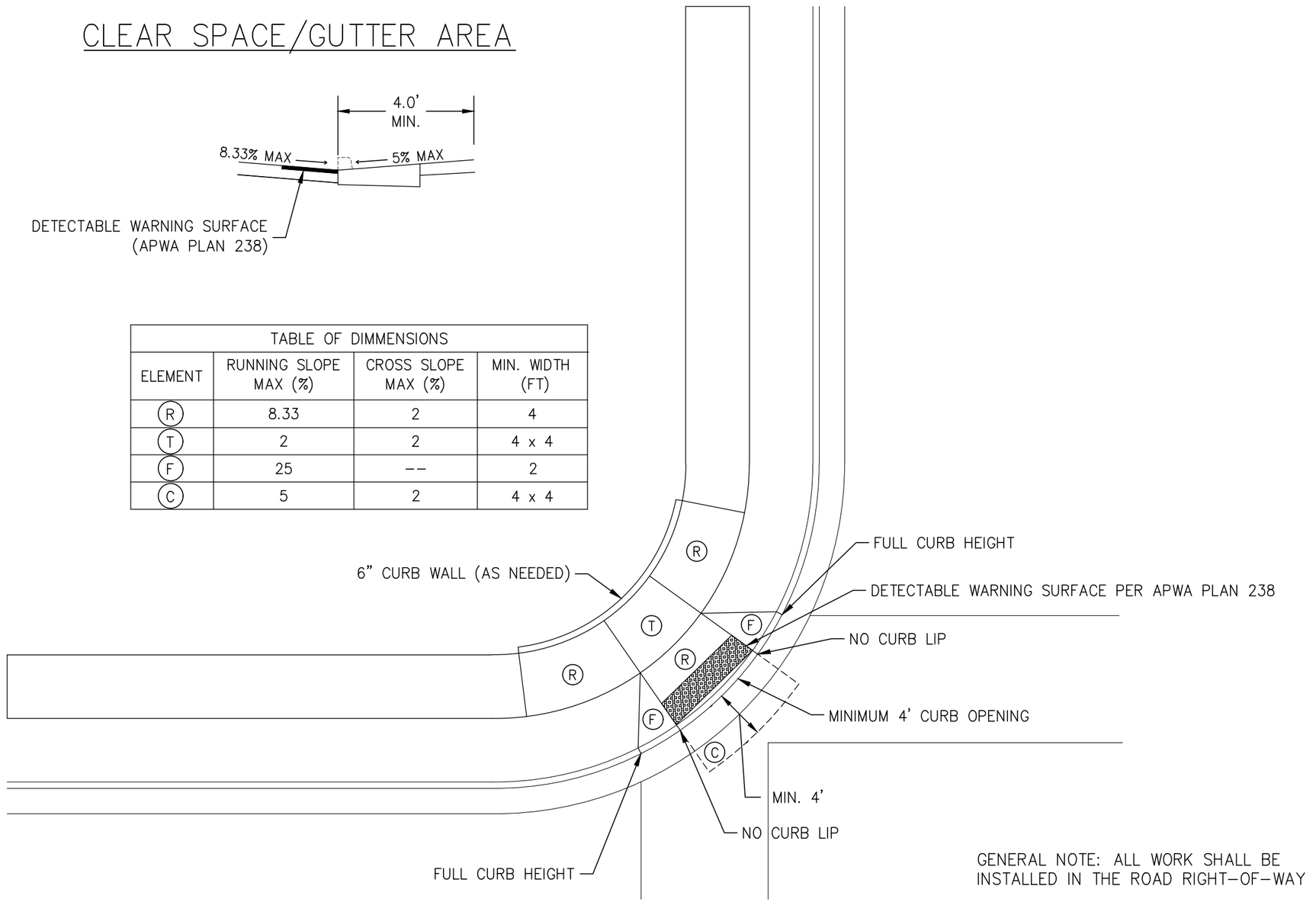
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CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

CALL BLUESTAKES @ 1-800-662-4111 AT LEAST 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

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APEX BIDIRECTIONAL RAMP

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Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY: Eric Didericksen		**DATE:** 8-27-2025	
PROJECT NAME: Rosecrest Inspection		**JOB NUMBER:** 20	
Street Names: Rosecrest Park Entrance		**Orientation:** (NW) NE SE SW MID	
Ramp Area		**CRITERION**	**PASS**	**FAIL**
R	Running Slope	≤ 8.33%		
	Cross Slope	≤ 2%		
Clear Space/Gutter Area				
C	Min 4' x 4'	Yes		
	Running Slope (counter slope)	≤ 5%		
	Cross Slope	≤ 2%		
Tripping Hazards				
	Tripping Hazard at Flow-line	No		
	Tripping Hazard at Lip of Gutter	No		
	Tripping Hazard at Back of Curb	No		
Curb Ramp Opening				
	Minimum Width	4 Feet		
	Detectable Warning Surface Spans Entire Opening	Yes		
	Detectable Warning Surface Color	Dark Gray		
Landing/Turning Space				
T	Minimum Width by Minimum Length	4' X 4'		
	Running Slope	≤ 2%		
	Cross Slope	≤ 2%		
Flare				
F	Within Pedestrian Walk Way	≤ 10%		
	In Parkstrip	≤ 25% or ≥ 2' Wide		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

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CONTRACTOR SIGNATURE **DATE**

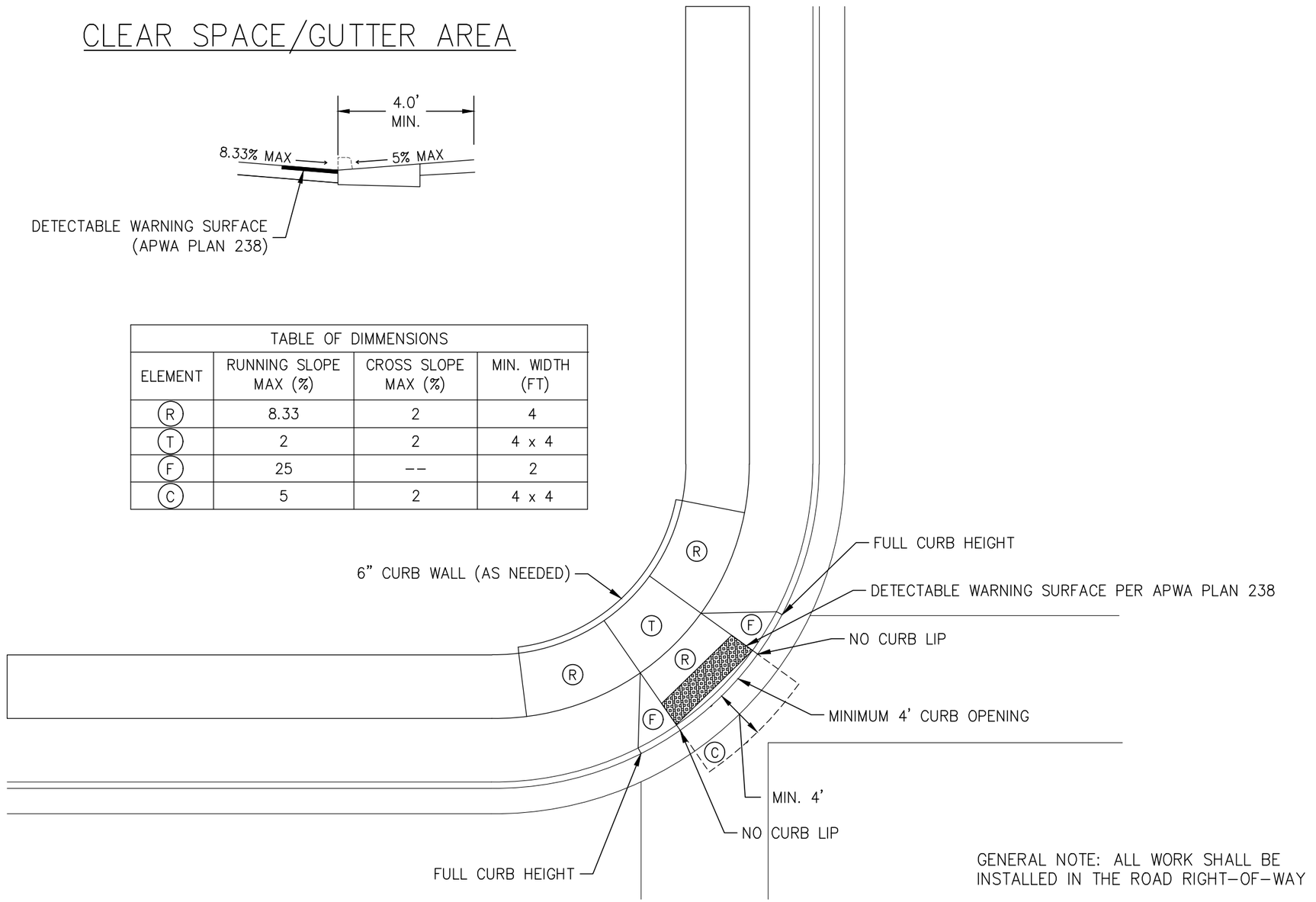
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CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

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APEX BIDIRECTIONAL RAMP

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Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY: Eric Didericksen **DATE:** 8-27-2025

PROJECT NAME: Rosecrest Inspection **JOB NUMBER:** 21

Street Names: Rosecrest Rd Rocky Point Dr. **Orientation:** NW NE (SE) SW MID

	CRITERION	PASS	FAIL
Ramp Area			
R — Running Slope	≤ 8.33%	4.85%	
R — Cross Slope	≤ 2%		4.10%
Clear Space/Gutter Area			
C — Min 4' x 4'	Yes	Yes	
C — Running Slope (counter slope)	≤ 5%		8.80%
C — Cross Slope	≤ 2%		2.95%
Tripping Hazards			
Tripping Hazard at Flow-line	No	no	
Tripping Hazard at Lip of Gutter	No		yes
Tripping Hazard at Back of Curb	No		yes
Curb Ramp Opening			
Minimum Width	4 Feet	yes	
Detectable Warning Surface Spans Entire Opening	Yes		no
Detectable Warning Surface Color	Dark Gray		no
Landing/Turning Space			
T — Minimum Width by Minimum Length	4' X 4'	yes	
T — Running Slope	≤ 2%		4.85%
T — Cross Slope	≤ 2%	1.35%	
Flare			
F — Within Pedestrian Walk Way	≤ 10%		
F — In Parkstrip	≤ 25% or ≥ 2' Wide		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

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CONTRACTOR SIGNATURE **DATE**

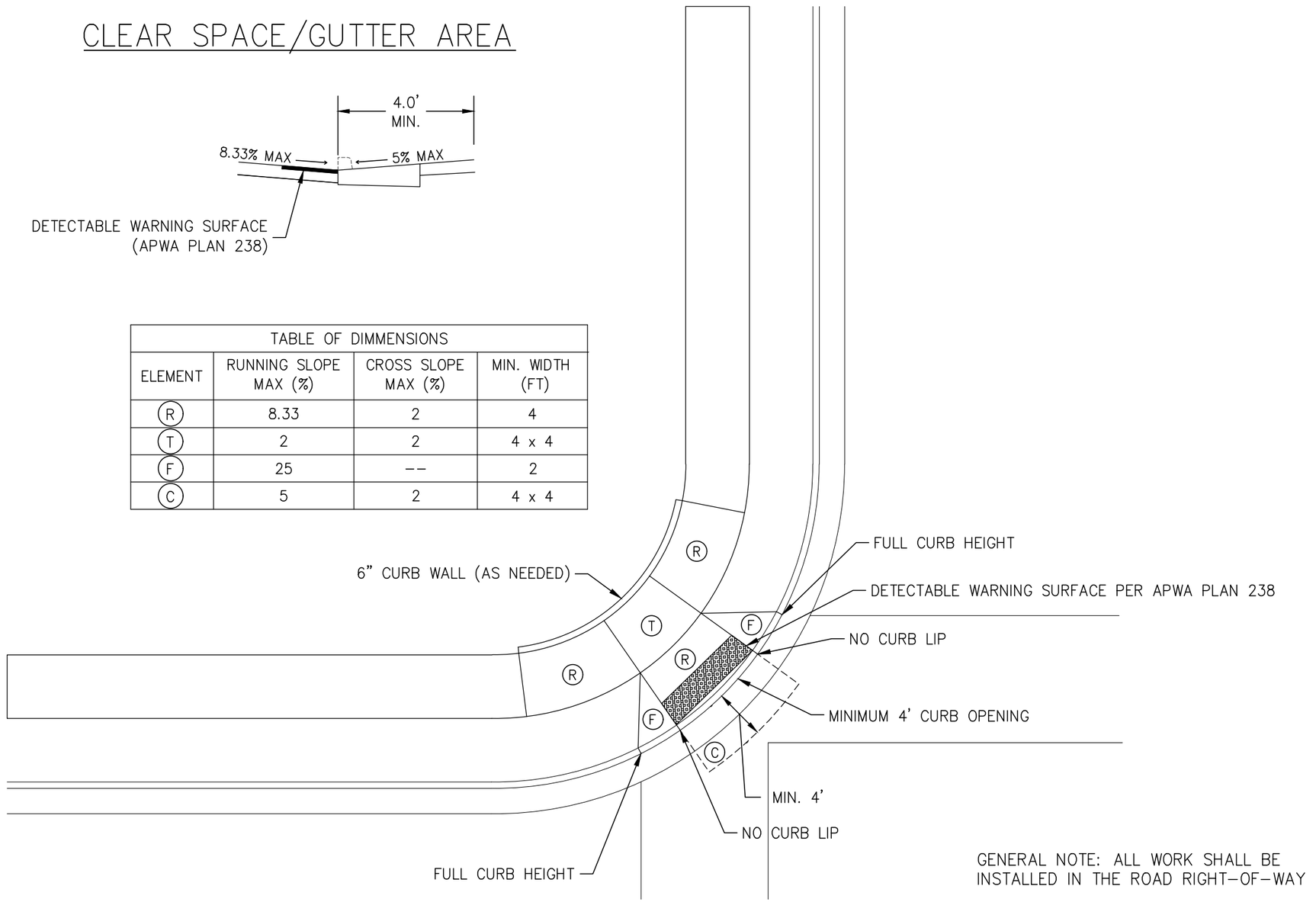
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CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

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APEX BIDIRECTIONAL RAMP

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Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY: Eric Didericksen		**DATE:** 8-27-2025	
PROJECT NAME: Rosecrest Inspection		**JOB NUMBER:** 22	
Street Names: Rosecrest Rd. High Spirit Ct.		**Orientation:** NW NE SE **SW** MID	
Ramp Area	**CRITERION**	**PASS**	**FAIL**
R — Running Slope	≤ 8.33%	6.20%	
Cross Slope	≤ 2%	0.25%	
Clear Space/Gutter Area			
C — Min 4' x 4'	Yes	yes	
Running Slope (counter slope)	≤ 5%		9.95%
Cross Slope	≤ 2%	.05%	
Tripping Hazards			
Tripping Hazard at Flow-line	No	no	
Tripping Hazard at Lip of Gutter	No	no	
Tripping Hazard at Back of Curb	No	no	
Curb Ramp Opening			
Minimum Width	4 Feet	yes	
Detectable Warning Surface Spans Entire Opening	Yes		no
Detectable Warning Surface Color	Dark Gray		no
Landing/Turning Space			
T — Minimum Width by Minimum Length	4' X 4'	yes	
Running Slope	≤ 2%		6.10%
Cross Slope	≤ 2%	0.15%	
Flare			
F — Within Pedestrian Walk Way	≤ 10%		
In Parkstrip	≤ 25% or ≥ 2' Wide		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

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CONTRACTOR SIGNATURE **DATE**

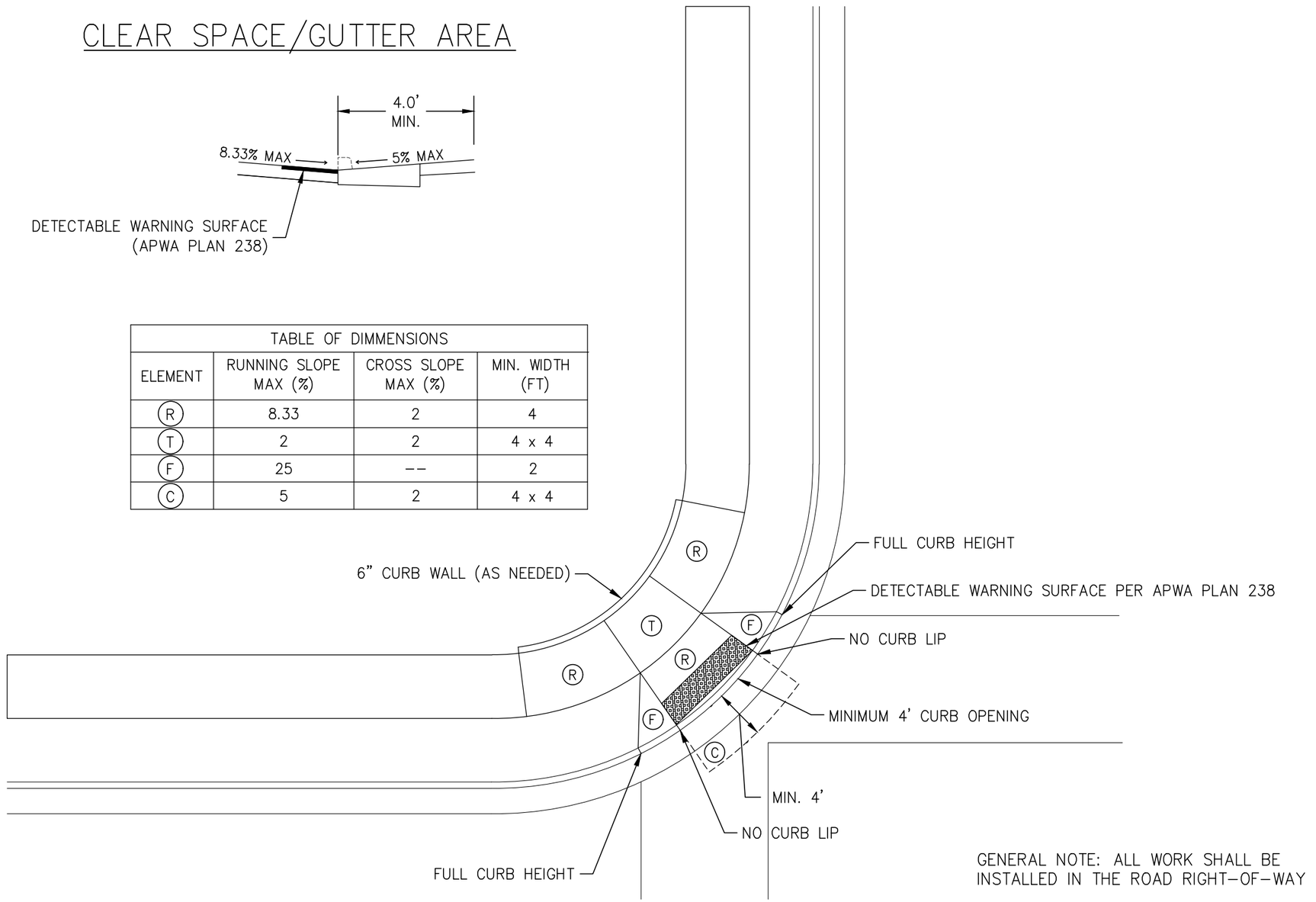
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CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

CALL BLUESTAKES @ 1-800-662-4111 AT LEAST 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

HERRIMAN CITY

HERRIMAN CITY
ENGINEERING DEPARTMENT
ADA Curb Ramps

APEX BIDIRECTIONAL RAMP

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Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY: Eric Didericksen **DATE:** 8-27-2025

PROJECT NAME: Rosecrest Inspection **JOB NUMBER:** 23

Street Names: Rosecrest Rd. High Sririt Ct. **Orientation:** NW NE SE SW MID

	CRITERION	PASS	FAIL
Ramp Area			
(R) Running Slope	≤ 8.33%	5.20%	
Cross Slope	≤ 2%		3.05%
Clear Space/Gutter Area			
(C) Min 4' x 4'	Yes	yes	
Running Slope (counter slope)	≤ 5%		7.65%
Cross Slope	≤ 2%	1.70%	
Tripping Hazards			
Tripping Hazard at Flow-line	No	no	
Tripping Hazard at Lip of Gutter	No		yes
Tripping Hazard at Back of Curb	No	no	
Curb Ramp Opening			
Minimum Width	4 Feet	yes	
Detectable Warning Surface Spans Entire Opening	Yes		no
Detectable Warning Surface Color	Dark Gray		no
Landing/Turning Space			
(T) Minimum Width by Minimum Length	4' X 4'	yes	
Running Slope	≤ 2%		6.35%
Cross Slope	≤ 2%	1.65%	
Flare			
(F) Within Pedestrian Walk Way	≤ 10%		
In Parkstrip	≤ 25% or ≥ 2' Wide		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

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CONTRACTOR SIGNATURE **DATE**

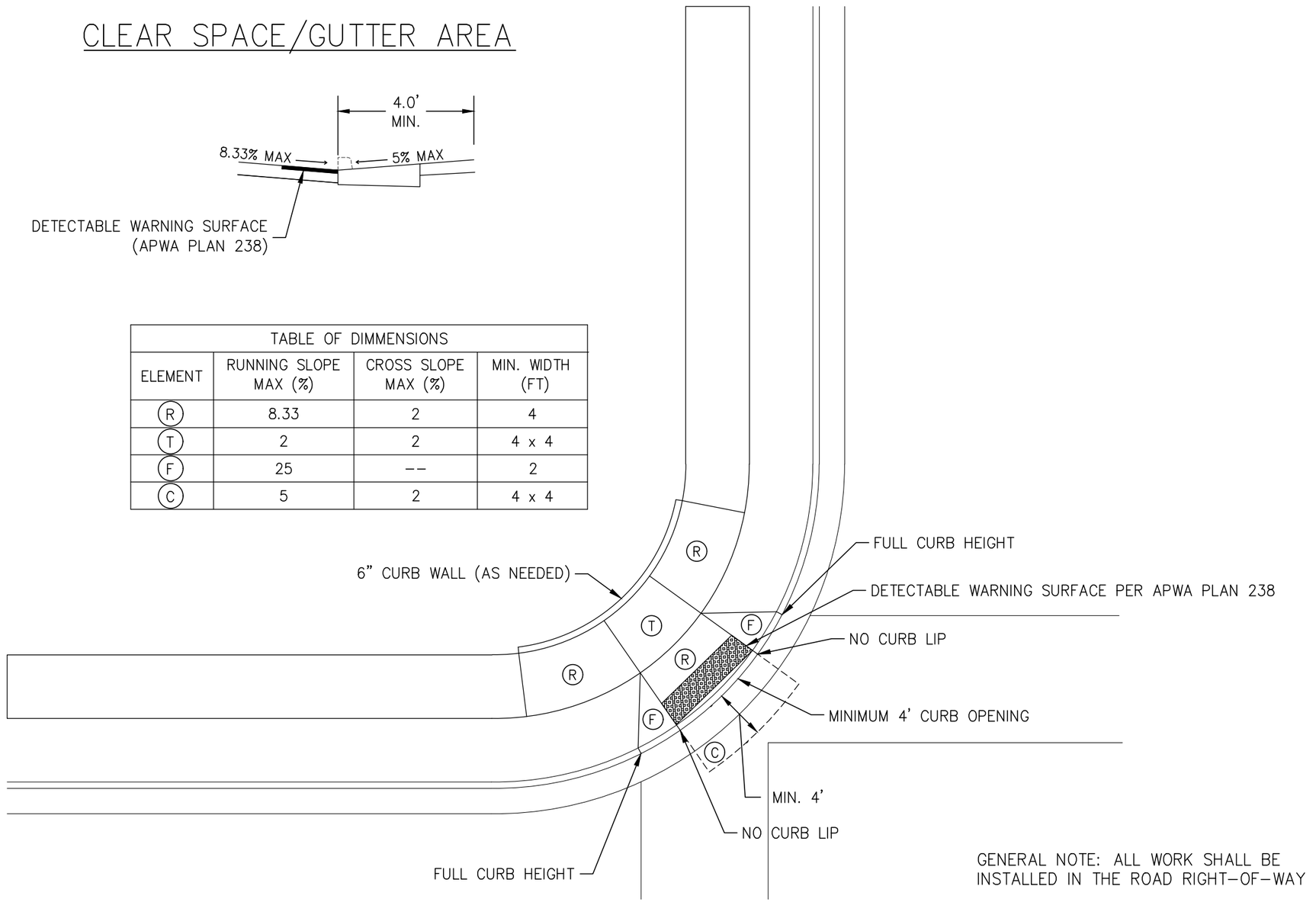
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CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
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PLOT DATE:	8/16/23

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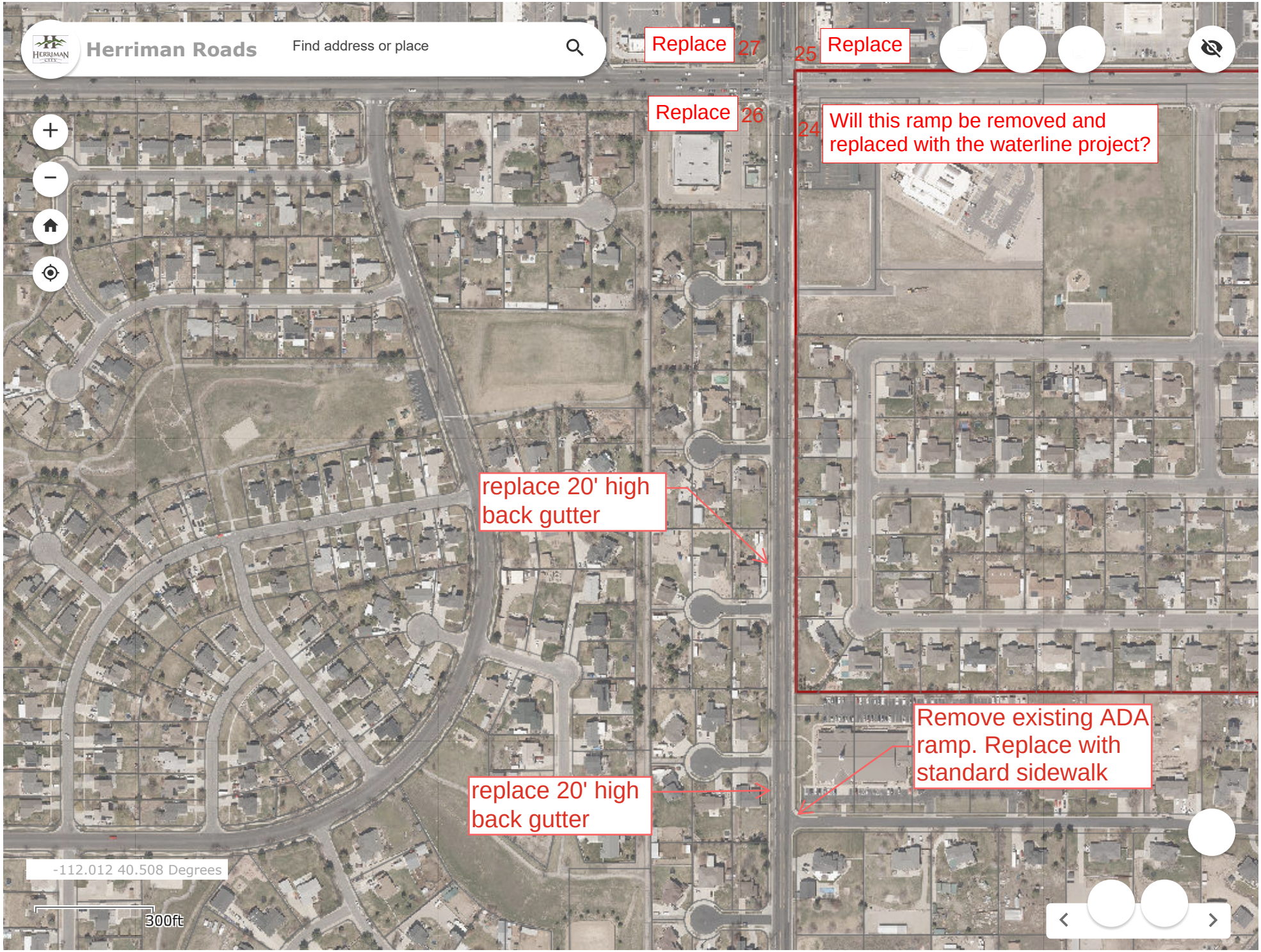
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ADA Curb Ramps

APEX BIDIRECTIONAL RAMP

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Herriman Roads
Find address or place
Replace
27
Replace
25
Replace
26
24
Will this ramp be removed and replaced with the waterline project?
replace 20' high back gutter
Remove existing ADA ramp. Replace with standard sidewalk
replace 20' high back gutter
-112.012 40.508 Degrees
300ft

Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY: Eric Didericksen		**DATE:** 8-27-2025	
PROJECT NAME: Rosecrest Inspection		**JOB NUMBER:** 24	
Street Names: Rosecrest Rd 14300 So.		**Orientation:** NW NE (SE) SW MID	
Ramp Area	**CRITERION**	**PASS**	**FAIL**
(R) Running Slope	≤ 8.33%		8.55%
Cross Slope	≤ 2%		3.10%
Clear Space/Gutter Area			
(C) Min 4' x 4'	Yes	yes	
Running Slope (counter slope)	≤ 5%		5.75%
Cross Slope	≤ 2%		2.85%
Tripping Hazards			
Tripping Hazard at Flow-line	No		yes
Tripping Hazard at Lip of Gutter	No		yes
Tripping Hazard at Back of Curb	No		yes
Curb Ramp Opening			
Minimum Width	4 Feet	yes	
Detectable Warning Surface Spans Entire Opening	Yes	yes	
Detectable Warning Surface Color	Dark Gray	yes	
Landing/Turning Space			
(T) Minimum Width by Minimum Length	4' X 4'	yes	
Running Slope	≤ 2%		9.85%
Cross Slope	≤ 2%		
Flare		4.70%	
(F) Within Pedestrian Walk Way	≤ 10%		
In Parkstrip	≤ 25% or ≥ 2' Wide		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility: extend Landing to crosswalk buttens ADA specs

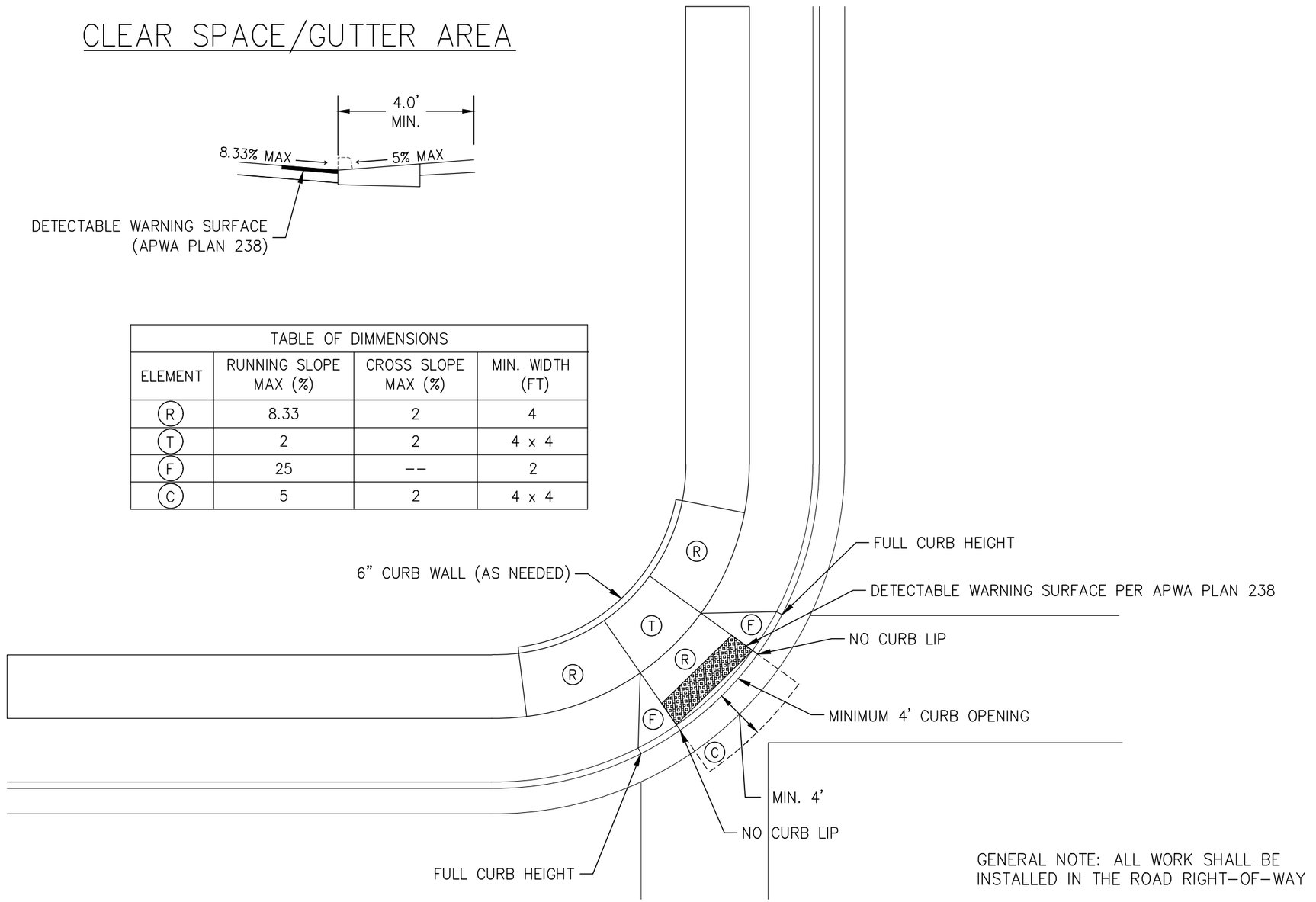
CONTRACTOR SIGNATURE **DATE**

CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

CALL BLUESTAKES @ 1-800-662-4111 AT LEAST 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

HERRIMAN CITY

HERRIMAN CITY
ENGINEERING DEPARTMENT
ADA Curb Ramps

APEX BIDIRECTIONAL RAMP

D1

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Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY: Eric Didericksen		**DATE:** 8-27-2025	
PROJECT NAME: Rosecrest Inspection		**JOB NUMBER:** 25	
Street Names: Rosecrest Rd 13400 So.		**Orientation:** NW (NE) SE SW MID	
Ramp Area		**CRITERION**	**PASS**	**FAIL**
R	Running Slope	≤ 8.33%	7.50%	
	Cross Slope	≤ 2%	0.75%	
Clear Space/Gutter Area				
C	Min 4' x 4'	Yes		
	Running Slope (counter slope)	≤ 5%		5.15%
	Cross Slope	≤ 2%	0.65%	
Tripping Hazards				
	Tripping Hazard at Flow-line	No	no	
	Tripping Hazard at Lip of Gutter	No	no	
	Tripping Hazard at Back of Curb	No		yes
Curb Ramp Opening				
	Minimum Width	4 Feet	yes	
	Detectable Warning Surface Spans Entire Opening	Yes	yes	
	Detectable Warning Surface Color	Dark Gray	yes	
Landing/Turning Space				
T	Minimum Width by Minimum Length	4' X 4'	yes	
	Running Slope	≤ 2%		2.60%
	Cross Slope	≤ 2%	1.00%	
Flare				
F	Within Pedestrian Walk Way	≤ 10%		
	In Parkstrip	≤ 25% or ≥ 2' Wide		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility: Extend ramp for crosswalk buttons ADA Specs

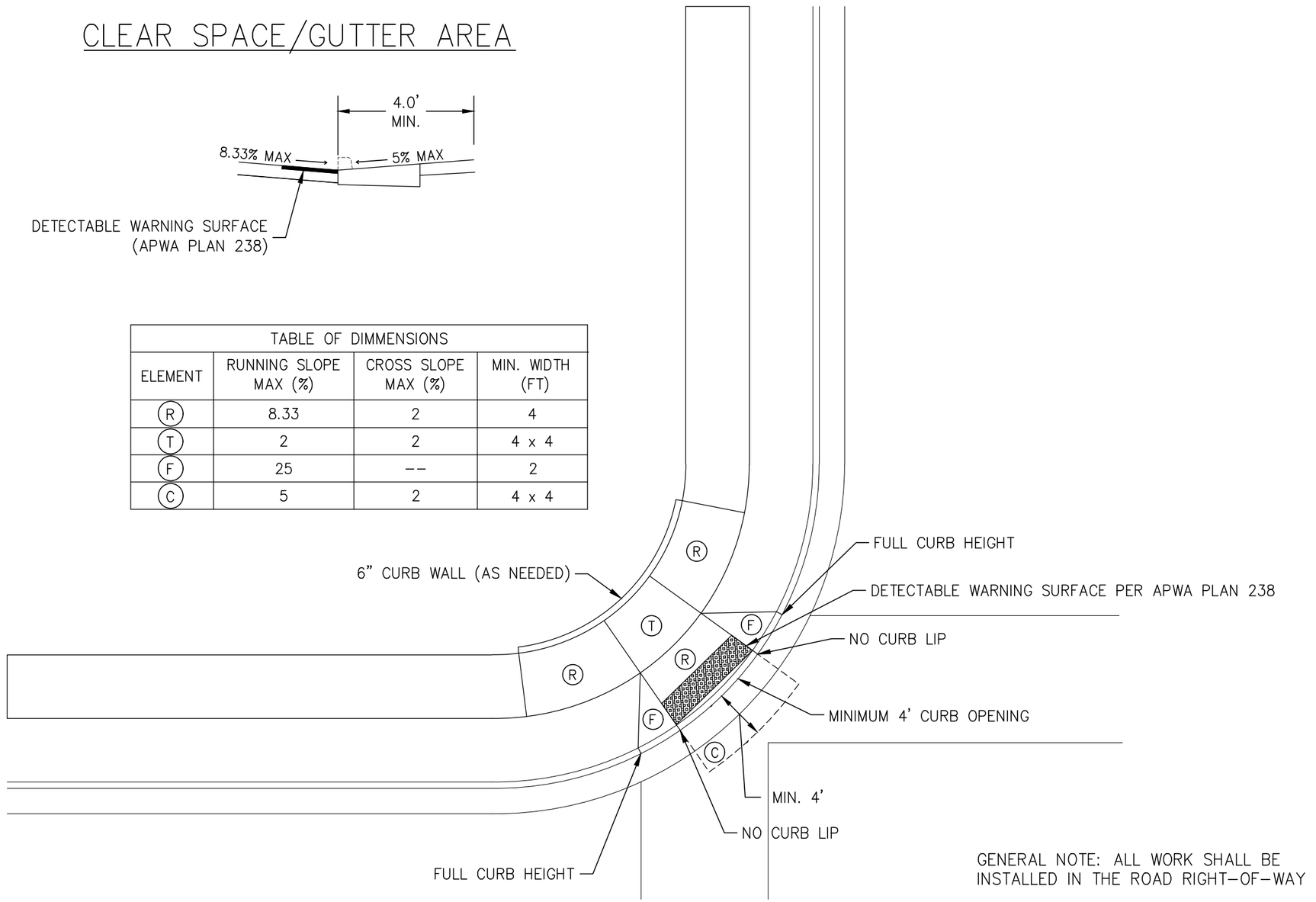
CONTRACTOR SIGNATURE **DATE**

CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

CALL BLUESTAKES @ 1-800-662-4111 AT LEAST 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

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ENGINEERING DEPARTMENT
ADA Curb Ramps

APEX BIDIRECTIONAL RAMP

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Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY: Eric Didericksen		**DATE:** 8-27-2025	
PROJECT NAME: Rosecrest Inspection		**JOB NUMBER:** 26	
Street Names: Rosecrest Rd 13400 So.		**Orientation:** NW NE SE SW MID	
Ramp Area	**CRITERION**	**PASS**	**FAIL**
R Running Slope	≤ 8.33%	7.25%	
Cross Slope	≤ 2%		2.50%
Clear Space/Gutter Area			
C Min 4' x 4'	Yes	yes	
Running Slope (counter slope)	≤ 5%		7.05%
Cross Slope	≤ 2%		2.85%
Tripping Hazards			
Tripping Hazard at Flow-line	No	no	
Tripping Hazard at Lip of Gutter	No	no	
Tripping Hazard at Back of Curb	No		yes
Curb Ramp Opening			
Minimum Width	4 Feet	yes	
Detectable Warning Surface Spans Entire Opening	Yes		no
Detectable Warning Surface Color	Dark Gray		no
Landing/Turning Space			
T Minimum Width by Minimum Length	4' X 4'		
Running Slope	≤ 2%		5.75%
Cross Slope	≤ 2%		3.20%
Flare			
F Within Pedestrian Walk Way	≤ 10%		
In Parkstrip	≤ 25% or ≥ 2' Wide		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

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CONTRACTOR SIGNATURE **DATE**

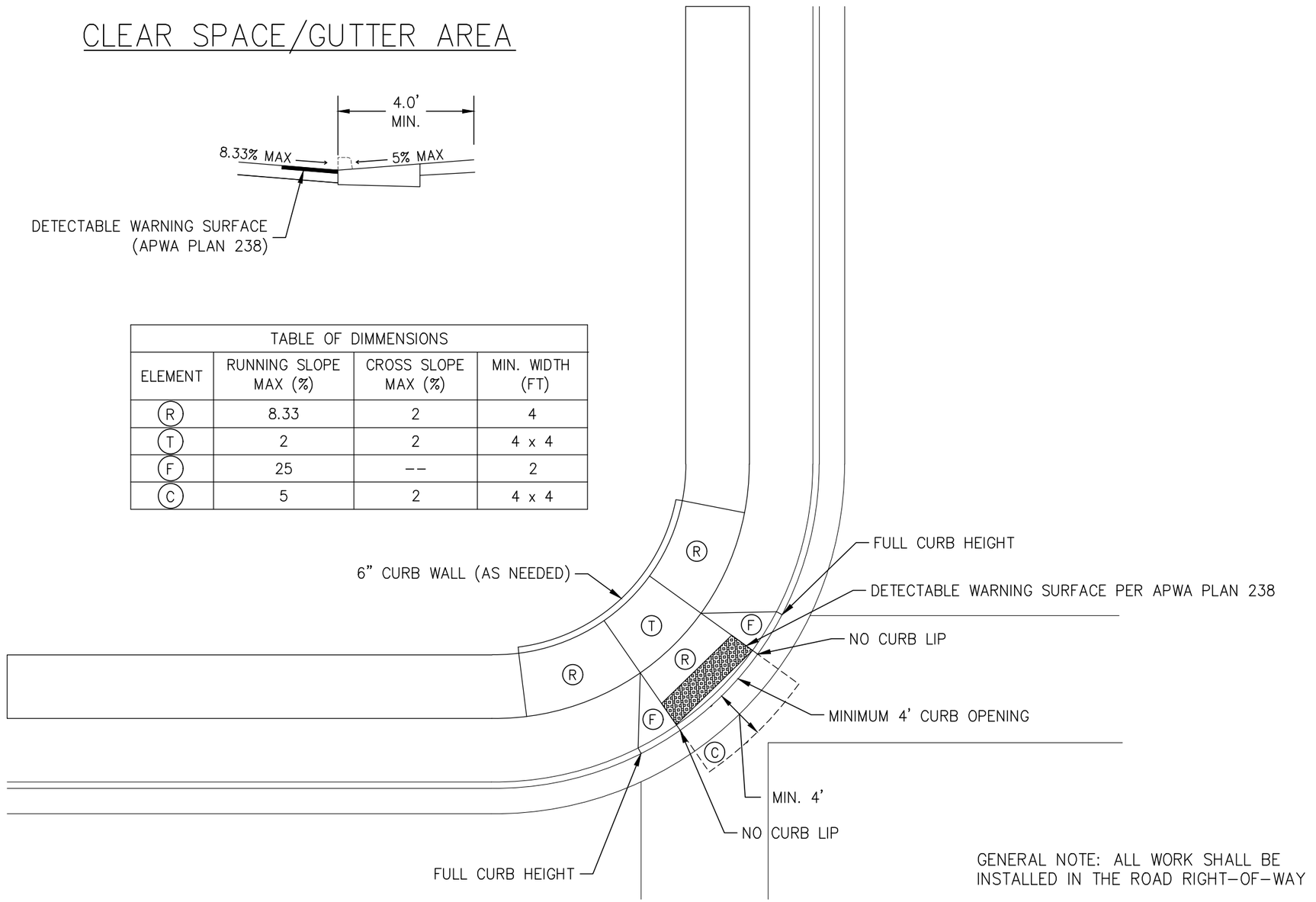
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CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

CALL BLUESTAKES @ 1-800-662-4111 AT LEAST 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

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ENGINEERING DEPARTMENT
ADA Curb Ramps

APEX BIDIRECTIONAL RAMP

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Pedestrian Curb Ramp Inspection Form

DATA ENTRY BY: Eric Didericksen **DATE:** 8-27-2025

PROJECT NAME: Rosecrest Inspection **JOB NUMBER:** 27

Street Names: Rosecrest Rd. 13400 So. **Orientation:** NW NE SE SW MID

	CRITERION	PASS	FAIL
Ramp Area			
R — Running Slope	≤ 8.33%	5.55%	
R — Cross Slope	≤ 2%		3.05%
Clear Space/Gutter Area			
C — Min 4' x 4'	Yes		
C — Running Slope (counter slope)	≤ 5%		6.8%
C — Cross Slope	≤ 2%		3.5%
Tripping Hazards			
Tripping Hazard at Flow-line	No	no	
Tripping Hazard at Lip of Gutter	No	no	
Tripping Hazard at Back of Curb	No		yes
Curb Ramp Opening			
Minimum Width	4 Feet	yes	
Detectable Warning Surface Spans Entire Opening	Yes		no
Detectable Warning Surface Color	Dark Gray		no
Landing/Turning Space			
T — Minimum Width by Minimum Length	4' X 4'		
T — Running Slope	≤ 2%		5.08%
T — Cross Slope	≤ 2%		3.8%
Flare			
F — Within Pedestrian Walk Way	≤ 10%		
F — In Parkstrip	≤ 25% or ≥ 2' Wide		

Does Technical Infeasibility Apply Regarding Non-compliant Responses? Yes or No

Explanation for Invoking Technical Infeasibility:

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CONTRACTOR SIGNATURE **DATE**

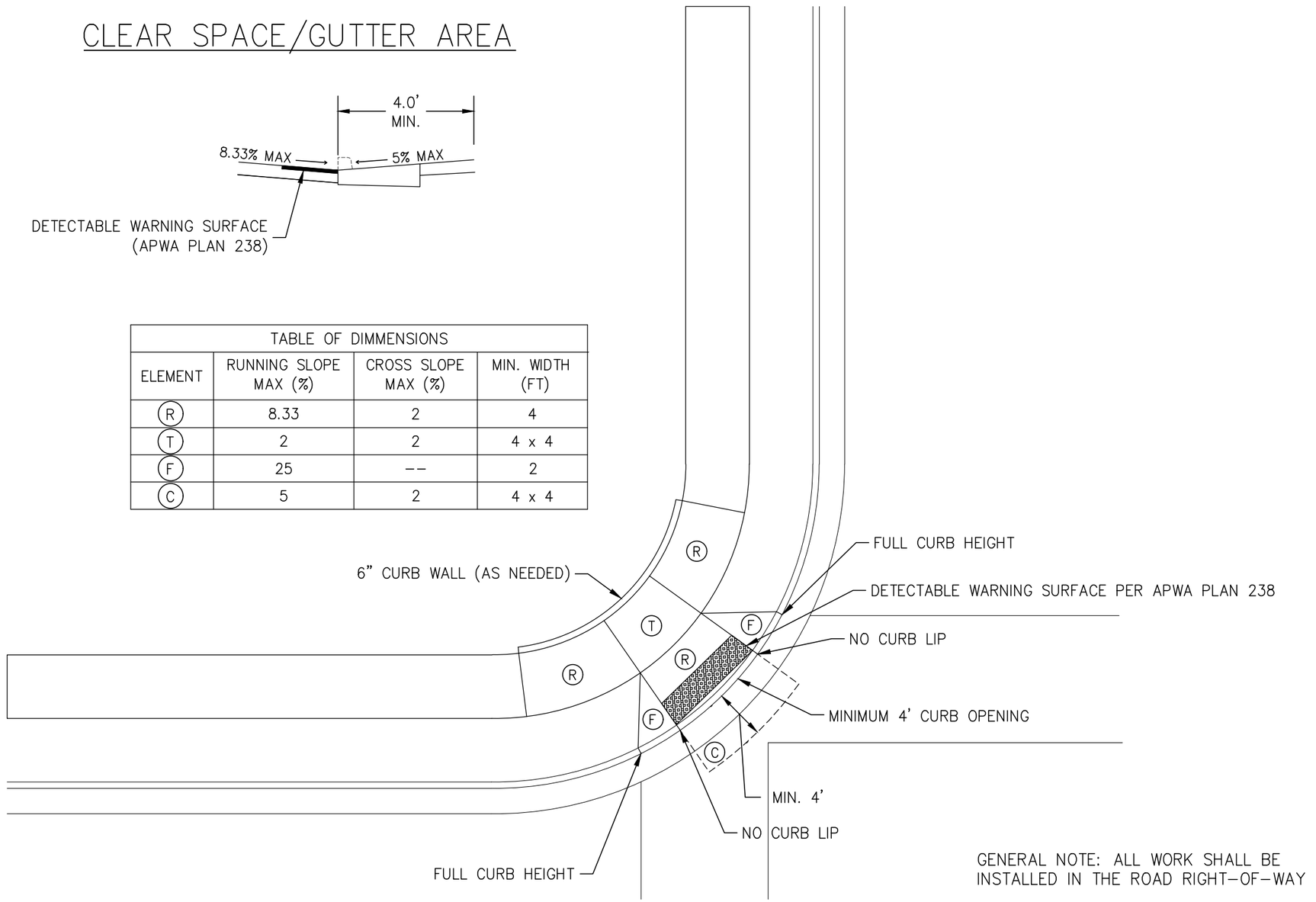
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CITY REPRESENTATIVE SIGNATURE **DATE**

APEX BIDIRECTIONAL CURB RAMP DETAIL

CLEAR SPACE/GUTTER AREA

TABLE OF DIMMENSIONS			
ELEMENT	RUNNING SLOPE MAX (%)	CROSS SLOPE MAX (%)	MIN. WIDTH (FT)
(R)	8.33	2	4
(T)	2	2	4 x 4
(F)	25	--	2
(C)	5	2	4 x 4



GENERAL NOTE: ALL WORK SHALL BE INSTALLED IN THE ROAD RIGHT-OF-WAY

NO.	REVISION DESCRIPTION	DATE

SUBMITTAL	TYPE
DRAWN BY:	BCT
CHECKED BY:	INITIALS
APPROVED BY:	BJT
RELEASE:	
PLOT DATE:	8/16/23

CALL BLUESTAKES @ 1-800-662-4111 AT LEAST 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.

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ENGINEERING DEPARTMENT
ADA Curb Ramps

APEX BIDIRECTIONAL RAMP

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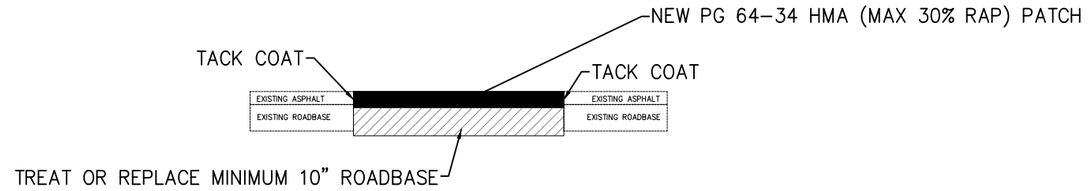
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APPENDIX C

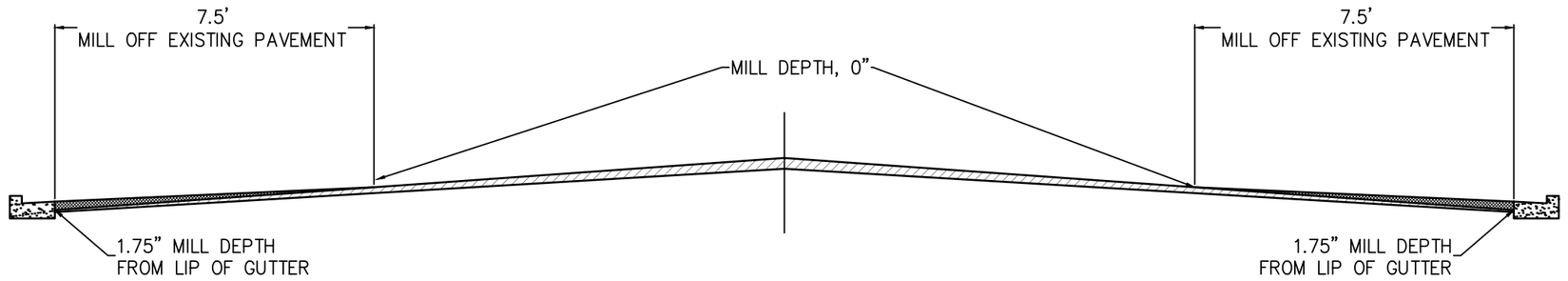
HERRIMAN CITY
ROADWAY DOCUMENTS

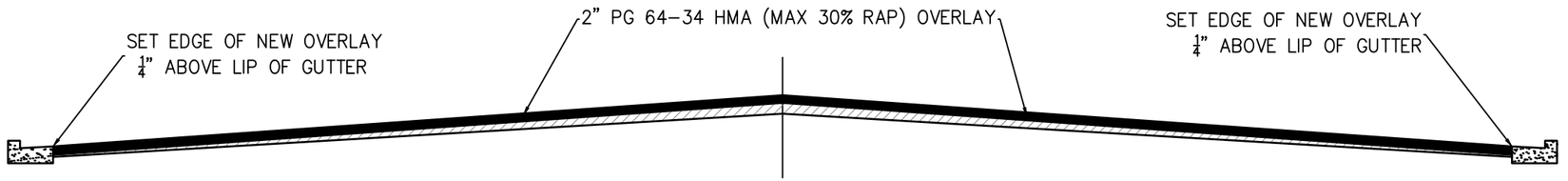
TYPICAL ROADWAY TREATMENTS

PATCHING

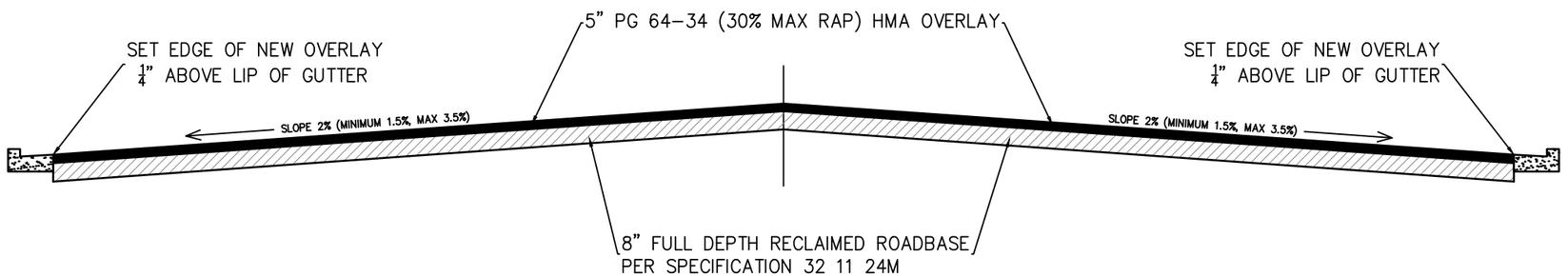


EDGE MILL & OVERLAY





FULL DEPTH RECLAMATION



NO.	REVISION DESCRIPTION	DATE



SUBMITTAL TYPE	
DRAWN BY:	
CHECKED BY:	
APPROVED BY:	
RELEASE:	
PLOT DATE:	2/07/25

CALL BLUESTAKES
1-800-662-4111 AT
LEAST 48 HOURS PRIOR
TO THE COMMENCEMENT
OF ANY CONSTRUCTION.

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ENGINEERING DEPARTMENT
2025 ROADWAY REHABILITATION

TYPICAL ROADWAY TREATMENTS

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SECTION 32 11 24M

PULVERIZED PAVEMENT BASE COURSE

REPLACE APWA SECTION 32 11 24 WITH THE FOLLOWING:

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Full depth reclamation by pulverizing and mixing an existing asphalt pavement and/or road base with a hydraulic cement, pozzolan or chemical stabilizer in-place to produce a stabilized base course mix. This specification is not intended for use with emulsion, foamed asphalt or other bituminous stabilizing agents.

1.2 REFERENCES

A. **ASTM Standards**:

C 136 Sieve Analysis of Fine and Coarse Aggregates.

C 150 Portland Cement.

C 593 Fly Ash and Other Pozzolans for Use with Lime for Soil Stabilization

C 595 Blended Hydraulic Cements

C 618 Coal Fly Ash and Raw or Calcined Natural Pozzolan for use in Concrete

C 977 Quicklime and Hydrated Lime for Soil Stabilization

C 1157 Blended Hydraulic Cement (Performance)

D 558 Moisture-Density Relations of Soil-Cement Mixtures.

D 1633 Compressive Strength of Molded Soil-Cement Cylinders

D 1883 California Bearing Ratio (CBR) of Laboratory-Compacted Soils

D 2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D 4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

B. Technical Documents

1. NCHRP 144: Recommended Practice for Stabilization of Subgrade Soils and Base Materials
2. PCA Guide to Full-Depth Reclamation (FDR) with Cement
3. PCA Soil Cement Laboratory Handbook

1.3 SUBMITTALS

A. Traffic control plan, Section 01 55 26.

B. List of equipment to be used.

C. Mix design showing percentage and quantity of stabilizer and moisture needed.

1.4 WEATHER

A. Temperature: Do not pulverize when the soil, aggregate or subgrade is frozen, or when the ambient temperature is below 40 deg F or when freezing temperatures are anticipated within seven (7) days of the end of the full depth replacement process.

1. Contractor may request permission from Engineer to process in above conditions. Submit a cold weather plan detailing changes to mix design, construction practices, curing practices

and testing practices to achieve design results. Obtain written approval of cold weather plan and permission to process from the engineer before beginning pulverization efforts.

1.5 **ACCEPTANCE**

A. Gradation: Random measure, 2 times per day, minimum.

B. Depth: Random measure each 1,000 square yards.

C. Density: Nuclear gauge each 1,000 square yards.

D. Moisture Content: 2 times per day, minimum, and immediately after a precipitation event.

E. Quantity of stabilizer added matches submittal data.

PART 2 PRODUCTS

2.1 **TACK COAT CURING COMPOUND**

A. Cationic or anionic emulsified asphalt, Section 32 12 03.

2.2 **STABILIZERS and ADDITIVES**

A. Hydraulic Cements:

1. Type I or II, ASTM C 150
2. Type GU or MS, ASTM C 1157
3. Type IP or IS, ASTM C 595.
4. Non-specification cement is acceptable, provided mix design requirements are met and Contractor can demonstrate consistency of cement to be supplied for duration of the stabilization efforts.

2.3 **MIX DESIGN**

A. Mix Design Requirements:

1. Unless stabilizer content is otherwise specified or approved, follow mix design recommendations of NCHRP 144: Recommended Practice for Stabilization of Subgrade Soils and Base Materials.
2. Perform mix design on materials obtained from project. Do not use “Representative” materials not obtained from project site.
3. Unless otherwise specified, meet unconfined compressive strength per ASTM D 1633, method A, of 300 to 500 psi at seven (7) days, using samples vacuum saturated according to ASTM C 593.
4. If project documents require pulverized pavement to be used without stabilizer, submit target gradation using all common soil sieves and source acceptance testing demonstrating compliance with section 2.3C and following:
   a. CBR (ASTM D 1883): 70%, minimum, with a 10 lb. surcharge.
   b. Plastic Index (ASTM D 4318): 6, max.

B. Stabilizer Selection: Hydraulic Cement
   a. Hydraulic Cement at 4% content shall be used for this project.

C. Pulverized Pavement Material Requirements
   1. Pulverize existing pavement to the following gradation, ASTM C 136

Sieve	Percent Passing by Weight
3”	100
2”	< 95
#4	> 55

   2. For pulverized materials with PI>20, demonstrate ability to intimately mix stabilizer with the pulverized material that will produce a reasonably homogeneous and continuous stabilized matrix.

PART 3 EXECUTION

3.1 CONSTRUCTION EQUIPMENT

A. Pulverizing Machine: Capable of cutting to the required depth, pulverizing, and sizing the material.

B. Blending Machine: Capable of mixing stabilizer and pulverized material to a reasonably homogeneous and continuous stabilized matrix.

3.2 PREPARATION

A. Identify location of all buried utilities.

B. Notify neighborhood of day and time of operation.

C. Implement traffic control plan requirements in Section 01 55 26.

D. Install Invert Covers, Section 01 71 13.

E. Lower Street Fixtures.

3.3 CONSTRUCTION

A. Pulverize remaining asphalt pavement and additionally untreated base course to depth of 8”

B. Control dust, Section 01 57 00.

C. If necessary for grade control, remove amount of pulverized material as shown on plans, or as directed by the Engineer. If contractor is directed to remove poor materials situated below the pulverized materials, push the pulverized material to the side, remove underlying material as directed, and push pulverized material back to original location.
   1. If it is necessary to remove material below pulverized product to meet specified grade, method of payment is to be determined by ENGINEER.

D. Prior to adding stabilizer, verify that the moisture content of the UNSTABILIZED material is between minus 1% and plus 3% of design moisture content.

E. If stabilizer is required, add stabilizer and pulverize a second time.
   1. For powdered stabilizers, add stabilizer in slurry format or use shroud to prevent dust clouds. Replace shroud with slurry form if placed stabilizer produces dust clouds prior to pulverization.

F. Shape, grade, compact, finish. Complete all finishing operations within 4 hours of application of stabilizer.

1. Finish: Uniform with surface deviation no more than 3/8 of an inch from line and grade in 10 feet in any direction.

G. Moist-cure stabilized material for 7 days with either continuous water spray or asphalt tack coat at a minimum residual application rate of 0.06 gal/SY. Apply in a manner that achieves >99% coverage.

H. Pre-crack treated surface between 24 and 48 hours after final compaction.

1. Roll treated surface with 2 to 3 passes (1 pass is down and back) of a 12-ton, minimum, vibratory roller at maximum amplitude and walking speed.

3.4 FIELD QUALITY CONTROL

A. Gradation: Test gradation twice daily, and after visual changes in type of material being processed, i.e. change from granular to clay.

1. If -#200 material changes by more than 10% of total sample weight, revise mix design to accommodate.

B. Compaction:

1. Ninety-eight (98) percent or greater density with stabilizer relative to a standard proctor density (without stabilizer), Section 31 23 26. Use the following procedures:

a. Maintain moisture content between minus 1% and plus 3% of optimum moisture content, ASTM D 558. Test 1 time per every two hours of processing, minimum, and immediately after a precipitation event.

b. Nuclear gauge, direct transmission procedure, ASTM D 2922.

3.5 REPAIR

A. Repair surface irregularities.

1. Scarify or add additional treated material as necessary to meet finishing requirements.

B. Seal cracks in cured stabilized material.

3.6 OPENING TO TRAFFIC

A. Completed portions of pulverized pavement can be opened to low-speed traffic and to construction equipment, provided the curing material or moist curing operations are not impaired and provided the pulverized material is sufficiently stable to withstand marring or permanent deformation.

B. Open to all traffic after the pulverized material has received a curing compound or a subsequent overlay surface, or it is sufficiently stable to withstand marring or permanent deformation.

END OF SECTION

SPECIAL PROVISION

SECTION 32 12 05.01S
REINFORCING FIBERS FOR ASPHALT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Reinforcing fibers for use in fiber reinforced asphalt pavements (FRAP) and fiber reinforced asphalt rubber hot mix (FR-ARHM).

1.2 REFERENCES

A. ASTM D2172 – Quantitative Extraction of Bitumen from Bituminous Paving Mixtures.

B. ASTM D6433 – Pavement Condition Index (PCI) Surveys.

C. AASHTO T322 – Standard Method of Test for Determining Dynamic Modulus of Asphalt Mixtures

D. AASHTO TP79 – Dynamic Modulus and Flow Number (FN) for Asphalt Mixtures.

E. Zeiada, W., Underwood, S., Stempihar, J., *Extraction of Aramid Fibers from Fiber Reinforced Asphalt Concrete – Special Test Method*, Arizona State University, 2016.

1.3 DEFINITIONS

A. Reinforcing Fibers: High tensile strength aramid fiber blend specially formulated to reinforce hot mix asphalt.

B. Fiber Reinforced Asphalt Pavement (FRAP): A mixture of hot or warm mix asphalt mix and reinforcing fibers that has greater resistance to rutting, thermal cracking, fatigue cracking, and reflective cracking as compared to conventional non-fiber asphalt mixes.

C. Fiber Reinforced Asphalt Rubber Hot Mix (FR-ARHM): A mixture of rubberized asphalt and reinforcing fibers that has greater resistance to rutting, thermal cracking, fatigue cracking, and reflective cracking as compared to non-fiber rubberized asphalt mixes.

D. Aramid Dispersion State Ratio (ADSR): A measure of the dispersion efficiency of the Reinforcing Fibers within asphalt mixes. ADSR is calculated by comparing the mass of aramid in the individual state to the total mass of extracted aramid fibers, expressed as a percentage.

1.4 SUBMITTALS

A. Representative fiber product sample.

B. Fiber product data sheet and certification from the Manufacturer that the fiber product supplied meets the requirements of this specification.

C. Manufacturer's instructions and general recommendations.

D. Performance results of ADSR testing from a minimum of three separate field trials to validate Dispersion Efficiency.

E. Performance results of PCI testing from a minimum of three separate field trials to validate Cracking Resistance.

F. Performance results of FN testing from a minimum of three separate laboratory trials to validate Rutting Resistance.

    a. Testing is NOT required on samples from field mix. Submission of previously completed lab testing is acceptable.

G. Submit a minimum of five unique project examples and references where the reinforcing fiber product was used in similar applications.

1.5 QUALITY ASSURANCE

A. Submit a Contractor Quality Control (QC) Plan for review prior to production describing procedures to implement FIELD QUALITY CONTROL requirements in Section 3.4. The plan shall include sampling and testing frequencies, visual inspection methods, corrective actions, equipment calibration procedures, and documentation methods for test results and adjustments.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fiber-reinforcement in sealed, undamaged containers with labels intact and legible, indicating material name and lot number.

B. Deliver fiber-reinforcement to location where it will be added to each batch or loaded into the mixer.

C. Store materials covered and off the ground. Keep sand and dust out of boxes and do not allow boxes to become wet.

PART 2 PRODUCTS

2.1 REINFORCING FIBER

A. Provide a reinforcing fiber blend of Virgin Polyolefins and Virgin Aramids that meets the requirements in Table 1 and Table 2 below.

Table 1 - Reinforcing Fiber Material Properties			
Property	Test Method	Polyolefin	Aramid
Form	Manufacturer Certification	Serrated	Monofilament
Nominal Specific Gravity	ASTM D276	0.91	1.44
Tensile Strength (psi)	ASTM D7269	NA[1]	400,000
Length (in)	Manufacturer Certification	0.75	0.75
NOTES: 1 – Polyolefin fibers will melt or become plastically deformed during production			

Table 2 - Reinforcing Fiber Performance Properties			
Performance Measure	Test Method	Standard	Requirement
Dispersion Efficiency	Aramid Dispersion State Ration (ADSR)	Modified ASTM D2172	≥ 85%
Field Performance Cracking Resistance	Pavement Condition Index	ASTM D6433	≥ 10 PCI Points Increase, Minimum 4 Years
Resistance to Permanent Deformation (Rutting)	Flow Number (FN)	AASHTO TP79	≥ 75% Increase

B. FORTA-FI®, provided by the Forta Corporation, is an acceptable product and meets the performance and material properties outlined in this section.

C. Alternate aramid-based fiber blend may be proposed. Submit performance test results complying with Section 2.2 below at least one week prior to bid date for approval by engineer.

D. Non-aramid fiber blends will not be considered as acceptable alternatives to this specification.

2.2 PERFORMANCE REQUIREMENTS

A. Aramid Dispersion State Ratio (ADSR) Tests from a minimum of three (3) separate laboratory trials.

1. Perform ADSR test based on modified ASTM D2172 procedures as provided in the document entitled “Extraction of Aramid Fibers from Fiber Reinforced Asphalt Concrete – Special Test Method”. A copy of the modified extraction methodology can be obtained by making an inquiry to the Pavement and Materials Laboratory at Arizona State University at NCE@asu.edu.

2. To validate ADSR results, average extracted aramid fiber quantity must average 0.007 percent by total sample weight or higher with no individual result less than 0.005 percent of the total sample weight.

3. All tested fiber mixes must achieve a minimum ADSR of 85%.

B. Pavement Condition Index (PCI) side by side comparison from a minimum of three (3) field trials with a minimum in-service pavement age of four years.

1. PCI surveys shall be performed according to ASTM D6433.

2. Test results shall include a control and a fiber reinforced pavement section. FRAC mix shall be identical to control mix except for the inclusion of fibers added at the same dosage as proposed on the project.

3. In-field performance sections shall be subject to the same environmental and traffic conditions. A minimum surface area of 500 yd^2 per FRAC and control section is required.

4. PCI results from fiber sections shall show a minimum 10 PCI points greater than the control section after a minimum of 4 years.

C. Flow Number (FN) Tests from a minimum of three (3) separate laboratory trials.

1. Perform FN tests using the protocol from AASHTO TP79.

2. Test results shall include a control and a fiber reinforced mix. FRAC mix shall be identical to control mix except for the inclusion of fibers added at the same dosage as proposed on the project.

3. Results from fiber specimens shall each show an average FN increase of at least 75% over control specimens.

D. All historical test results submitted to validate the fiber's performance in asphalt mixes shall be from previously completed laboratory and field trials using plant-produced FRAP from a documented source only. Results from lab-produced FRAP or FRAP form an undocumented source will not be accepted. Testing is not required on samples from the job mix. Fiber dosage rate in all submitted test reports must be equal to the rate proposed for this project. Only testing performed by an AASHTO accredited laboratory or nationally recognized university testing lab will be considered.

PART 3 EXECUTION

3.1 PREPARATION

A. Follow manufacturer's and engineer's recommendations for preparation prior to placement of FRAP.

3.2 MIXING AND PRODUCTION

A. Add reinforcing fiber at a dosage rate required by FRAC mix justification. Use a minimum of one (1) pound fiber per one (1) ton of asphalt, minimum.

B. Have a fiber manufacturer's representative on site during mixing and production. This requirement can be waived if fiber manufacturer and asphalt producer can supply evidence of manufacturer's brand of fiber being successfully produced a minimum of three times at the asphalt plant to be used for the project.

C. Batch Plant: When a batch plant is used, add fiber to the aggregate in the weigh hopper and increase both dry and wet mixing times. Ensure that the fiber is uniformly distributed before the injection of asphalt cement into the mixture

D. Drum Plant:

1. Inject fibers through the RAP collar manually or by feeding them with a metered air blown system to promote rapid and complete fiber dispersion. Rate the feeding of fibers with the rate the plant is producing asphalt mix. If there is any evidence of fiber bundles at the discharge chute, increase the mixing time and/or temperature or change the angle of the fiber feeder line to increase dry mixing time.

2. Add fibers continuously and in a steady uniform manner. Provide automated proportioning devices and control delivery within ±10% of the mass of the fibers required. Perform an equipment calibration to the satisfaction of the

fiber manufacturer's representative to show that the fiber is being accurately metered and uniformly distributed into the mix.

3. Include the following with the air blown system:
   • Low level indicators
   • No-flow indicators
   • A printout of feed rate status in pounds/minute
   • A section of transparent pipe in the fiber supply line for observing consistency of flow or feed
   • Manufacturer's representative's approval of fiber addition system

3.3 PLACEMENT

A. Follow manufacturer's and engineer's recommendations for placement of FRAP

3.4 FIELD QUALITY CONTROL

A. Aramid Dispersion Visual Test: Collect a 10 kg sample of mix from the discharge chute during first 50 tons of production. Visually assess the state of aramid fibers in the sample according to Reference 4 (Section 1.2 of this specification) and rate the sample as "Pass" or "Fail".

   1. Pass = All fibers exist in an Individual State and no Undistributed Clips or Agitated Bundles of fiber are detected.

   2. Fail = One or more Undistributed Clips or Agitated Bundles are detected.

B. If a sample is rated as "Fail", adjust mixing operations to improve fiber dispersion and repeat Step 1 above.

C. If Visual Test results in three consecutive "Fail" ratings, plant mix samples should be sent to a third-party laboratory for complete ADSR testing before production is allowed to commence.

D. In addition to Visual Test, use a shovel to inspect FRAP mix in the back of first three trucks and every fifth truck thereafter to confirm adequate blending of the fiber.

E. Remove any observed fiber bundles from placed mixture and adjust operations per the manufacturer's recommendation to eliminate future fiber bundle development, and repeat Steps 1 through 3 above to confirm adequate aramid fiber dispersion.

END OF SECTION